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Two kinds of distributivity

Hanna de Vries¹ 

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Abstract This paper argues that lexical and operator-based analyses of distributivity are not in conflict, but are both necessary components of any theory of distributivity that aims to account for all the relevant data. I use several contrasts between plural definites (e.g. *the girls*) and group NPs (e.g. *the group of girls*) to show that we need an operator-based analysis of distributivity; this kind of distributivity is available with plural definites but not with group subjects, which can be explained under the common assumption that group NPs denote atoms rather than sums and hence do not allow quantification over their individual parts. At the same time, we need a lexical theory of distributivity to account for the various distributive interpretations that we do find with groups; a formalisation of such a theory is outlined in the final section of this paper.

Keywords Distributivity · Quantification · Group nouns · Non-logical inferences

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?

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✉ Hanna de Vries
devr.hanna@gmail.com

¹ Utrecht Institute of Linguistics OTS, Trans 10, 3512 JK Utrecht, The Netherlands

- (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. We know that in order to be able to laugh one needs lungs and a vocal apparatus, and we know that individuals have these things but groups or collections do not; hence, we interpret *The children laughed* as a statement about individual children. Similarly, we know that gathering cannot be done by single individuals but only by groups, and hence we interpret *The children gathered* as a statement about a collection of children. 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 the lexical meaning of the predicate.

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. According to the operator-based account, the semantics of (1a), for example, should be analysed as follows:

- (3) $(D(\text{LAUGH}))(\text{THE_CHILDREN}) = \forall x \in \text{THE_CHILDREN} [\text{LAUGH}(x)]$

In the most radical version of the operator-based analysis, exemplified by Link (1983, 1987), there is a direct correlation between the semantic mechanism used and the interpretation derived: direct predication over a plural individual results in a collective interpretation; using a D-operator results in a distributive interpretation. This means

¹ Link (1983) proposes an operator $*$ that pluralises distributive predicates like *laugh*; from the algebraic properties of $*$ 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 $*P$, 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 (1987). Unlike $*$, 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.

that a plural distributive predicate like *laugh* must be interpreted via an operator-based mechanism, and a plural collective predicate like *gather* must be interpreted via direct predication. A sentence like (1b) (*The girls had a beer*) can be interpreted in both ways: if its semantics is derived by means of a D-operator, we get the distributive interpretation according to which each girl had a beer of her own, and if it is derived by means of direct predication, we get the collective interpretation according to which the girls shared the beer.

In practice, the operator-based analysis as it is usually adopted is somewhat less radical. Roberts (1987), citing Dowty (1987) as her influence, explicitly argues that applying a D-operator to a distributive predicate is unnecessary, because the distributive aspect is part of “the sense of the predicate”. Just as there is no need to formally restrict the extension of the predicate *grasp* to those entities that have opposable thumbs, there is no need to restrict our formal semantics in such a way that distributive predicates can only apply to individuals (and collective predicates to pluralities): this restriction simply follows from their lexical meaning. Like Roberts, Winter (1997), while accepting that we need a D-operator to be able to adequately capture the truth conditions of more complex sentences like (1b), suggests that simple cases like (1a) may involve direct predication and lexical semantics, as in Scha’s analysis. A similar distinction between lexical and operator-based distributivity is adopted by Hoeksema (1988) and Champollion (2010).²

These more mixed approaches to distributivity agree with the observation made by various authors (Dowty 1987; Verkuyl 1994; Verkuyl and Does 1996) that the line between collectivity and distributivity is not as clear-cut as Link’s division suggests. Dowty (1987) notes that even many collective predicates enable certain inferences about individuals; he calls these inferences *subentailments*. For example, while we cannot infer (4b) from (4a), we can infer (4c):

- (4) a. The children gathered in the garden.
 b. *Each child gathered in the garden.
 c. Each child was in the garden.

If the inference from (4a) to (4c) were enabled by some covert operator, such an operator would need to be able to break up the lexical meaning of *gather* and distribute only part of it to the individual children. There is no way to do this in standard model-theoretic semantics, and even if there were, every subentailing predicate would need its own corresponding operator to ensure the distribution of only the intended meaning parts. Considering this, it is reasonable to assume that the inference from (4a) to (4c) is enabled not by a covert quantificational mechanism but by the lexical properties of the predicate *to gather*. But then, if the distributive inference from (4a) to (4c) can be lexically based, without actual quantification over individual children, the same should hold for the distributive inference from *The children laughed* to *Each*

² Bartsch (1973) is an early example of an account of plurality in which distributivity is sometimes made explicit in the formal semantics and sometimes left to lexical inferencing, but she is not very explicit about this aspect of her theory. In Kroch (1974), plural predication introduces a universal quantifier, but an additional interpretation rule ensures that distributive readings generated in this way come out as anomalous if they are incompatible with the lexical semantics of the predicate.

child laughed. Put differently, if *part of* a predicate meaning can be distributed over members of a plurality by a lexical process, there is no reason why the same process couldn't be responsible for the lexical distributivity of *entire* predicate meanings, if this were supported by the semantics of the verb and the context. There seems to be little conceptual sense in a theory that allows for subentailment but not for full lexical distributivity.

A counterargument to this kind of reasoning, however, is brought up by Landman (1996, 2000) (who, as far as I am aware, is the only author who has explicitly argued against the possibility that at least some distributive interpretations could be due to lexical inferences). Landman's point is based on argument structure: whatever saturates the argument position of LAUGH in the sentence *The children laughed* is not just there to give the sentence a grammatical subject so it may end up as an expression of type *t*; it also receives the thematic agent role from the verb. If the subject argument of a distributive predicate could be a collection of individuals, Landman argues, this entire collection would be assigned the role of agent; but that would render the notion of 'agent' both meaningless and useless, since the collection itself is not in fact the agent of the expressed event (it's the individual children that are the laughing agents, not the group of children as a whole). So according to Landman, we really do need a quantificational mechanism that allows us to interpret *The children laughed* as expressing a whole series of laughing events, each with its own individual agent. On the other hand, with a collective verb like *gather*, the subject plurality as a whole should receive the agent role; the fact that there are certain subentailments to individuals does not change the fact that the agent of the gathering event is still the collection as a whole. So, on the one hand, we have a conceptual argument suggesting that what I have called the 'radical' Linkian approach, which assumes that covert quantification is the only way to derive a distributive interpretation, is somewhat too strict, and that it is plausible that lexical semantics takes care of at least some distributive inferences. On the other hand, we have a similarly conceptual argument against this idea, suggesting that sentences cannot be properly interpreted when the individual agents of distributive events are not identified as such in the formal semantics. This means that the question of lexical distributivity needs to be decided on empirical grounds: can we demonstrate empirically whether we need to equip our theory with some lexical means of deriving distributive inferences (in addition to a formal one)?

Although Winter (1997, 2000) does not make an explicit empirical case for lexical distributivity, such a case can easily be made on the basis of the data in Winter (2000): if we assume that Winter's analysis of codistributivity is correct, any codistributive interpretations involving proper noun conjunctions must be lexically based. More recently, Champollion (2010) argues (following observations by Lasersohn 1989, 1995; Schwarzschild 1996, and others) that lexical distributivity freely allows intermediate or non-atomic interpretations when these are supported by the lexical semantics of the predicate, while operator-based distributivity only allows a non-atomic interpretation if this is made sufficiently salient by the context. In both Winter's and Champollion's approaches, lexical distributivity accounts for the existence of distributive interpretations that, according to these authors, cannot be explained in terms of covert quantification. A related point is made in Kratzer (2008), who assumes that all distributivity involves application of an operator (either in the lexicon or in the syn-

tax), but whose observations on the availability of certain distributive inferences with sentences involving group NPs are closely related to the argument I will be making here.³

In this paper I provide some new empirical evidence along the same lines. I claim that an operator-based distributivity mechanism is unable to account for certain cases of distributivity involving group nouns (singular nouns referring to collections of things, like *committee* or *choir*):

- (5) The committee laughed.

Sentence (5) clearly has a distributive interpretation, which has motivated some researchers (e.g. Bennett 1974; Magri 2012; Pearson 2011) to analyse the denotations of group NPs as pluralities that can be quantified over. However, in many cases, distribution over members of a group is not possible, as exemplified by the following contrast:

- (6) a. The children are hiding somewhere.
 ⇐ For each child x , there is a place y such that x is hiding in y .
 ⇐ There is a place y such that each child is hiding in y .
 b. The class is hiding somewhere.
 ⇔ There is a place y such that each child is hiding in y .

Sentence (6b) cannot mean that each child in the class hid in a different place: the only available interpretation is one where *somewhere* takes wide scope, indicating that there is a single place in which all the children are hiding. In contrast, sentence (6a) does have a distributive interpretation, which can be readily accounted for in terms of covert quantification: if (6a) involves a covert quantifier over children, this quantifier may take scope over the adverbial *somewhere*.

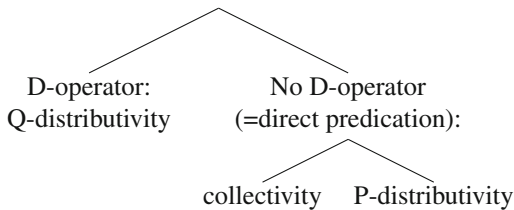
Based on contrasts like the one in (6), I show that group NPs in general do not allow distribution over individual members, which is in line with the common assumption that they are not associated with pluralities but with atoms (e.g. Barker 1992; Landman 1989; Link 1984; Schwarzschild 1996; Winter 2002). If groups are atomic, it will not be possible to quantify over their individual members, as these are not accessible to the compositional semantics. This means that any distributive effects that we do find with group NPs—such as the distributivity in (5)—cannot be derived by means of a D-operator. I conclude that we need a theory of lexical distributivity to account for interpretations like these. I end the paper by sketching a basic formal account of lexical distributivity in terms of pseudo-equivalences (following Winter and Scha 2015); I assume that the interpretation of lexically distributive predication is determined by a combination of lexical semantics (in the form of non-logical inferences that are listed as part of the lexical meaning of the verb) and world knowledge.

³ Recent unpublished experimental work by Jakub Dotlačil and Adrian Brasoveanu also shows a processing difference between operator-based distributive inferences and distributive inferences that might be explained in terms of lexical reasoning (Jakub Dotlačil, p.c.).

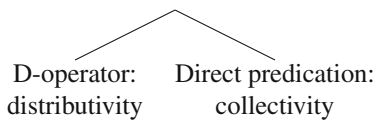
2 Two kinds of distributivity

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. The advocated approach is represented schematically in (7a); it is contrasted with both what I have called a 'radical' operator-based approach (represented in (7b)), according to which distributive inferences are always the result of applying a quantificational D-operator, and a Scha-style lexical approach (represented in (7c)), according to which distributivity and collectivity reflect lexical properties of the predicate but are not distinguished in the formal semantics.

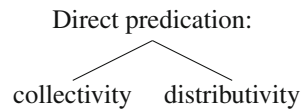
(7) a. *Advocated approach (based on Champollion 2010; Winter 1997, 2000):*



b. *Radical operator-based approach:*



c. *Purely lexical approach:*



Because the analysis in (7a) 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* in a pre-theoretical sense in order to refer to interpretations, as follows:

(8) *Distributive and collective interpretations*

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 $\llbracket \text{Pred} \rrbracket(x)$ for every member *x* of $\llbracket X \rrbracket$; otherwise it is *collective*.^{4,5}

⁴ For now, I am ignoring cases of 'intermediate distributivity', as in *Rodgers, Hammerstein, and 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 (8) can be straightforwardly extended to accommodate such cases. See also Sect. 2.3.

⁵ In paraphrasing distributive interpretations in terms of universal quantification, I am also abstracting away from the well-observed fact that plural predication usually leaves room for exceptions (i.e. members of the subject collection for which the predicate does not hold). Thus, the sentence *The girls are linguists* (unlike the universal paraphrase *All the girls are linguists*) can be true even if some of the girls are not

The two semantic mechanisms that I use to derive these interpretations are covert quantification (by means of a D-operator), and direct predication over a collection.⁶ Formally:

(9) *Mechanisms underlying distributivity*

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:

- Applying a *D-operator* derives the logical form $\forall x \in \llbracket X \rrbracket \llbracket \llbracket \text{Pred} \rrbracket (x) \rrbracket$.
- *Direct predication over a collection* derives the logical form $\llbracket \llbracket \text{Pred} \rrbracket \rrbracket (\llbracket X \rrbracket)$.

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

For now, I will put aside the question of the exact nature of P-distributivity and what it means for a distributive inference to be ‘rooted in the lexical semantics of a predicate’—I will discuss these questions in more detail in Sect. 2.3. My goal at this point is to show that we need *some* lexical theory of distributivity in addition to a compositional one; to this end, we first need a clearer picture of the kind of distributive inferences that demonstrate the need for an operator-based distributivity mechanism.

2.1 Q-distributivity

As several authors have shown in reply to Scha (1981) (e.g. Brisson 1998; Winter 1997), there are some distributive interpretations that cannot be reduced to a combination of direct predication and lexical semantics. (10) is an example of a sentence

Footnote 5 continued

linguists, especially if we are talking about a large number of girls. This particular kind of vagueness is known as *non-maximality* (Brisson 1998; Dowty 1987). There are three general strategies for dealing with non-maximality: it can be built into the semantics of the D-operator (e.g. Brisson 2003; Schwarzschild 1996); it can be treated as a property of direct predication (Landman 1989; Winter 2002), a view that predicts that non-maximality should be tied to lexical rather than operator-based distributivity; or it can be treated as a specific instance of a more general phenomenon of ‘pragmatic slack’ (Lasnik 1999). Since I will not address the issue of non-maximality in this paper, I will simply treat distributivity as more or less paraphrasable by universal quantification.

⁶ I am using the word ‘collection’ in a pre-theoretical sense here to refer to NP denotations that are at least conceptually plural: the referents of plural NPs like *the girls*, conjunctions like *Mary, Jane, and Sue*, or collectives like *the group of girls*. I will remain agnostic on the ontological status of these collections, which depends on the larger theory of plural predication we choose to adopt and on the way we analyse singular group NPs like *the group*. Here are several options (some of which are more compatible with the ideas put forward in this paper than others). In Scha (1981), collections are analysed as sets, but so are all NPs; Scha’s framework does not make any type-theoretic or sortal distinction between the denotations of singular and plural NPs. In Link (1983) and Schwarzschild (1996), plural NPs and conjunctions are analysed as sets (or sums, if we prefer a lattice-theoretical formalisation), while singular NPs are analysed as atomic entities. The proposal in Winter (2002) is similar but also assumes that the sets associated with plurals and conjunctions can be mapped into an atomic entity through a type-shifting operation. In Landman (1996, 2000), collections can be either atomic or set-denoting (with two type-shifts mapping these different interpretations to each other), but only the latter denotation supports any distributive inferences. In de Vries (2015), all collection-referring NPs can denote either a set or (via a type-shift) an atom; the former denotation is associated with Q-distributivity, the latter with P-distributivity.

for which a purely lexical approach (like Scha's) does not completely cover the truth conditions of the different available interpretations:

(10) The children are hiding somewhere.

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

(11) $\exists x$ [LOCATION(x) \wedge HIDE_IN(THE_CHILDREN, x)]

But this only allows an interpretation in which there is one particular place where the entire group of children is hiding, whereas (10) also has a distributive interpretation according to which each child is hiding in a different place. To derive the latter, the members of the plurality *the children* need to take scope over the existential quantifier introduced by *somewhere*. And the only way to allow *the children* to have wider scope than *somewhere* is to introduce another quantifier, as in (12):

(12) $\forall x \in \text{THE_CHILDREN}$ [$\exists y$ [LOCATION(y) \wedge HIDE_IN(x , y)]]

As we have seen, such a quantificational analysis is generally formalised 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 (11).

In the literature, the argument for Q-distributivity is generally made based on the availability of a distributive interpretation for sentences with an indefinite object, such as *The girls are wearing a dress* or *The boys ate a sandwich*. But the range of sentence types that demonstrate the need for a quantificational distributivity mechanism is much broader, as I will show in this section.⁷ Two additional cases of Q-distributivity are covered in Sect. 2.2.3. *DI* and/or *CI* are shorthand for 'distributive interpretation' and 'collective interpretation', as defined in (8).⁸

2.1.1 Disjunction

The mathematical equivalence shown in (13) can be seen playing out in natural language in entailments like (14):

(13) $x \in (P \cup Q) \Leftrightarrow x \in P \vee x \in Q$

⁷ de Vries (2014) argues that many of these indefinite-based cases are not examples of Q-distributivity at all, but involve P-distributivity over two arguments

⁸ Note that, according to the definition in (8), it is the entire VP that is relevant here, not just the verb; thus, (13) has a distributive interpretation not because we interpret both walking and cycling as properties of individuals, but because the whole predicate *be walking or cycling* can apply to each individual semanticist. Similarly, 'CI' in the case of (13) does not signify that the walking or the cycling are somehow performed collectively, but that the disjunction *be walking or cycling* applies to the collection of semanticists rather than the individuals. As will become clear, formulating the definition in this way will help us to separate Q- from P-distributivity since it takes into account the VP with all its internal structure, rather than only looking at the meaning of the verb.

- (14) Sue is walking or cycling.
 ⇔ Sue is walking or Sue is cycling.

When we replace *Sue* in (14) with a plural definite, the entailment pattern gets a bit more complicated. A disjunctive sentence like (15) can be interpreted in two different ways:

- (15) The semanticists are walking or cycling.
 ⇐ For every semanticist x , x is walking or x is cycling. (DI)
 ⇐ The semanticists are walking or the semanticists are cycling. (CI)

There are two ways to analyse (15), each of them corresponding to a possible interpretation of the sentence. According to the first analysis, the disjunction *walking or cycling* applies to each individual semanticist, which means that (15) is compatible with a situation in which some of the semanticists are cycling while the others are 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 disjunction to apply to each individual semanticist, we need quantification over the set of semanticists.

2.1.2 Quantified expressions

We already saw an example of Q-distributivity involving a quantified expression (*somewhere*) at the beginning of this section. The following examples also involve quantifiers (a comparative quantifier in (16), and a numerical quantifier in (17)); all examples are similarly ambiguous between two interpretations. The examples were chosen in such a way that the DI does not entail the CI; hence it is possible to imagine a situation that verifies the DI but falsifies the CI. This means that if we can accept a sentence as true in such a situation, we have to be able to derive the DI as a separate reading. It can be shown for each of the cases below that this is only possible by assuming covert quantification over the members of the subject plurality.

- (16) The cows won fewer prizes at the fair than the pig.
 a. ⇐ The cows together won fewer prizes than the pig. (CI)
 b. ⇐ Every cow won fewer prizes than the pig. (DI)

As a context for (16), imagine a country fair at which prizes are awarded to animals in various categories. One farmer brought three of her cows and her very best pig, and all four animals ended up winning a number of prizes. One possible distribution of prizes is depicted in Fig. 1; sentence (16) is true in this situation under its first, distributive, interpretation, since the cows each have two prizes while the pig has three. However, it is false under its collective interpretation, since the cows together have six prizes, which is more than the pig has. Direct predication only gives us the CI: without quantification over individual cows, the quantifier *fewer prizes than the pig* necessarily takes scope over the entire subject plurality. Again, we need to assume some covert quantification mechanism in order to derive the distributive interpretation.

The reasoning is similar for the next example:

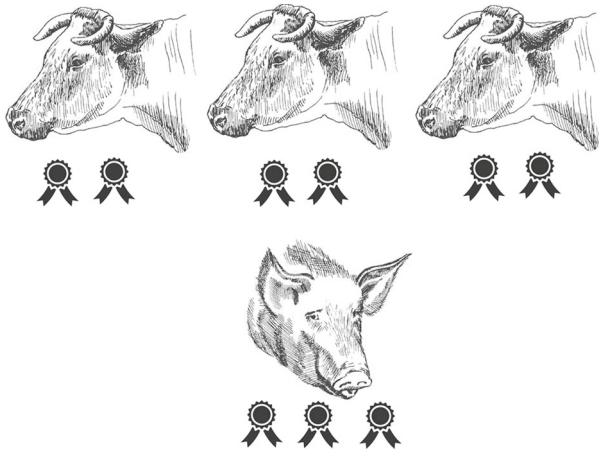


Fig. 1 Cows, pigs and prizes

(17) These artists dress in black one day a week.

⇐ For every artist x , there is one day a week y such that x dresses in black on y . (DI)

⇐ There is one day a week y such that every artist dresses in black on y . (CI)

Without quantification over individual artists, the only interpretation that can be derived is the CI, according to which all the artists dress in black on the same day of the week.

2.1.3 Pronoun binding

When a pronoun or reflexive is bound by a plural definite subject, it can be interpreted as either referring back to the entire plurality, or to each of the members of the plurality individually (as when the pronoun is bound by a universal quantifier). The availability of the latter interpretation points to the presence of a covert quantifier in the derivation. I will provide Dutch examples here, to avoid the complications posed by dependent plurality in English, among other reasons.⁹

⁹ Winter (2000) provides an English example along the following lines:

(i) The boys will be glad when their mothers arrive.

⇐ For every boy x , x will be glad when x 's mother arrives.

However, most varieties of English really need the dependent plural *mothers* here to bring out the distributive interpretation, which means it is hard to tell whether the DI here is really due to covert quantification and not just a special case of the collective interpretation (for *The boys will be glad when the mothers of the boys arrive* to be true, it is only necessary for the boys to be glad when the mothers arrive, a condition that is satisfied when each boy is happy to see his own mother). When the singular *their mother* is used, most speakers are only able to get a collective interpretation in which the boys are all children of the same mother. In contrast, Dutch (sometimes) allows dependent plurality but does not require it, so the Dutch equivalent of *The boys will be glad when their mother arrives* can easily be interpreted both collectively and distributively.

- (18) Deze jongens worden woedend als je hun moeder beledigt.
 These boys become furious if you their mother insult
 ‘These boys get furious if you insult their mother(s).’

- a. \Leftarrow These boys get furious if you insult their mum (they are brothers). (CI)
 b. \Leftarrow For every boy x , x gets furious if you insult x ’s mum. (DI)

Because the NP *hun moeder* ‘their mother’ is singular here, we would not expect the distributive interpretation (in a situation in which the boys are not siblings, which means that we are talking about more than one mother) unless the NP is interpreted in the scope of a quantifier. Hence, the fact that we can interpret (18) as true in such a situation provides another piece of evidence for the presence of a covert quantifier in the semantics of sentences like (18).

Dutch is also the source of the next example, which involves a reflexive anaphor. Unlike English, the Dutch third person reflexive pronoun *zichzelf* is not inflected for either number or gender; as (19) demonstrates, *zichzelf* can be interpreted as ‘himself’, ‘herself’, ‘itself’, or ‘themselves’. This will make Dutch reflexive predication particularly useful when we compare the behaviour of plurals with that of group nouns in Sect. 2.2.

- (19) $\left\{ \begin{array}{l} \text{Jantje vindt} \\ \text{De kinderen vinden} \end{array} \right\}$ zichzelf nogal slim.
 $\left\{ \begin{array}{l} \text{Johnny considers} \\ \text{The children consider} \end{array} \right\}$ SELF.3SG/PL rather clever
 ‘Johnny considers / the children consider himself/themselves rather clever.’

When the subject is a plural definite like *the children*, two different interpretations arise, depending on whether we take the antecedent of *zichzelf* to be the entire group denoted by the subject, or each of the members of that group in turn:

- (20) De kinderen vinden zichzelf nogal slim.
 ‘The children consider themselves rather clever.’
 a. \Leftarrow The children consider the children rather clever (as a group). (CI)
 b. \Leftarrow For every child x , x considers itself rather clever. (DI)

In a situation in which each child considers itself clever but thinks the other children are stupid, (20) is false on its collective interpretation but true on its distributive one. This interpretation cannot be derived if only the plurality *de kinderen* ‘the children’ as a whole may function as the antecedent of *zichzelf*, but it can be derived if we allow *zichzelf* to be bound by a quantifier over individual children.

To summarise, while simple distributive sentences like *The children laughed* might in principle be analysed in terms of direct predication over a collection, 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 Contrasts between plurals and group NPs

In order for quantification over the members of a collection to be possible, this collection needs to be associated with a set on the compositional level, since quantifiers (the D-operator included) by definition only apply to sets. This is relevant because there is a class of noun phrases that intuitively seem to refer to the same collections as the plural definites we have been looking at so far, yet are generally taken to denote atomic entities: singular definites formed with group nouns like *team*, *committee*, *set*, or *pile*. If it is true that these group NPs are atomic, we expect them to ‘fail’ the Q-distributivity tests from the previous section. As we will see, this turns out to be the case: in this section I will show that none of the relevant sentences has a Q-distributive interpretation when the subject is a group NP rather than a plural. This result supports both the validity of our Q-distributivity tests and the atomic analysis of group NPs. In addition, I will use this contrast between plurals and group nouns to identify two more Q-distributivity tests.

Finally, I will show that group NPs, despite their incompatibility with Q-distributivity, do show distributivity effects (as has been recognised in most of the literature on this topic); this confirms the need for a theory of P-distributivity, without which we would be unable to account for these observations.

2.2.1 Group denotations as atoms

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

- (21) a. The $\left\{ \begin{array}{l} \text{choir} \\ \text{members of the choir} \end{array} \right\}$ sang beautifully.
 b. The $\left\{ \begin{array}{l} \text{council} \\ \text{councillors} \end{array} \right\}$ voted on the issue today.
 c. The $\left\{ \begin{array}{l} \text{bouquet} \\ \text{flowers} \end{array} \right\}$ has/have wilted.

Group nouns behave like plurals in other respects: they may appear as the argument of a collective predicate (as in (22)) and function as the antecedent of both discourse and bound plural anaphors ((23b-c) were found through Google, along with many similar examples):¹⁰

- (22) The committee gathered in the meeting room.

¹⁰ An elicitation study by Bock et al. (2006) found that British and American speakers are equally likely to follow up a group antecedent with a plural pronoun, regardless of whether the pronoun is bound by the antecedent or not. Examples (22b) and (22c) were both found on U.S. websites reporting on local news. Since the ability of group NPs to function as the antecedent of plural pronouns is not limited to a particular dialect of English, it appears to be unrelated to their ability (in some varieties of the language) to occur with a plural VP.

- (23) a. The committee debated for two hours before *they* could agree on a solution.
 b. HUD will continue to enforce the Fair Housing Act to ensure that no family has *their* housing options limited because of *their* race.
 c. The crew was obviously enjoying *themselves* and having fun with the script.

In some varieties of English, most notably British English, they may also take plural agreement:¹¹

- (24) This art collective are always dressed in black.

Considerations like these led Bennett (1974) to treat group NPs as pluralities, denoting the set of the group's members; however, most researchers afterwards have argued that groups are not reducible to the set of their members, but are entities in their own right (Barker 1992; Landman 1989; Link 1984; Schwarzschild 1996; but see Magri 2012; Pearson 2011, and the fifth chapter of de Vries 2015 for a different account in the spirit of Bennett). This is intuitively reasonable: groups have identities, purposes, and histories that may be independent of any properties of the group's members. In line with this, (25) shows that while plurals and proper name conjunctions inherit the properties shared by their members and vice versa (Link 1983), this does not always happen with groups:

- (25) Supposing *the women* below refers to, and the intended *committee* consists of, Lily and Naomi:
 a. Lily is old and Naomi is old \Leftrightarrow Lily and Naomi are old \Leftrightarrow The women are old.
 b. *but*: Lily is old and Naomi is old \nLeftrightarrow The committee is old.

There are several other examples that show that a group NP denotation can be in the extension of a certain predicate while the plurality formed by conjoining the group's members is not, or vice versa; Barker (1992) lists many of them.

- (26) a. The committee has two members.
 b. *The women/Lily and Naomi have two members.
- (27) The women/Lily and Naomi are members of the committee \nRightarrow The committee is a member of the committee.

Data like these suggest that group NPs (like *the committee*) do not have the same denotation as the corresponding pluralities (like *Lily and Naomi* or *the members of the committee*).

On independent grounds, Schwarzschild (1996) argues that the denotations of group NPs must be atomic. His argument is based on contrasts like the following:

¹¹ According to Corbett (2000), the same phenomenon is attested in various other languages, like Spanish, Old Church Slavonic, Samoan, the Brazilian language Paumarí, and the Caucasian language Kumaxov. My mother-in-law, who is not a linguist, reported noticing plural agreement with singular group nouns in her studies of Ancient Greek, for which I found official support in a recent corpus study (Birkenes and Sommer 2014).

- (28) a. Each of the boys is from Texas.
 b. *Each of the car was manufactured in the Czech Republic.
 c. *Each of the group is from Texas.
- (29) a. *Part of the boys is/are from Texas.
 b. Part of the car was manufactured in the Czech Republic.
 c. Part of the group is from Texas.

In both of these cases, group NPs pattern with singular entities (*the car*), not with pluralities (*the boys*).

For various other empirical arguments that support an analysis of groups as atoms, see Barker (1992), Schwarzschild (1996), Chierchia (1998), and Krifka (2003).¹²

Link, Barker, Schwarzschild, and (up to a point) Landman all conclude that group NP denotations are atomic: they lack internal structure, and their individual members are inaccessible to the compositional semantics. I will adopt this conclusion; as we will see, the data discussed in the next section are in line with it, adding more support to the groups-as-atoms analysis.

2.2.2 Distributivity behaviour of group nouns

None of the examples of Q-distributivity listed in Sect. 2.1 is available with group NPs, as a comparison between the data in (15)–(20) and the examples below shows. Consider first (30), which parallels (15) but involves a group subject (*the group of semanticists*) rather than a plural one (*the semanticists*):

- (30) The group of semanticists is walking or cycling.
 ⇐ For every semanticist x , x is walking or x is cycling. (DI)
 ⇐ The semanticists are walking or the semanticists are cycling. (CI)

If the subject is a plural definite, as in (15), both a distributive and a collective interpretation are available. However, only the latter is available in (30). Sentence (30) is not entailed by the explicitly distributive statement below it, according to which the disjunction *walking or cycling* applies to each individual semanticist. It is, however, entailed by the second, collective statement, according to which the disjunction *walking or cycling* applies to the collection of semanticists as a whole: either they are all walking, or they are all cycling. In Sect. 2.1, I have shown that only this second interpretation can be analysed in terms of direct predication over a collection; the first must be derived by means of a D-operator. The data in (30) suggest that this option is unavailable with a group noun subject.

Our next examples also run parallel to our earlier data in Sect. 2.1, and show a similar contrast between plurals and group nouns:

¹² Krifka (2003), citing Barker (1992) and Kleiber (1989), mentions that group NPs seem to be incompatible with cardinality predicates such as *be numerous* or *be few*, suggesting that groups do not have countable members, but not everyone seems to agree with this judgement (cf. Champollion 2010: 189) and the analysis of *numerous* as an ‘atom predicate’ in Winter (2002); according to my own intuitions, Dutch cardinality predicates such as *talrijk* ‘numerous’ are clearly ungrammatical with group subjects, but to many of my acquaintances such sentences are just fine.

- (31) The herd/trio of cows won fewer prizes at the fair than the pig. (cf. (16))
 ⇐ For every cow x , x won fewer prizes than the pig. (DI)
 ⇔ The cows together won fewer prizes than the pig. (CI)
- (32) The class is hiding somewhere. (cf. (10)–(12))
 ⇐ For every pupil x , there is a place y such that x is hiding in y . (DI)
 ⇔ There is a place y such that every pupil is hiding in y . (CI)
- (33) This art collective dresses in black one day a week. (cf. (17))
 ⇐ For every artist x , there is one day a week y such that x dresses in black on y . (DI)
 ⇔ There is one day a week y such that every artist dresses in black on y . (CI)
- (34) Groep 8 wordt woedend als je hun moeder beledigt. (Dutch; cf. (18))
 ‘The 6th grade gets furious when you insult their mother.’
 ⇐ For every 6th-grader x , x gets furious if you insult x ’s mother.
 ⇔ The 6th-graders get furious when you insult their mum (the pupils are siblings).
- (35) Mijn familie vindt zichzelf nogal slim. (Dutch; cf. (20))
 ‘My family considers REFL.3SG/PL rather clever.’
 ⇐ For each of my family members x , x considers itself rather clever. (DI)¹³
 ⇔ My family considers my family rather clever (as a group). (CI)

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 (31) can only be false in the situation depicted in Fig. 1; sentences (32) and (33) must mean that everyone hid in the same place or dresses in black on the same day; sentence (34) presupposes that the pupils in the sixth grade are siblings; and finally, sentence (35) can be true even in a situation where my individual family members do not consider themselves particularly clever, as long as they feel that our family as a whole is.

The generalisation that emerges is that sentences with group subjects systematically lack a distributive interpretation that their plural-subject counterparts do have. As I have argued at the beginning of this section, this is expected under an analysis in which group NPs are associated with atomic individuals: since Q-distributivity involves quantifying over the members of a set by means of a D-operator, Q-distributive interpretations should only be available if the sentence subject denotes a set. The contrast between (15)–(20) on the one hand and (30)–(35) on the other thus supports an analysis of groups as atoms.¹⁴

¹³ According to my judgement, P-distributivity is available with Dutch reflexive predicates. For example, a psychiatrist might say *Deze groep patiënten snijdt zichzelf* ‘This group of patients cuts REFL.3SG/PL’, just as an English-speaking psychiatrist might say *This group of patients self-harms*. However, in a small clause construction like *vinden zichzelf slim* ‘consider REFL.3SG/PL clever’ that does not involve a single reflexivised verb, a distributive interpretation is clearly out.

¹⁴ In British English, the missing Q-distributive interpretations in (32)–(35) reappear when the group NPs appear with a plural VP; related observations are made in Pollard and Sag (1994) and Barker (1992). See de Vries (2013) for an in-depth investigation of this.

2.2.3 Further examples of Q-distributivity

The Q-distributivity tests from Sect. 2.1 were based on theory: given standard assumptions about disjunction, scope, and binding, we expect not to be able to derive distributive interpretations for the relevant sentences unless distributivity involves covert quantification. This expectation is confirmed by the contrast between plural-subject and group-subject sentences that was established in the previous section. Now that we have established that we can diagnose whether a given distributive interpretation is Q-distributive by checking whether it is available when the sentence subject is a group NP, we can in turn use this observation to identify additional Q-distributivity tests involving linguistic phenomena that different theories have different predictions about, and perhaps use the results to decide between competing theories (just as our original Q-distributivity tests provided support for an atomic, rather than set-based, analysis of group NPs). In this section, I will mention two such additional tests, and briefly discuss the theoretical implications.

Proportionality modifiers The first of these examples is from Dutch, where the adverb *gedeeltelijk* ‘partly’ modifies the telic predicate *kaalgeschoren* ‘shaved bald’ to indicate that the shaving-bald event was only partly completed:

- (36) De studenten zijn gedeeltelijk kaalgeschoren. (Dutch)
The students are partly bald.shaved
 ‘The students were partly shaved bald.’
 a. \Leftarrow Part of the students have been shaved bald. (CI)
 b. \Leftarrow Every student has been shaved partly bald. (DI)

If we take the group of students as a whole to be the incremental theme of the shaving-bald event, and this event was only partially completed, we get the collective interpretation according to which only some of the students were shaven bald. If we quantify over individual students, we get a partially completed shaving-bald event for each of them, resulting in the distributive interpretation according to which every student is now partly bald.

There is a possible objection to this, however. Perhaps the DI simply entails the CI in this case: a situation in which every student is shaved partly bald might be interpreted as a partially completed shaving-bald event involving the entire group, so the collective interpretation of sentence (36) would be verified in such a situation. However, when we compare the entailment pattern in (36) to that of its group-subject counterpart, we see that this cannot be the case:

- (37) Het dispuut is gedeeltelijk kaalgeschoren. (Dutch)
The fraternity is partly bald.shaved
 ‘The fraternity was partly shaved bald.’
 a. \Leftrightarrow Part of the students have been shaved bald. (CI)
 b. \nLeftrightarrow Every student has been shaved partly bald. (DI)

If the collective interpretation—a partially completed shaving-bald event with the entire fraternity as its theme—could be verified by a distributive situation in which

each of the students has been partly shaved, we would expect (37) to have precisely the same range of interpretations as (36). However, in the case of (37), a distributive interpretation is clearly out: unlike (36), it is false in the described situation.¹⁵ This shows that (a) we do need to derive the DI in (36b) as a separate (Q-distributive) reading, and (b) however we analyse an adverb like ‘partially’, we should take into account the fact that its behaviour depends on the semantic number of the sentence subject.

VP conjunction Another Q-distributivity test that I have not discussed in Sect. 2.1 is VP conjunction, which shows a contrast between plural and group subjects that is very similar to the disjunction data:

- (38) a. The women are short and tall.
b. # The committee is short and tall.

While (38a) is acceptable to many speakers, and is interpreted as equivalent to ‘Some of the women are short, the others are tall’, this non-Boolean interpretation seems to be out for (38b). The only interpretation available for (38b) is an intersective one according to which each member of the committee is (impossibly) both short and tall, which makes the sentence anomalous.

The issue of non-Boolean VP conjunction has received some attention in the literature (e.g. Krifka 1990; Poortman 2014, 2017; Winter 2001). The contrast between plural and group subjects, however, seems to have gone unnoticed so far. It is unexpected under Krifka’s account, which is explicitly designed to capture both (38a) and the non-Boolean interpretation of (39) with a single analysis:

- (39) The flag is green and white.

Krifka posits an interpretation rule according to which sentences like (38a) and (39) are true if the subject denotation can be partitioned in such a way that the first predicate holds of one partition and the second predicate holds of the other one. Since the rule must be able to account for (39), it needs to be defined for both plural and singular entities. This predicts that the atomic entity corresponding to *the committee* should be able to be similarly partitioned into a short part and a tall part, which means that (38b) should be completely equivalent to (38a). However, we have seen that this is not the case.

The account in Winter (2001) is better equipped to deal with the plural/group contrast, since it only works on pluralities (Winter analyses singular predicate conjunctions like (39) as an independent phenomenon, following Lasersohn 1995). Under this account, the strong, Boolean meaning of (38a) is basic, but it is weakened under the influence of lexical knowledge that tells us that being short and being tall are mutually exclusive. The actual interpretation, then, will be the strongest interpretation

¹⁵ I have checked this with several native speakers of Dutch, who all shared my intuitions about these sentences.

compatible with this lexical knowledge—i.e., an interpretation according to which each of the women is either short or tall.¹⁶

As a Q-distributivity test, the VP conjunction test functions much the same as the disjunction test: since the non-Boolean interpretation can only be derived when the subject is a set, (38a), but not (38b), is true in a situation where some of the women are short while the rest are tall.

2.3 P-distributivity

All this does not mean, however, that group-subject sentences may never receive a distributive interpretation. The sentences in (40) show that group nouns, like plurals, allow both collective and distributive interpretations:

- (40) a. The class $\left\{ \begin{array}{l} \text{gathered in the garden.} \\ \text{met last week.} \\ \text{is a good team.} \end{array} \right\}$
 b. The class $\left\{ \begin{array}{l} \text{laughed.} \\ \text{sang.} \\ \text{told riddles.} \end{array} \right\}$

Following the argument made in the previous section and our conclusion that group NP denotations are atomic, this means that distributive interpretations like the ones in (40b) cannot be based on covert quantification over group members. The distributivity effects in (40b), then, have to be lexical in nature: the behaviour of group NPs makes clear that a formal, operator-based account of distributivity alone is not sufficient to cover the full range of distributivity data, and provides empirical support for the notion of P-distributivity. In this section, we will further explore this notion by trying to capture the lexical inferences underlying P-distributivity using *pseudo-equivalences* (following Winter and Scha 2015), which are meaning postulates that hardwire the distributive properties of the predicate into its lexical entry, while leaving room for various nuances based on context and world knowledge.

Recall that, in our present approach, there is no formal semantic difference between collectivity and P-distributivity: they are modelled using precisely the same compo-

¹⁶ Essentially, we can view plural predication as expressing a relation between two sets—a set of entities and a set of properties—where the Boolean interpretation can be expressed by universal quantification over both of these sets, as follows:

(i) $\llbracket \text{The women are short and tall} \rrbracket = 1$ iff $\forall (x, P) \in \text{WOMAN} \times \{\text{SHORT, TALL}\} : P(x)$

In order to derive the non-Boolean interpretation, we can ‘chip away’ at the Cartesian product of WOMAN and {SHORT, TALL} by removing ordered pairs until it is compatible with our lexical knowledge—for example, this weakened relation may contain either the pair $\langle w_1, \text{SHORT} \rangle$ or the pair $\langle w_1, \text{TALL} \rangle$, but not both. The result is a set of new, weakened relations with the mutual exclusivity of SHORT and TALL taken into account; the ‘Extended Strongest Meaning Hypothesis’ states that the strongest of these relations (i.e. the maximal subsets of $\text{WOMAN} \times \{\text{SHORT, TALL}\}$ that are still compatible with our lexical knowledge) are used in evaluating the truth of the sentence.

For our purposes, the precise workings of the ESMH are not important—the important thing is that the above procedure is only defined for predication over sets, not for singular predication. This means that the same mechanism cannot be applied to derive a non-Boolean interpretation for (38b).

sitional 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, as we have already seen, *The team laughed* receives a distributive interpretation, *The class is a good team* a collective one, and *The family gathered* is collective with respect to the predicate as a whole but distributive with respect to certain parts of the predicate meaning.

In principle, there are various ways we can go about formalising this idea, which should strike a balance between two extremes. One extreme is a completely lexicon-based approach, in which all possible collective and distributive inferences are listed as part of a predicate's lexical entry (for example, in the form of meaning postulates). The other extreme is an approach fully based on context, in which the lexical semantics of the relevant predicates is underspecified with respect to the way its meaning pertains to individual parts of the collections it applies to, and contextual/pragmatic factors like world knowledge and discourse goals are left to fill in the blanks. I will briefly discuss some reasons why the best approach is likely to be located somewhere in the middle—not as flexible as the pragmatic approach, but not as rigid as the fully lexical approach either.

2.3.1 Support for a lexicon-based approach: stubborn distributivity

While lexical semantics is of course closely related to world knowledge in the sense that words and their meanings enable us to express things about the world, it is not merely a way of capturing world knowledge a bit more formally. The lexical semantics of a word may impose restrictions on its meaning that do not seem to have anything to do with our understanding of how the world works, and this also holds for the availability of P-distributivity effects. As [Schwarzschild \(2009\)](#) observes, some predicates do not seem to be vague between a collective and a distributive interpretation, even though such vagueness would be perfectly compatible with our world knowledge. For example, according to Schwarzschild's judgements, sentence (41a) has no interpretation under which it means the same as (41b), and vice versa:

- (41) a. The boxes are large.
 b. The collection of boxes is large.

According to Schwarzschild, sentence (41b) can only mean that the collection itself is large, not that the boxes that make up the collection are. Sentence (41a) has the opposite meaning: it can only be used to express that the individual boxes are large, not that the boxes together are (compare *The boxes take up a lot of space*, which means roughly the same but does have a collective interpretation in addition to a distributive one). For this reason, Schwarzschild calls predicates like *large* 'stubbornly distributive'.

Stubbornly distributive predicates are relevant to our present discussion because world knowledge tells us that largeness can be a property of individuals as well as collections, so if collective and P-distributive inferences were a matter of applying world knowledge to a lexically underspecified predication structure, we would expect both inferences to be available with *large*. The fact that this does not seem to be the case shows that an approach to P-distributivity that is fully based on pragmatic factors

like context and world knowledge leads to overgeneration. A property like stubborn distributivity needs to be made explicit in the lexical semantics of *large* (but not *take up a lot of space*) in such a way that the plural/group contrast in (41) follows.

2.3.2 Support for a pragmatic approach

On the other hand, it can be shown that pragmatic reasoning does influence the availability of certain inferences from wholes to parts, which supports an analysis in which these inferences are not fully lexically specified. A commonly made argument for the involvement of pragmatic factors involves sentences like the following:

- (42) a. The shoes cost €50.
 (Champollion 2010; Lasersohn 1995; Schwarzschild 1996)
 b. The new collection costs €50.

The most natural interpretation of (42a) is that the relevant shoes cost €50 *a pair*—an ‘intermediate’ (neither collective nor fully distributive) interpretation facilitated by our knowledge of the world, in which shoes are usually sold in pairs. While the intermediate interpretation of sentences like (42a) is usually invoked in arguments about the various properties of the D-operator (i.e., in discussions of Q-distributivity), the fact that this interpretation is also available for (42b) if it is uttered in the same shoe-pricing context shows that pragmatic factors influence P-distributive interpretations as well.

2.3.3 Pseudo-equivalences

In Scha (1981), the derivation of distributive and collective interpretations is governed by meaning postulates on the predicate. For example:

- (43) WALK(X) (where X is a non-singleton set) is to be interpreted as $\forall x \in X[\text{WALK}(x)]$

A more recent version of Scha’s meaning postulates approach can be found in Winter and Scha (2015). Winter and Scha propose a pseudo-formalisation of P-distributivity using *pseudo-equivalences*, which are non-logical and context-sensitive equivalences (written with a squiggly arrow \rightsquigarrow) between pairs of statements, designed to capture the lexical semantics of certain expressions. Just as the sentence pairs in (44a) and (44b) are pseudo-equivalent, so are the pairs in (45):

- (44) a. The table is white. \rightsquigarrow Every part of the table is white.
 b. The machine is broken. \rightsquigarrow Some part of the machine is broken.
 (45) a. The boys are tall. \rightsquigarrow Every boy is tall.
 b. The books touch the ceiling. \rightsquigarrow Some book touches the ceiling.

I will take Winter and Scha’s pseudo-equivalences as my starting point, but make some adjustments to their form for several reasons. First, Winter and Scha do not address ‘mixed’ predicates, which may be interpreted both distributively and collectively.

(Note that this distinction cannot be captured in terms of quantificational force; a non-maximally distributive interpretation like (45b) is still distributive. See also Landman 1996.) But the existence of mixed predicates has always formed a problem for an approach to collectivity and distributivity based on meaning postulates (Hoeksema 1988; Roberts 1987), since it entails that those meaning postulates are only optional and that we need additional factors to determine whether they apply in a given context or not; this robs the theory of much of its explanatory power. Second, even though Winter and Scha tell us that their pseudo-equivalences are context-sensitive, they do not specify the mechanism through which pseudo-equivalences like the ones in (44)–(45) are influenced by context. If we want our analysis to make any verifiable predictions about the way contextual factors influence the interpretation of predicates, we need to be more formally explicit about this by enriching the relevant pseudo-equivalences with contextually-defined variables.

At the end of this section, we will have constructed a general template for the pseudo-equivalences that govern the kind of part-whole inferencing that (P-)distributivity and collectivity are the result of, that takes into account both the previous two points and our discussion in Sects. 2.3.1 and 2.3.2 above.

Let's start with the challenge posed by mixed predicates. Many predicates, like *win* and *vote in favour*, are vague between a collective and a distributive interpretation, or—given the right context—fall somewhere in between, as in the shoes example (42a) above. For example:

- (46) a. Five boy/girl pairs played a game of chess against each other. (Each of) the girls won.
 b. Five girls played a football match against five boys. (*Each of) the girls won.
- (47) The councillors voted in favour of the proposal.
 a. \Leftarrow Each of the councillors voted in favour.
 b. \Leftarrow The majority of the councillors voted in favour (i.e., the proposal got enough yes-votes to pass).

However, the above interpretations could all follow from a pseudo-equivalence like (48) if we allow for different contextually salient granularities in deciding what counts as the 'parts' of a collection (cf. Verkuyl and Does 1996, who argue that the difference between collectivity and distributivity is more quantitative than qualitative).¹⁷

- (48) *Template for pseudo-equivalences* (captures collective and distributive interpretations of mixed predicates)
 $P(X) \leftrightarrow \forall x[x \text{ is a salient part of } X \rightarrow P(x)]$ (where X is a collection¹⁸)

Consider the predicate *cost 50 euros*. In an ordinary clothing shop, where shoes are priced and sold in pairs, a partitioning of 'the shoes' into pairs of shoes might be the

¹⁷ Compare also Schwarzschild's (1996) cover-based approach to (Q-)distributivity and Champollion's (2010) claim that Q-distributivity is usually atomic, while P-distributivity can easily distribute over larger non-atomic partitionings.

¹⁸ Recall that 'collection' is our pre-theoretical term for any NP denotation that is conceptually plural, i.e. that refers to a collection of entities or objects (see footnote 6).

most contextually salient; but if the shop is going out of business and selling its entire inventory in bulk, the most contextually salient partitioning of ‘the shoes’ might be one in which it has just a single part, namely the entire collection of shoes. If we allow a collection to count as a part of itself, the collective interpretation of (47) could be captured by the context-sensitive application of the meaning postulate in (48).

Salient partitionings also appear to be relevant for certain non-maximally distributive interpretations, where a smaller subpart of a collection functions to ‘represent’ the collection as a whole. For example, whether the sentence *The girls are touching the ceiling* is true depends very much on the way the girls are grouped together in the context—if they are forming a human pyramid together, it is sufficient for just the girl at the top to be touching the ceiling, but if they are all in different locations, it is more likely that we will only judge the sentence as true if each of the girls is touching the ceiling independently (cf. observations in Lasersohn 1990). Similarly, a sentence like *The reporters asked the president questions* can be true if only a few of the individual reporters actually asked a question (Dowty 1987), because it is easy to regard a group of reporters at a press conference in terms of their collective function, rather than as a collection of salient individuals (and the non-maximal interpretation becomes more and more difficult the more the reporters are individuated).

But the salience of the partitioning is not the only factor influencing the interpretation—there is, of course, also the contribution of the predicate itself. The pseudo-equivalence in (48) fails to capture, for example, the difference between collectively winning and ‘collectively’ touching the ceiling. If a football team wins a match, this is a truly collective property of the team as a whole: individual players can’t win football matches. But when a human pyramid touches the ceiling, one of the individuals in the pyramid is touching the ceiling on everyone’s behalf. While we can say that *the girls are touching the ceiling* if the girls as a whole form a salient group, *touch the ceiling* is still a distributive predicate, a property of individuals rather than collections. In order to capture this, we need a slightly different template from the one given in (48):

(49) *Template for pseudo-equivalences* (captures maximal and non-maximal P-distributivity)

$$P(X) \iff \forall x[x \text{ is a salient part of } X \rightarrow \exists y \leq x[P(y)]]$$

So, while the mixed predicate *to win* is lexically associated with a pseudo-equivalence like the one in (48), the purely distributive *to touch the ceiling* is associated with the template in (49), according to which saying that a predicate P holds of a collection X amounts to saying that every salient part of X contains an entity to which P applies (note that I am using \leq here, not \in , since the pseudo-equivalence should be applicable to collections that correspond to atomic entities in the formal semantics).

To sum up, the ‘salient part’ requirement captures the way contextual factors are involved in the interpretation of predicates as (non-)maximally P-distributive or collective. While salient partitionings are important for all predicates, the availability of different pseudo-equivalence templates reflects the observation that different predicates impose different requirements upon these salient parts: they can either be agents themselves or contain an agent. Of course, the templates may be dressed up with fur-

ther lexical information to capture other particularities of individual predicates, such as the fact that certain subproperties of the predicate *gather* do distribute to all individual members of the subject collection (see Dowty 1987 for many excellent observations related to subtailments and what it means to ‘take part’ in a given event). And some predicates may not have pseudo-equivalences associated with them at all (such as the stubbornly distributive ones discussed in Sect. 2.3.1).

3 Conclusions

I have argued that distributivity effects can be derived in two different ways: either by context-based reasoning about parts and wholes in relation to a predicate meaning (P-distributivity) or by covert quantification over members of a collection (Q-distributivity). While P-distributivity is available with singular group NPs like *my family* or *the team*, Q-distributivity is limited to actual pluralities: in order for quantification over members of a collection to be possible, those members need to be accessible to the compositional semantics. I have shown that the contrast between group NPs and plurals supports an analysis of groups as atoms, in line with Barker (1992) and Schwarzschild (1996) (but see de Vries 2013, 2015 for a more nuanced view on this). I have also demonstrated how the observed group-versus-plurals contrast can be used to shed light on the role of semantic number in phenomena like event modification and non-Boolean conjunction.

Finally, I have sketched a more formal analysis of P-distributivity based on a generalisation of the notion of pseudo-equivalence (Scha 1981; Winter and Scha 2015), proposing two basic templates that can be used to capture various P-distributive inferences depending on the particular predicate and on contextual information.

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References

- Barker, C. 1992. Group terms in English: Representing groups as atoms. *Journal of Semantics* 9 (1): 69–93.
- Bartsch, R. 1973. The semantics and syntax of number and numbers. *Syntax and Semantics* 2: 51–93.
- Bennett, M. 1974. Some extensions of a Montague fragment of English. PhD dissertation, UCLA.
- Birkenes, M.B., and F. Sommer. 2014. The agreement of collective nouns in the history of Ancient Greek and German. In *Language change at the syntax-semantics interface*, ed. C. Gianollo, A. Jaeger, and D. Penka, 183–221. Berlin: de Gruyter Mouton.
- Bock, K., A. Cutler, K. Eberhard, S. Butterfield, C. Cutting, and K. Humphreys. 2006. Number agreement in British and American English: Disagreeing to agree collectively. *Language* 82 (1): 64–113.
- Brisson, C. 1998. Distributivity, maximality and floating quantifiers. PhD dissertation, Rutgers University.
- Brisson, C. 2003. Plurals, all, and the nonuniformity of collective predication. *Journal of Semantics* 26: 129–184.
- Champollion, L. 2010. Parts of a whole: Distributivity as a bridge between aspect and measurement. PhD dissertation, University of Pennsylvania.
- Chierchia, G. 1998. Reference to kinds across language. *Natural Language Semantics* 6 (1): 339–405.
- Corbett, G. 2000. *Number*. Cambridge: Cambridge University Press.

- de Vries, H. 2013. Distributivity and agreement: New evidence for groups as sets. In *Proceedings of the 19th Amsterdam Colloquium*, ed. M. Aloni, M. Franke, and F. Roelofsen, 241–248. Amsterdam: ILLC.
- de Vries, H. 2014. Lexical distributivity with group nouns and property indefinites. In *Proceedings of NELS 43*, ed. H.-L. Huang, E. Poole, and A. Rysling, 91–102. Amherst, MA: GLSA.
- de Vries, H. 2015. Shifting sets, hidden atoms: the semantics of distributivity, plurality and animacy. PhD dissertation, Utrecht University.
- Dowty, D. 1987. A note on collective predicates, distributive predicates, and all. In *Proceedings of the Third Eastern States Conference on Linguistics*, ed. F. Marshal. Columbus: The Ohio State University.
- Gillon, B. 1987. The readings of plural noun phrases in English. *Linguistics and Philosophy* 10: 199–219.
- Hoeksema, J. 1988. The semantics of non-Boolean 'and'. *Journal of Semantics* 6: 19–40.
- Kleiber, G. 1989. 'Le' generique: Un massif? *Langage* 94: 73–113.
- Kratzer, A. 2008. On the plurality of verbs. In *Event structures in linguistic form and interpretation*, ed. J. Dölling, T. Heyde-Zybatow, and M. Schäfer, 269–300. Berlin: De Gruyter.
- Krifka, M. 1990. Boolean and non-Boolean 'and'. In *Papers from the second Colloquium on Logic and Language*, ed. L. Kalman and L. Polos, 161–188. Budapest: Akadémiai Kiadó.
- Krifka, M. 2003. Bare NPs: Kind-referring, indefinites, both, or neither? In *Proceedings of SALT 13*, ed. R.B. Young and Y. Zhou, 1–24. Ithaca, NY: CLC Publications.
- Kroch, A. 1974. The semantics of scope in English. PhD dissertation, MIT.
- Landman, F. 1989. Groups. *Linguistics and Philosophy* 12: 559–605, 723–744.
- Landman, F. 1996. Plurality. In *The handbook of contemporary semantic theory*, ed. S. Lappin, 425–457. Oxford: Blackwell.
- Landman, F. 2000. *Events and plurality: The Jerusalem lectures*. Dordrecht: Kluwer.
- Laserson, P. 1989. On the readings of plural noun phrases. *Linguistic Inquiry* 20: 130–134.
- Laserson, P. 1990. Group action and spatio-temporal proximity. *Linguistics and Philosophy* 13 (2): 179–206.
- Laserson, P. 1995. *Plurality, conjunction and events*. Dordrecht: Kluwer.
- Laserson, P. 1999. Pragmatic halos. *Language* 75 (3): 522–551.
- Link, G. 1983. The logical analysis of plurals and mass terms: A lattice-theoretical approach. In *Meaning, use and interpretation of language*, ed. R. Bäuerle, C. Schwarze, and A. von Stechow, 302–323. Berlin: De Gruyter.
- Link, G. 1984. Hydras. On the logic of relative constructions with multiple heads. In *Varieties of formal semantics*, ed. F. Landman and F. Veltman, 245–257. Dordrecht: Foris.
- Link, G. 1987. Generalized quantifiers and plurals. In *Generalized quantifiers: Linguistic and logical approaches*, ed. P. Gardenfors, 151–180. Dordrecht: Reidel.
- Magri, G. 2012. Collective nouns without groups. In *Proceedings of IATL 27*, ed. E. Cohen, 183–202. Cambridge, MA: MIT.
- Pearson, H. 2011. A new semantics for group nouns. In *Proceedings of WCCFL 28*, ed. M.B. Washburn, et al., 160–168. Somerville, MA: Cascadilla Press.
- Pollard, C., and I. Sag. 1994. *Head-driven phrase structure grammar*. Chicago: University of Chicago Press.
- Poortman, E. 2014. Between intersective and 'split' interpretations of predicate conjunction: The role of typicality. In *Proceedings of the Formal & Experimental Pragmatics Workshop*, (ESSLI 2014), ed. J. Degen, M. Franke, and N. Goodman, 36–42. Tübingen University.
- Poortman, E. 2017. *Concepts and plural predication* (Unpublished doctoral dissertation). Utrecht University.
- Roberts, C. 1987. Modal subordination, anaphora, and distributivity. PhD dissertation, University of Massachusetts at Amherst.
- Scha, R. 1981. Distributive, collective and cumulative quantification. In *Formal methods in the study of language*, ed. J. Groenendijk, M. Stokhof, and T. Janssen, 483–512. Amsterdam: Mathematisch Centrum.
- Schwarzschild, R. 1996. *Pluralities*. Dordrecht: Kluwer.
- Schwarzschild, R. 2009. Stubborn distributivity, multiparticipant nouns and the count/mass distinction. In *Proceedings of NELS 39*, ed. S. Lima, K. Mullin, and B. Smith, 661–678. Amherst, MA: GLSA.
- Verkuyl, H. 1994. Distributivity and collectivity: A couple at odds. In *Dynamics, polarity, and quantification*, ed. M. Kanazawa and C. Pinon. Stanford: CSLI Publications.
- Verkuyl, H., and J. van der Does. 1996. The semantics of plural noun phrases. In *Quantifiers, logic and language* (CSLI Lecture Notes 54), ed. J. van der Does and J. van Eyck. Stanford: CSLI Publications.
- Winter, Y. 1997. Choice functions and the scopal semantics of indefinites. *Linguistics and Philosophy* 20: 399–467.

-
- Winter, Y. 2000. Distributivity and dependency. *Natural Language Semantics* 8: 27–69.
- Winter, Y. 2001. Plural predication and the Strongest Meaning Hypothesis. *Journal of Semantics* 18: 333–365.
- Winter, Y. 2002. Atoms and sets: A characterization of semantic number. *Linguistic Inquiry* 33: 493–505.
- Winter, Y., and R. Scha. 2015. Plurals. In *Handbook of contemporary semantics*, 2nd ed, ed. S. Lappin and C. Fox, 77–113. New York: Wiley.