

Groups vs. covers revisited: Evidence from symmetric readings of sentences with plurals*

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Abstract

We present new arguments for the existence of genuine symmetric readings of sentences with plural terms, which we claim challenge all current semantic theories of plurality. We sketch two analytical directions and describe some of the diverging predictions they make.

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1 Introduction

The subject of sentence (1) is a conjunction of two plural terms. The sentence can be true in a context in which the French students hit the Italian students and the

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Italian students hit the French students. On standard theories of plurality (e.g., Link 1983), conjunction of two pluralities generates a flat plurality, so how does the compositional semantics gain access to the two sub-pluralities that hit each other?

(1) The French students and the Italian students hit each other.

Landman (1989) introduces a group-forming operator (\uparrow) that may apply to plural noun phrases. Thus, \uparrow [*the French students*] and \uparrow [*the Italian students*] denotes a plurality containing two atomic groups. On this logical form, (1) is true if members of each group hit members of the other one. Schwarzschild (1996) proposes an alternative analysis on which the interpretation of sentences with plural arguments depends on the choice of covers of their denotations. Any cover that is recoverable from context can in principle serve this role. The reading above is obtained with a cover of the students (here, explicitly mentioned) that divides them into two pluralities: the French students and the Italian students.

Schwarzschild's semantics generates many more readings as well, since every possible cover yields a possible reading, and possible covers are restricted only by pragmatic factors. This is in sharp contrast with Landman's analysis, which is restricted by the syntactic structure of plural noun phrases, according to which each plural noun phrase may denote a group. In favor of his own analysis, Schwarzschild argues that sentences like (2) have an equivalent reading, but that there is no relevant node in the logical form at which a group-forming operator can attach. For sentence (3), too, he suggests that such a reading exists, arguing that (3) can be true in a situation like the one described above.

(2) The students from the two countries hit each other.

(3) The students hit each other.

Let us call the putative reading described above the "symmetric" reading (cf. Winter and Scha 2015). The empirical question we address in this squib is which, if any, of (1–3) genuinely have a symmetric reading. We argue that genuine ambiguity between two or more readings must be dissociated from (mere) underspecification, and we present experimental results to that effect. We show that, contra Landman (1989), sentence (2) *does* have a reading equivalent to the one in (1). But we also show that, contra Schwarzschild (1996), sentence (3) *does not* have this reading, even in a context in which the relevant cover is highly salient. Our results thus pose a challenge to two longstanding views on plurals.

In the second part of the squib, we address the theoretical question of how to account for the symmetric reading of (2) while excluding an analogous reading for (3). We present two potential directions for analysis: first, by enriching Landman (1989) with scope-taking; second, by restricting Schwarzschild (1996) using dynamic

semantics. We discuss the diverging predictions these analyses would make.

2 Ambiguity vs. underspecification

Sentence (3) may be true in the situation described above, but this does not mean that this is an independent reading of the sentence. This may simply correspond to underspecification, just as *sibling* is underspecified with respect to gender. To detect genuine ambiguity, one should consider not only when the sentence is true, but also when it is false. Specifically, if a sentence is ambiguous between several readings, then there may be situations in which it is judged true under one reading, and false under another (Gillon 1990, 2004). In practice, speakers' intuitions about truth and falsity turn out to be not so clear when focusing on simple sentences like (1). To alleviate this problem, we consider sentences with ellipsis and negation, such as (4), uttered in a context in which two separate covers are relevant.

- (4) *Context: This class has only French and Italian students. On Monday, a fight broke out: the French students hit the Italian students, and the Italian students hit the French students. On Tuesday, another fight broke out, but this time within the two groups: the French students hit one another, and the Italian students hit one another.*

On Monday, the French students and the Italian students hit each other, but not on Tuesday.

If sentence (1) has the reading characterized at the outset, then the sentence on this reading should be judged true with respect to Monday, but false with respect to Tuesday. The full sentence in (4) should thus be able to be judged true. If (1) has only a single, underspecified reading – roughly, “some students hit some other students” – then (4) should be false, because this is true on both Monday and Tuesday (cf. the “inclusive alternative ordering” reading of Dalrymple et al. 1998).

Structures of this form thus provide a way to test the existence of the relevant reading for the sentences in (1–3). Notably, as is highlighted by both Landman (1989) and Schwarzschild (1996), the mechanisms giving rise to such a reading are not specific to reciprocals, but arise from general properties of plural predication. Examples with a parallel structure can thus be constructed using sentences with no overt reciprocal, as in (5).

- (5) *Context: This zoo has two types of tigers – Indian tigers and Chinese tigers – who typically live together. In April, there were two special exhibits, one on Indian animals and one on Chinese animals, so the zookeeper separated the tigers into two groups according to their country of origin. In May, it was mating season, so*

to have careful control over breeding, the zookeeper again separated the tigers into two groups, but this time by sex.

- a. In April, the zookeeper separated the Indian tigers and the Chinese tigers, but not in May.
- b. In April, the zookeeper separated the tigers of the two countries, but not in May.
- c. In April, the zookeeper separated the tigers, but not in May.

These judgments were tested in an online experiment with 30 native speakers of English. Eight short context paragraphs were created, paired with three sentences containing the target NP structures: “the As and the Bs”, “the Xes from the two Ys”, and “the Xes”. In order to judge the availability of the target reading, subjects were asked to read each context paragraph, then evaluate (on a continuous scale) whether each of the three sentences could be used as a true description of that context. Full details on methodology and analysis are provided in the Appendix.

Judgments on the eight trios of sentences showed that both (a) sentences and (b) sentences can be judged as true in the relevant context, but that the (c) sentences cannot. This suggests that the (a) and (b) sentences share a reading – the symmetric reading discussed for (1) – that (c) sentences don’t have. This contradicts the predictions of both Landman’s analysis and Schwarzschild’s analysis. Note that it is unlikely that Schwarzschild could explain the data via pragmatics, since the (c) sentences were always presented following (a) and (b) on the same page of the survey, so the relevant cover should in principle be highly salient in all cases.

3 Directions for analysis

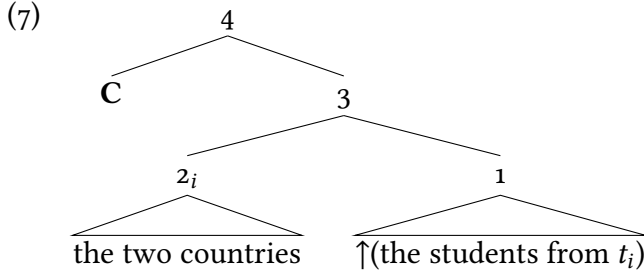
These results paint a picture that is challenging to all current theories. In particular, we find that the symmetric reading of (1) corresponds to a distinct logical form that is not derivable by simple pragmatic means. On the other hand, this reading is not likely to be due to group-forming operators, nor to “generalized conjunction” (Partee and Rooth 1983), since the reading is also available for (2), whose subject is a single noun phrase, without conjunction. How are we to analyze (2)? Here, we sketch two analytical directions – one an enrichment of Landman (1989); the other a revision of Schwarzschild (1996) – then describe the diverging predictions they make.

3.1 Group-forming operators plus scope

On Landman’s analysis, we would ideally like to assign the noun phrase in (6a) an interpretation equivalent to the one in (6b).

- (6) a. the students from the two countries
 b. $\uparrow[\text{the students from France}] \oplus \uparrow[\text{the students from Italy}]$

Such an interpretation can be obtained by combining Landman’s group-forming operator with a mechanism of scope taking and the operation of “collectivity raising” from Winter (2001). We assume that (6a) is assigned the structure in (7), in which the DP *the two countries* has been quantifier raised outside of a structure containing a group-forming operator. Following Kobele (2010)’s analysis of inverse linking, this structure is assigned the interpretation in (8).



- (8) $C(\lambda P.\text{the two countries}(\lambda t.P(\uparrow \text{the students from}(t))))$

Node 1 denotes the (atomic) group of students from country *i*. Node 2 is a generalized quantifier that is true of all predicates that contain each of the two contextually salient countries (here, France and Italy). Using the compositional system of Kobele (2010), Node 3 returns another generalized quantifier: the set of predicates that contain both the atomic group of students from France and the atomic group of students from Italy. Finally, we apply Winter (2001)’s **C** operator, defined in (9), which transforms a generalized quantifier into a (lifted) plurality.

- (9) a. $\text{min} = \lambda Q.\lambda A.Q(A) \wedge \forall B \in Q[B \subseteq A \rightarrow B = A]$
 b. $\mathbf{E} = \lambda A.\lambda P.\exists X[A(X) \wedge P(X)]$
 c. $\mathbf{C} = \lambda Q.\mathbf{E}(\text{min}(Q))$

Given a generalized quantifier, the function “min” returns the set of all of its minimal predicates. Thus, applied to Node 3, it returns the singleton set containing the set $\{\uparrow(\text{students from France}), \uparrow(\text{students from Italy})\}$. This is precisely the plurality desired in (6b). (Winter (2001) models pluralities as sets instead of sums, but the translation can be made easily.) Existential raising in (9b) asserts that there

is some such plurality that has the property denoted by the predicate.¹ With the predicate *hit each other*, the resulting sentence is true if the group of students from France hit the group of students from Italy, and vice versa.

This analysis thus explains our data by enriching Landman’s framework with more recent hypotheses regarding scope-taking and the relation between generalized quantifiers and plurality.

3.2 Covers plus dynamic semantics

A second strategy of analysis retains the essential compositional components of Schwarzschild (1996), but places further restrictions on the pluralities that can be recovered from context. In particular, the framework of dynamic semantics aims to provide a precise system that determines what singular and plural discourse referents are recoverable from a given discourse context.

One thread of work on dynamic semantics focuses on the way that plural discourse referents are introduced and manipulated (van den Berg 1996; Nouwen 2003; Brasoveanu 2008). On these theories, when one plurality is placed in a semantic relation with another plurality, the dynamic system represents not only the two pluralities, but also the thematic relation between them. Thus, the DP in (10a) generates an information state like the one in (10b); here, horizontal rows indicate that the “from” relation holds between the values of x and y .

(10) a. the ^{y} students from the ^{x} two countries

b. G:

x	y
France	student 1
France	student 2
Italy	student 3
Italy	student 4

Recent work has argued that these semantic associations – and the subpluralities that are created by them – can be accessed by linguistic items elsewhere in the sentence (Dotlačil 2013; Kuhn 2017). One can modify Schwarzschild’s analysis to be similarly sensitive to the relations established in the discourse representation. Schwarzschild’s analysis involves two variables: a plurality, and a cover over that plurality. For a plural information state G , we let $G|_{x=d}(y)$ be the set of values that y takes on those rows that map x to d . Collecting the sets as d ranges over the values of x provides a cover of y with respect to x . For the information state in (10b), $G(y/x)$ generates the cover $\{\{\text{student 1, student 2}\}, \{\text{student 3, student 4}\}\}$.

¹ Existential raising plays a less trivial role in cases with indefinites, where “min” does not return a singleton set, as in *The students from two countries hit each other*.

$$(11) \quad G(j/i) = \{S : \exists d[d \in G(i) \wedge G|_{i=d}(j) = S]\} \quad (\text{Kuhn 2017})$$

By restricting Schwarzschild’s cover variables to only those pluralities that are dynamically accessible, we rule out the cases of overgeneration that arise from a purely pragmatic theory. In particular, if no semantic relation is established between two pluralities, then no dependency is established in the information state. As an example, the discourse in (12a) produces an information state as in (12b), which encodes a trivial relation in which every student is associated with every country.

(12) a. Two^x countries are represented in the class. The^y students hit each other.

b. $G :$

x	y
France	student 1
France	student 2
France	student 3
France	student 4
Italy	student 1
Italy	student 2
Italy	student 3
Italy	student 4

For this information state, $G(y/x) = \{\{\text{student 1, student 2, student 3, student 4}\}\}$, and $G(y/y) = \{\{\text{student 1}\}, \{\text{student 2}\}, \{\text{student 3}\}, \{\text{student 4}\}\}$, but no choice of variables will provide the necessary cover for the relevant reading. This predicts that the second sentence in (12a) cannot receive a symmetric reading.

This analysis thus explains our data by restricting Schwarzschild’s framework using recent developments on the dynamic semantics of plurals.

3.3 Predictions of the two directions

The two analytical directions make differing predictions on a number of fronts.

Prediction 1: Cumulative readings. First, we observe that the DP in (13) exhibits a cumulative interpretation between the students and the two countries: each of the students comes from one of the two countries, and each country is the origin of at least one of the students. A relatively common way to derive a cumulative interpretation is via pluralization of the predicate (Beck and Sauerland 2000) – in this case, pluralization of the preposition *from*, as in (14a). The double-star operator is defined in (14b).

(13) the students from the two countries

(14) a. the students **from the two countries

b. $**R = \lambda X \lambda Y. \forall x \in X [\exists y \in Y [R(x)(y)]] \wedge \forall y \in Y [\exists x \in X [R(x)(y)]]$

On the other hand, close inspection of the structure in §3.1 reveals that an equivalent interpretation is derived from a rather different logical form on the scope-taking analysis. On the logical form in (15), the effect of cumulativity is generated by an anaphoric dependency. To paraphrase: “for each of the two countries, include the students *from that country*”. Of note, the resulting logical form ends up mirroring the analysis that Winter (2000) proposes for cumulative readings generally, which analyzes *the soldiers hit the targets* as equivalent to *the soldiers hit their targets*.²

(15) the two countries λx [the students from x]

As a matter of fact, it may be the case that either of these logical forms is available for the DP in (13). Evidence for the availability of both logical forms can be found by adding a numeral to the DP. Empirically, we observe that the two sentences in (16) can both be used to describe the same situation, in which each state is represented by two senators.

(16) *Context: Each state has exactly two senators.*

a. The twelve senators from those six states voted against the bill.

b. The two senators from those six states voted against the bill.

In order to capture this synonymy, the two sentences must be assigned different structures. On a logical form with pluralization of *from*, neither numeral is in the distributive scope of the other, so we can derive an interpretation of (16a) which also has twelve senators total. On a logical form with an anaphoric dependency, we can derive an interpretation of (16b) with twelve senators total, since the numeral *two* appears in the quantificational scope of *those six states*. That both of these sentences can be used in this context provides evidence in favor of the availability of two distinct logical forms.

Turning to the case at hand, the two analyses in §3.1 and §3.2 make different predictions regarding what logical forms should be available. On the dynamic revision of Schwarzschild (1996), both polyadic quantification and anaphoric dependency will generate a dependency relation, so both will generate an information state

² On the other hand, the analysis in §3.1 does not need to subscribe to other analytical assumptions of Winter (2000). Specifically, it is not committed to the availability of anaphoric dependencies everywhere – only to the fact that anaphoric dependencies may be generated by certain scope-taking operations.

of the correct form to provide a non-trivial cover variable. Thus, the symmetric reading should be available on either logical form. On the other hand, the scopal enrichment of Landman (1989) only allows the logical form in (15). Because *the two countries* raises out of the restrictor of the lower NP, the trace that remains below automatically introduces an anaphoric dependency.

The two analyses thus make differing predictions when it comes to (17). The dynamic revision of Schwarzschild (1996) predicts that (17) will allow a symmetric reading in a situation with ten students or with twenty students. The scopal enrichment of Landman (1989) predicts that (17) will only allow a symmetric reading in a situation with twenty students.

(17) The ten students from the two countries hit each other.

Prediction 2: Scope islands. A related prediction regards the interaction of the symmetric reading with scope islands. Because the scopal enrichment of Landman (1989) relies on the ability of *the two countries* to take wide scope, introducing an island boundary between the two DPs should rule out the necessary logical form. Since relative clauses are generally observed to introduce scope islands, the scopal analysis thus predicts that (18) will not allow the symmetric reading. On the other hand, it is not clear if the predictions are significantly different for the dynamic analysis. In particular, Beck and Sauerland (2000) show that island boundaries may also block the cumulative reading that is derived by polyadic quantification, since the double-star operator would need to apply to a constituent that spans an island boundary. Thus, it is possible that the island boundary in (18) simply reduces the acceptability of the cumulative reading across the board.

(18) The students ⟨who come from the two countries⟩ hit each other.

Prediction 3: Cross-sentential anaphora. Another prediction on which the two analyses differ regards the availability of cross-sentential anaphora. Since the dynamic analysis is built on a system developed for cross-sentential anaphora, it predicts that a plural pronoun in one sentence should be able to access a plural dependency established in a previous sentence. Under the dynamic analysis, the second sentence in (19) is thus predicted to have a symmetric reading. In contrast, the scopal analysis depends on sentence-internal mechanisms, so does not predict a symmetric reading for (19).

(19) The students come from two countries. They hit each other.

Discussion. Our own judgments on these sentences are not conclusive, and certainly not as clear as our judgments on the original trio of sentences, for which our judgments coincided with the experimental results. We found similar mixed results for these sentences in an informal survey of eight trained linguists. Thus, if indeed these sentences have intermediate availability of the symmetric reading, it is not fully clear how to interpret this middling acceptability, as both avenues outlined in this section predict categorical classification of the sentences as having the relevant reading or not. Building gradience into the analyses could potentially involve further elaboration of the role of context, or further specification of the processing difficulties of scope-taking, as in Wurmbrand (2018).

Furthermore, we note that it is possible to modify each of the theories to generate predictions that converge towards the other. For example, a post-suppositional analysis of numerals (Brasoveanu 2013) may provide a way for the dependency analysis to allow the “ten students” reading of sentences with numerals. Similarly, there is quite a bit of variation in the dynamic literature about regarding how cumulative readings are derived (van den Berg 1996; Brasoveanu 2013; Henderson 2014). These analytical choices have the potential to restrict the interpretations available on the dynamic analysis, potentially causing partial convergence with the scope-taking analysis.

4 Conclusion

Landman (1989) and Schwarzschild (1996) provide two clear and well-known perspectives on the debate regarding the way in which and the degree to which higher-order pluralities are represented in natural language. We have provided new data showing that this debate remains open. When we control for the distinct *readings* of sentences with plural predication, neither Landman (1989) nor Schwarzschild (1996) is able to capture the full pattern of judgments.

We have seen that either analytical perspective can be modified to capture the observed pattern, but that these modifications entail new theoretical commitments. Landman (1989) can capture the remaining attested reading, but needs to assume a mechanism of inverse linking plus further type shifters, such as Winter (2001)’s **C** operator. Schwarzschild (1996) can rule out the unattested reading, but needs to assume a rather powerful framework of dynamic semantics. In either case, there remain holes that would need to be filled by future research. For example, the dynamic system would need to be fleshed out with a compositional semantics that makes the necessary discourse referents available for both (1) and (2).

We hope that this investigation may serve as the start of a more detailed study of theories of symmetric readings, of the predictions those theories make, and how

best to test those predictions.

Appendix: Experimental results

Methods

Participants A pilot study was run with 9 participants, of which 3 were removed for failure on attention checks. A power analysis with the remaining participants indicated that 6 participants would be sufficient to find the predicted effect with 0.8 power and a significance level of 0.05. For the full experiment, we requested 30 participants through Amazon’s Mechanical Turk. 30 completed the study, of which 7 were removed for failure on attention checks.

Materials and procedure Eight short context paragraphs were created, paired with three sentences containing the target NP structures: “the As and the Bs”, “the Xes from the two Ys”, and “the Xes”. The eight predicates that were tested are listed in (20), and complete materials are available on OSF: <https://osf.io/9wk7c/>.

(20) ___ hit each other; The zookeeper separated ___; ___ shook hands; ___ worked together; ___ read the same books; Sally connected ___; ___ interacted; ___ exchanged letters.

In order to judge the availability of the target reading, subjects were asked to read each context paragraph, then evaluate whether each of the three sentences could be used as a true description of that context. Ratings were made on a continuous scale with endpoints labeled “The sentence **cannot** be true” and “The sentence **can** be true”. Instructions explicitly told subjects that ambiguous sentences should be judged as “can be true” if the sentence is true on at least one interpretation. (E.g. “Sarah touched the dog with the stick” can be true in a context in which Sarah picked up a stick and used it to touch the dog, even though there is a second reading of the sentence that is false in this context.) The eight contexts were presented in a random order without fillers, with all three sentences on the same screen as the context paragraph (cf. Marty, Chemla, and Sprouse 2020).

Results

Linear mixed-effects models were used to model subjects’ responses (Baayen, Davidson, and Bates 2008). Participants and predicates were included as random variables, with the maximal converging model used for each comparison (Barr et al. 2013). The NP structure was included as the predictor variable; for each pair of NP structures,

we compared the model with the predictor variable to the model without it. Model fit was assessed using chi-square tests on the log-likelihood values of competing models. These methods were preregistered on OSF: <https://osf.io/5edm9/>.

Means and standard deviations by participant for the three NP structures, on a scale from 0 to 100, are presented in (21), with distribution presented in Figure 1. The analysis revealed a significant difference between “the Xes” and each of the other two NP structures ((a) vs. (c): $\chi^2(1) = 15.40, p < .001$; (b) vs. (c): $\chi^2(1) = 18.42, p < .001$). No significant difference was found between “the As and the Bs” and “the Xes from the two Ys”, ($\chi^2(1) = 2.71, p = 0.10$).

(21)	a.	the As and the Bs	71.85	20.78
	b.	the Xes from the two Ys	66.14	21.10
	c.	the Xes	35.26	24.10

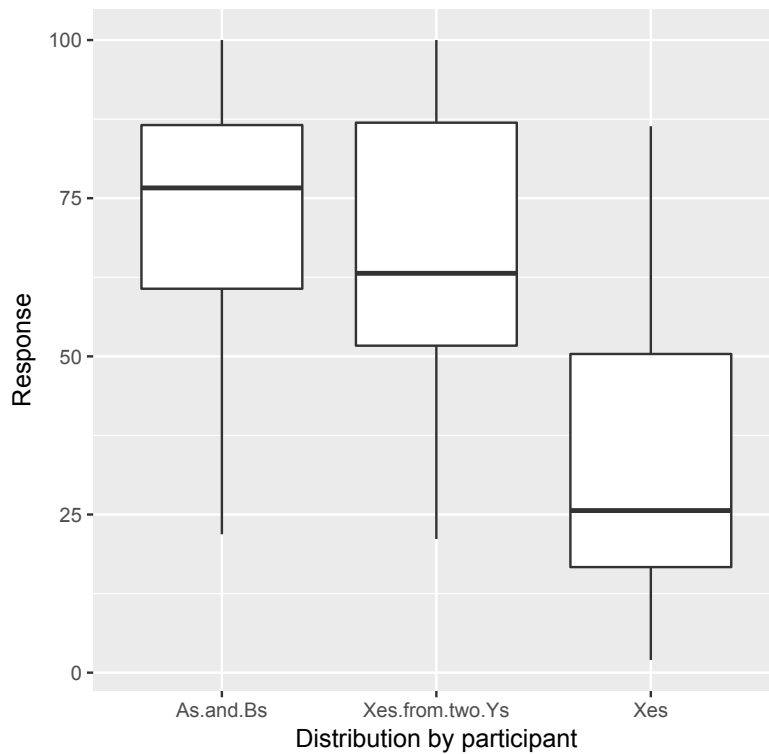


Figure 1: Distribution of responses by participant for the three NP structures

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