Events in the Semantics of Collectivizing Adverbials

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1. INTRODUCTION

Sentences containing plural or conjoined noun phrases often display an ambiguity between so-called *collective* and *distributive* readings. For example, sentence (1) can mean either than John and Mary each bought a house, which is the distributive reading, or that they bought one jointly, which is the collective reading.

(1) John and Mary bought a house.

With the addition of words such as *each* or *together*, we can force just one of the readings to be available. For example, sentence (2) only has the distributive reading, and the sentences in (3) only have the collective reading.

(2) John and Mary each bought a house.

(3)a. John and Mary together bought a house.

b. John and Mary bought a house together.

Each and *together* are by no means the only expressions that have this kind of effect, but we may take them as representative, and limit the present discussion largely to these two items, and especially to *together*.

Lasersohn (1990) argued that the "collectivizing" effect of *together* in sentences like (3)a. and b. was best described in terms of conditions on the part/whole structure of events. This analysis was critiqued by Schwarzschild (1992, 1994), who gave an alternative account which did not make use of events at all. In the wake of these articles it seems an open issue whether the semantics of collectivizing adverbials such as *together* requires reference to events or not.

The present article will review these two analyses (and also very briefly review some earlier ones); try to address the sort of concerns that Schwarzschild's papers raise; and see if we can still find some role for events in the semantics of *together* and similar expressions. I think we can, and in fact I think we can find some advantages to doing so.

2. Scope-Based Analyses

The use of events in analyzing the semantics of expressions like *each* and *together* has a fairly long history, and goes back at least to McCawley (1968). McCawley suggested that sentences such as (4) are ambiguous, between readings paraphrasable as in (5)a. and (5)b. He suggests essentially the formulas given in (6)a. and (6)b. for these readings.

(4) John and Harry went to Cleveland.

(5)a. John and Harry each went to Cleveland.

b. John and Harry went to Cleveland together.

(6)a. $(\forall x \in \{j, h\})\ (\exists e)$ **go-to-Cleveland**$'(x, e)$

b. $(\exists e)\ (\forall x \in \{j, h\})$ **go-to-Cleveland**$'(x, e)$

The reading paraphrased using *each* has an existential quantifier over events inside the scope of a universal quantifier over a set of individuals; for each of John and Harry, there is an event of his going to Cleveland. The reading paraphrased using *together* has an existential event quantifier taking wide scope with respect to the universal; there is a single event in which both John and Harry went to Cleveland.

Although McCawley doesn't quite come out and say it explicitly, it seems reasonably clear from context that this analysis is supposed to carry over to examples where *each* and *together* appear overtly, and not just examples like (4), where these words do not actually appear. Therefore it seems fair to characterize this analysis as claiming that the semantic effect of *together* is to force wide scope for the event quantifier, and the semantic effect of *each* is to force narrow scope.

Essentially the same idea was suggested, apparently independently, by Renate Bartsch (1973). Bartsch assumes a relation *I* (“be involved in”) which holds between events and their participants. Given a one-place predicate of individuals *F*, one may construct a corresponding predicate of events *F-V*, defined as in (7):

(7) $F(x) \Leftrightarrow \exists e[I(x, e) \,\&\, F\text{-}V(e)]$

Sentences (8)a. and b. are assigned formulas essentially as in (9)a. and b., respectively:

(8)a. John and Mary went to the movies together.

b. John and Mary went to the movies.

(9)a. $\exists e \forall x[x \in \{\text{John, Mary}\} \rightarrow [I(x, e) \,\&\, \textbf{go-to-the-movies}'\text{—}V(e)]]$

b. $\forall x \exists e[x \in \{\text{John, Mary}\} \rightarrow [I(x, e) \,\&\, \textbf{go-to-the-movies}'\text{—}V(e)]]$

Just as in McCawley's analysis, the effect of *together* is to force wide scope for the event quantifier.

Something reminiscent of these two analyses, though not quite equivalent, was also suggested by Higginbotham and Schein (1989). However, Higginbotham and Schein don't directly address the semantics of expressions like *together*, so we won't review the details of their analysis here, or try to evaluate it.[1]

There is something intuitively appealing about the kind of analysis that McCawley and Bartsch suggest; we view collective action as action by more than one individual in a single, unified event, and distributive action as multiple events involving separate individuals.

Unfortunately, there are some problems with this view. First of all, we should note that formulas of the form given in (10)a. systematically entail counterparts of the form given in (10)b., so there is a prediction here that a sentence with *together* should entail the distributive reading of the corresponding sentence without *together*.

(10)a. $\exists x \forall y \varphi$

b. $\forall y \exists x \varphi$

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[1]It should be noted that Higginbotham and Schein's analysis differs from the analyses given in Schein (1992, 1993), in that these latter two works make heavy use of event mereology in representing the collective/distributive distinction, while Higginbotham and Schein represent this distinction more purely as a matter scope.

This entailment does go through for examples like (11) or (12), but it is by no means general. So for example (13)a. doesn't entail (13)b.; (14)a. doesn't entail (14)b., and although people like Harnish (1976) have argued to the contrary, I don't think that examples like (15)a. entail examples like (15)b. either.

(11)a. John and Harry went to Cleveland together.

b.⇒ John went to Cleveland and Harry went to Cleveland.

(12)a. John and Mary went to the movies together.

b.⇒ John went to the movies and Mary went to the movies.

(13)a. John and Mary can lift more than 500 pounds together.

b. John can lift more than 500 pounds and Mary can lift more than 500 pounds.

(14)a. John and Mary finished off the leftovers together.

b. John finished off the leftovers and Mary finished off the leftovers.

(15)a. John and Mary built a table together.

b. John built a table and Mary built a table.

Another area in which this kind of analysis seems incapable of giving correct results is in accounting for the semantic difference between examples like (16)a. and b. on the one hand, and (16)c. on the other. Sentences (16)a. and (16)b. are consistent with a situation where John moved some of the sofas and Mary moved the rest. Sentence (16)c., in contrast, is more naturally interpreted as meaning that John and Mary went around to each sofa and moved it collectively. So what kind of formula can we use to represent the truth conditions of (16)a. or b.? All the possibilities would seem to be equivalent to one of (17)a. through d. However, one can easily verify that all these formulas entail (17)d., which presumably means that John moved each of the sofas and Mary did too. None of these formulas allows for the case where John moved some (but not all) of the sofas and Mary moved the rest.

(16)a. Together, John and Mary moved all the sofas.

b. John and Mary together moved all the sofas.

c. John and Mary moved all the sofas together.

(17)a. $\exists e\ (\forall x \in \{j, m\})\ (\forall y : \mathbf{sofa}'(y))\ \mathbf{move}'(x, y, e)$

b. $(\forall x \in \{j, m\})\ \exists e\ (\forall y : \mathbf{sofa}'(y))\ \mathbf{move}'(x, y, e)$

c. $(\forall y : \mathbf{sofa}'(y))\ \exists e\ (\forall x \in \{j, m\})\ \mathbf{move}'(x, y, e)$

d. $(\forall x \in \{j, m\})\ (\forall y : \mathbf{sofa}'(y))\ \exists e\ \mathbf{move}'(x, y, e)$

These seem to me like serious enough problems to reject the analysis.

3. An Analysis Based on Event Mereology

There are several alternatives to the scope-based analysis just sketched. One alternative, developed in Lasersohn (1990), is to consider whether there is some difference in internal structure between the eventualities described by a distributive sentence (or distributive reading of a sentence) and those described by a collective reading. We consider this analysis briefly, as well as the event-free analysis of Schwarzschild (1992, 1994) before returning to a revised analysis based on event-mereology in Section 5.

Consider an event in which the sentence *John and Mary lift the piano* is true on its distributive reading. Such an event has a part in which John lifts the piano, and a part in which Mary lifts the piano. In contrast, an event in which this sentence is true on its collective reading will have a part, namely the part consisting *just* of John and Mary's collective lifting, in which the group of John and Mary lifts the piano, but which in turn does not have parts in which John lifts the piano or Mary lifts the piano.

We can make use of this difference in part/whole structure of events in defining words which force a collective or a distributive reading, such as *together* or *each*. For example, we may define *together* as in (18):

(18) $\mathbf{together}' = \lambda P \lambda e \lambda g[P(g, e)\ \&\ \exists e' \leq e[P(g, e')\ \&\ \forall y \in g\ \forall e'' \leq e'\ [\neg P(y, e'')]]]$

That is, a group g has property P together in an event e iff g has P, and there is a part e' of e in which g has P, such that no member of g has P in any parts e'' of e'.

It will be useful, however, to give a slightly different definition — one which does *almost*, though not quite the same thing. First, we assume that predicate denotations are "curried," so that rather than denoting relations between events and groups and/or individuals, we let them denote functions from events to sets of groups and/or individuals. In this case `$P(e)$' will denote the set of groups and/or individuals that have property P in e.

Now we require that for any event e in which a group g has P together, e must have a part e' where g has P, such that P returns the same value for all the parts of e' in which someone has P as it does in e' itself. This gives a definition like that in (19):

(19) $\textbf{together}' = \lambda P \lambda e \lambda g[P(e)(g) \ \& \ \exists e' \leq e[P(e')(g) \ \& \ \forall e'' \leq e' \ [\exists y \ P(e'')(y) \rightarrow P(e'') = P(e')]]$

To see that this definition has a similar effect to that in (18), first consider the case where e' is an event consisting just of John and Mary lifting the piano distributively. Then, representing the group of John and Mary as the set $\{j, m\}$, it holds that $\{j, m\} \in [\![\textit{lift the piano}]\!](e')$. Since this is a case of distributive action, e' has a part e'' consisting of John lifting the piano and a part e''' of Mary lifting the piano. $\{j, m\} \notin [\![\textit{lift the piano}]\!](e'')$. Similarly, $\{j, m\} \notin [\![\textit{lift the piano}]\!](e''')$. Therefore $[\![\textit{lift the piano}]\!](e') \neq [\![\textit{lift the piano}]\!](e'')$. (And $[\![\textit{lift the piano}]\!](e') \neq [\![\textit{lift the piano}]\!](e''')$.) So e' is not an event in which John and Mary lift the piano together.

Now let e' be an event consisting just of John and Mary lifting the piano in the collective sense. As before, $\{j, m\} \in [\![\textit{lift the piano}]\!](e')$. Since John and Mary lift the piano collectively, e' will not have a part in which John lifts the piano, or a part in which Mary lifts the piano (though it may have, for example, a part in which John lifts *his end* of the piano, etc.) In fact, the only parts of John and Mary's lifting of the piano which are themselves liftings of the piano will have the same set of lifters as e', namely $\{\{j, m\}\}$. So e' will be an event in which John and Mary lift the piano together.

How does this kind of analysis fare with respect to the problems pointed out for the McCawley/Bartsch analysis? The first of these was the problem with examples like (13) to (15), where the a. sentences were falsely predicted to entail the b. sentences. It should be clear that in the mereological analysis just sketched, we no longer obtain this entailment. Unfortunately, it also looks like we no longer capture the fact that in examples like (11) and (12), the a. sentences *do* entail the b. sentences; but this point will be addressed shortly.

The other problem for the McCawley/Bartsch analysis was that in examples like (16), it did not produce the contrast between the a. and b. sentences on the one hand and the c. sentence on the other. The pattern here is reminiscent of that exhibited by examples like (20), involving a manner adverb.

(20)a. Slowly, John moved all his books.

b. John slowly moved all his books.

c. John moved all his books slowly.

(20)a. and b. have readings which assert that the entire event of moving all the books was slow. However (20)c. strongly prefers a reading which asserts that each individual book was moved slowly. This looks very much like a scope effect, and in fact we may follow Thomason and Stalnaker (1973) and assume that the effect in (20) comes from some general principle assuring that postverbal adverbs take scope just over their verbs, while preverbal or sentence-initial adverbs can take scope over their entire verb phrases or sentences.

Extending this idea to *together*, we get the result that (16)c. means that for each sofa, John and Mary moved it together, that is, collectively, while (16)a. and b. have readings which mean that the entire event of John and Mary moving all the sofas was collective — that is, that any of its subevents in which all the sofas are moved have the same set of movers (namely, the set containing the group of John and Mary).

One of the main attractions of this analysis was that it extended to readings of expressions like *together* other than the collectivizing one. There are several of these, some of which are illustrated in (21).

(21)a. John and Mary sat (close) together. (spatial)

b. John and Mary stood up together. (temporal)

c. John and Mary work together. (coordinated action)

d. John and Mary went out together. (social accompaniment)

e. John put the bicycle together. (assembly)

McCawley and Bartsch's examples of going to Cleveland or the movies together may be viewed as exemplifying the social accompaniment reading, or perhaps the coordinated action reading, of *together* rather than the collectivizing reading.

In some sense it seems natural that the different meanings illustrated in (21) would be expressed by the same lexical item, and in fact we find that it is cross-linguistically common for this to be the case. An analysis therefore ought to offer some explanation of *why* this is natural — of what it is about these meanings which leads them to cluster together in the same lexical items in this way.

Lasersohn (1990) made a start toward such an explanation by extending the semantics for the collectivizing use of *together* to the spatial and temporal uses. To make this extension, we follow Krifka (1989) and others in making use of spatial and temporal "trace" functions. These are functions mapping events, states, or processes onto their "running" times and locations — the times and locations at which they occur. Specifically, let σ be a function mapping any eventuality onto its running location, let τ be a function mapping any eventuality onto its running time, and let K be a function mapping any eventuality onto the pair of its running time and its running location. We require σ and τ to be homomorphisms with respect to the part/whole structures on events and locations or times.

Now, to obtain the temporal reading for *together*, we substitute the temporal trace function in for the predicate denotation in the last clause of the definition for the collectivizing reading. This gives (22), which may be compared to (19):

(22) $\textbf{together}'_{\text{temp}} = \lambda P \lambda e \lambda g[P(e)(g) \; \& \; \exists e' \leq e \; [P(e')(g) \; \& \; \forall e'' \leq e' \; [\exists y \, P(e'')(y) \rightarrow \tau(e'') = \tau(e')]]$

According to this analysis, *John and Mary stand up together* is true in e iff e has a part e' in which John and Mary stand up, such that any part e'' of e' in which someone stands up has the same running time as e'. Since an event of John and Mary standing up must have a part consisting of John standing up and a part consisting of Mary standing up, both these events must take place at the same time as the composite event of the group standing up, hence at the same time as each other.

The analysis proceeds in essentially the same way for the locative use of *together*, except that we substitute the paired spatio-temporal trace function K in place of the temporal trace function τ. This gives the definition in (23):

(23) $\textbf{together}'_{\text{loc}} = \lambda P \lambda e \lambda g[P(e)(g) \; \& \; \exists e' \leq e \; [P(e')(g) \; \& \; \forall e'' \leq e' \; [\exists y \, P(e'')(y) \rightarrow K(e'') = K(e')]]$

According to this analysis, *John and Mary sit together* is true in e iff e has a part e' in which John and Mary sit, such that any part e'' of e' in which someone sits has the same running time and location as e'. Since an event of John and Mary sitting must have a part consisting of John sitting and a part consisting of Mary sitting, both these events must take place at the same time and location as the composite event of the group sitting, hence at the same time location as each other.

This, briefly summarized, is the analysis of Lasersohn (1990); for additional details readers are referred to the original article.

4. An Analysis Based on Predicate Negation

Schwarzschild (1992, 1994) criticizes this analysis both on syntactic and semantic grounds. The syntactic objections are mainly over the classification of *together* in the position between a subject and its predicate as an adverb attached to the verb phrase, rather than as a kind of adnominal modifier attached to the noun phrase. We may ignore issue here; as Schwarzschild himself points out in his (1994) article, we can give essentially the same lexical semantics in either case, just by adjusting the order of lambda operators in the translation language. An expression of the form given in (24)a. will be of the correct type to serve as a predicate modifier, while something of the form given in (24)b. will be of the correct type to serve as a term modifier, but φ can be the same in both cases:

(24)a. $\lambda P \lambda x \varphi$

b. $\lambda x \lambda P \varphi$

The semantic issues with which we will be concerned here are largely independent of this syntactic issue, so we may set the syntactic issue aside for the purposes of this article.[2]

Schwarzschild makes two main semantic criticisms of the analysis just outlined. The first concerns the difference between preverbal and postverbal *together*. In the analysis outlined in Section 3, the difference between these was treated purely as a matter of scope. But as Schwarzschild points out, there seems to be a contrast between the a. and b. examples in (25) and (26):

(25)a. The famine and the hurricane together caused this crisis.

b.? The famine and the hurricane caused this crisis together.

(26)a. John and Mary had a child together.

b.? John and Mary had a grandmother together.

Postverbal *together* seems to imply a kind of agentivity, and so the b. examples sound strange. Preverbal *together* does not, so the a. examples sound comparatively better. So it appears that there is something more of a semantic difference here than just a scope difference. No doubt there *is* a scope difference, but there is some other difference as well.

Schwarzschild's second, and more disturbing criticism, is that it is possible for a group to do have a property "together" in an event, even though the members of the group also have that same property in that same event. For example, consider the sentences in (27).

(27)a. John and Mary together lifted fewer than three pianos.

b. *p* and *q* together entail *r*.

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[2]One piece of evidence favoring an adverbial over an adnominal analysis of *together* is that it occurs with verbal gerundive forms but not with true nominal gerunds:

(i) John and Mary's together lifting two pianos was very impressive.

(ii) * John and Mary's together lifting of two pianos was very impressive.

c. The box and the axe together are light enough to carry.

We don't want to claim that an event in which John and Mary together lift fewer than three pianos can't have a part in which John lifts fewer than three pianos or a part in which Mary lifts fewer than three pianos. But the analysis of Section 3 would seem to make just this claim. Likewise, we don't want to claim that if *p* and *q* together entail *r*, then neither one alone can entail *r*. And the box and the axe together being light enough to carry is certainly consistent with the box and the axe each being light enough to carry on its own.

It should be noted that many examples of this type involve "downward entailing" contexts. This is certainly the case with (27)a., which contains the monotone decreasing quantifier *fewer than three*. (27)c. also has somewhat of a downward-entailing "feel" to it, even if the predicate *be light enough to carry* is not really downward entailing in the strict sense.[3] But there are also examples like (27)b., which doesn't seem to involve downward-entailingness at all.

How can we give a semantics for *together* which is consistent with such examples? Schwarzschild's solution is to start from the fact that there are really two different ways a sentence can be true: collectively and distributively. This gives rise to four different possible combinations of truth values, summarized in (28).

(28) Where *S* = *NP VP*:

a. **Case 1:** *S* is true collectively but not distributively. In this case, we may both affirm *S* and deny it. The sentence *NP together VP* is true. It is not true that each of the members of ⟦*NP*⟧ has property ⟦*VP*⟧.

b. **Case 2:** *S* is true both collectively and distributively. We can affirm *S* but not deny it. *NP together VP* is true. It is true that each of the members of ⟦*NP*⟧ has ⟦*VP*⟧.

[3] Consider examples such as *The anvil and the helium balloon together are light enough to carry*.

c. **Case 3:** *S* is true distributively but not collectively. Again, we can both affirm *S* and deny it. In this case, however, *NP together VP* is not true. Each of the members of ⟦*NP*⟧ do have ⟦*VP*⟧.

d. **Case 4:** *S* is not true collectively or distributively. We can deny *S* but not affirm it. *NP together VP* is false. The individual members of ⟦*NP*⟧ do not have ⟦*VP*⟧.

Cases 1 and 2 are those in which *NP together VP* is true. Of course these are cases in which we can affirm *S* — but so is Case 3. We need some way of distinguishing Cases 1 and 2 on the one had from Case 3 on the other.

We can do this with (40). This informal definition forms what I take to be the intuitive basis for the more formal analysis which Schwarzschild proposes:

(29) *NP together VP* is true iff (i) *NP VP* can be affirmed, and (ii) if *NP VP* can also be denied, then the individual members of *g* do not have *P*.

This definition allows Cases 1 and 2, but disallows 3 and 4, which is precisely the right result. It is also easy to see that this kind of analysis avoids the problems posed by examples like those in (27). Consider, for example, *John and Mary together lifted fewer than three pianos*, in a situation where John lifted exactly one piano and Mary lifted exactly one piano. This situation falls under Case 2; the sentence is true both collectively and distributively. Clause (i) of (29) is therefore satisfied. Clause (ii) is also satisfied — vacuously, since the sentence cannot be denied, given that it is true both collectively and distributively.

The next question is how to state (29) in more precise, formal terms. Schwarzschild does this using the device of positive and negative denotations, as also employed by Cooper (1983) and others. The positive denotation $[\![P]\!]_+$ of a predicate *P* is a function mapping onto 1 all those individuals in its domain which have the property represented by *P*, as well as any groups in its domain which have the property collectively. Anything else in the domain is mapped onto 0.

The negative denotation $[\![P]\!]_-$ of P is simply the function which maps a group or individual onto 1 if the positive denotation maps it onto 0, and vice versa. The negative denotation is therefore in some sense redundant.

Now, for any predicate P, we let $\sim P$ be a predicate. We stipulate that $[\![\sim P]\!]_+ = [\![P]\!]_-$.

Distributive-like interpretations arise via the rule which combines predicates with their arguments, rather than from the denotations of the predicates themselves. As given in (30), a sentence is true iff the denotation of the subject is in the closure under group formation of the denotation of the predicate.

(30) $[\![P(t)]\!]_{+/-} = 1$ iff $[\![t]\!] \in \mathit{Grp\text{-}Cl}(\{u \mid [\![P]\!]_{+/-}(u) = 1\})$

In this way, *John and Mary lifted the piano* will be true either if they did so collectively, or if they each did so individually, despite the fact that in the distributive case the positive denotation of *lifted the piano* would not generally contain the group of John and Mary as a member.

Note that it is possible for a formula formed from a group-denoting term and a predicate to hold true, even while a corresponding sentence formed from the same group-denoting term and the negation of the original predicate also holds true. For example, let `j+m' be a translation-language term denoting $\{j, m\}$. Now suppose that John and Mary lift the piano collectively but not individually. In this case, $[\![\textbf{lift the piano}']\!]_+(\{j, m\}) = 1$, hence $\{j, m\} \in \mathit{Grp\text{-}Cl}(\{u \mid [\![\textbf{lift the piano}']\!]_+(u) = 1\})$, hence $[\![\textbf{lift the piano}'(j+m)]\!]_+ = 1$. But since John and Mary did not lift the piano individually, it holds that $[\![\textbf{lift the piano}']\!]_-(j) = 1$ and $[\![\textbf{lift the piano}']\!]_-(m) = 1$, hence $[\![\sim\textbf{lift the piano}']\!]_+(j) = 1$ and $[\![\sim\textbf{lift the piano}']\!]_+(m) = 1$, hence $\{j, m\} \in \mathit{Grp\text{-}Cl}(\{u \mid [\![\sim\textbf{lift the piano}']\!]_+(u) = 1\})$, hence $[\![\sim\textbf{lift the piano}'(j+m)]\!]_+ = 1$.

In this way, it can be simultaneously true that John and Mary lifted the piano and that John and Mary did not lift the piano. This is not to say, however, that the affirmative sentence is true under one reading, and the negative sentence is true under some other reading; there was no appeal to ambiguity here at all.

A distributive reading can be forced by modifying a predicate with the operator `EACH', defined as in (31). That is, a group is in the denotation (presumably we mean here the positive denotation) of `EACH(*P*)' iff each of its members has the property represented by *P*.

(31) EACH = $\lambda P \lambda x \forall y[y \in x \rightarrow P(y)]$

We can now define *together* as in (32). This more formal definition reflects the informal one in (29) quite directly. It is easy to see that it gives right results for the examples that seemed problematic for the earlier analysis. And, given the theme of this volume, it is worth noting that it does so without making reference to events at all.

(32) **together**′ = $\lambda x \lambda P[P(x)\ \&\ [\sim P(x) \rightarrow \text{EACH}(\sim P)(x)]]$

Schwarzschild's analysis easily accounts for examples which seemed problematic under the analysis of Lasersohn (1990). Therefore, Schwarzschild's analysis has a distinct advantage. However, this advantage does come at some cost. First, there does not appear to be any way to extend Schwarzschild's analysis to account for readings of *together* other than its collectivizing reading, such as the spatial and temporal readings. The systematicity of this sort of ambiguity, both across the vocabulary of English and across languages, suggests that there is in fact a significant connection or commonality among the different readings, which we might hope a semantic analysis would make explicit.

Second, Schwarzschild's use of predicate negation in combination with the group closure operation allows both an affirmative sentence and its corresponding negative sentence to be simultaneously true, even relative to a single reading — not because of any ambiguity, but simply because the semantics for negation is weak enough to allow it. The analysis rests crucially on the idea that both a collective and a distributive interpretation fall under a single reading, and on the idea that negation does not necessarily reverse the truth value of a sentence.

Schwarzschild suggests that ambiguity could be reintroduced into the system “for those who want it” by using the EACH operator in the manner of the implicit D-operator of Link (1987) and Roberts (1987), but even if we do make use of this technique, the reading which corresponds to the absence of the EACH operator must be general enough to allow both a collective and a distributive construal. That is, the analysis requires a reading which is neutral, or general; it is incompatible with treating collective and distributive readings as completely separate.

Treating the collective/distributive ambiguities as a case of just a single, very general reading rather than as a case of authentic ambiguity is an idea that many people find appealing, but to me it seems problematic. For one argument, consider examples like those in (33):

(33)a. The exact amount that John and Mary earned was $10,000.

b. The exact amount that John and Mary earned was $5000.

These sentences can be simultaneously true. But how can there be two distinct amounts, both of which are *the* exact amount that John and Mary earned? If there is a collective/distributive ambiguity, we can claim that (33)a. is true relative to one reading, and (33)b. relative to the other. But if there is no ambiguity, we are forced into an account of definite noun phrases like *the exact amount that John and Mary earned* which exempts them from the normal uniqueness presuppositions associated with definites. This is an unappealing prospect, and so, I would suggest, there is an ambiguity in these examples.

As a second argument in favor of the idea of an ambiguity, we may note briefly that collective and distributive sentences differ in their ability to license discourse anaphora, as Craige Roberts has argued at length in her (1987) dissertation. For example, the anaphora indicated in (34) is acceptable if the first sentence is interpreted collectively, but not if it is interpreted distributively (barring wide scope for *a piano*). This suggests some kind of structural or semantic difference between the collective and distributive readings

(34) The boys lifted a $piano_i$. It_i was heavy.

A third problem for Schwarzschild's analysis is that it makes available what seem to me to be spurious collective readings for lexically distributive predicates. These come out most clearly in negative sentences. To see this consider a lexically distributive predicate like *be asleep*. Let us suppose that John and Mary are asleep. In this case, the positive denotion of *be asleep* contains John and Mary individually; it should not contain the group of John and Mary. Therefore, this group should be a member of the negative denotation. So, we should have reading of sentence (35) which is true, even though John and Mary are both asleep.

(35) John and Mary are not asleep.

However, the sentence does not seem true in such circumstances.

This problem could be solved if we were to assume that in the situation described, the group of John and Mary is not in the negative denotation of *be asleep*. In this case, however, we predict that sentence (36)a. should be true. This is easy to see, given that the sentence is analyzed in terms of the formula in (36)b.

(36)a.* John and Mary together are asleep.

b. **asleep**′(j+m) & [~**asleep**′(j+m) → EACH(~**asleep**′)(j+m)]

Unfortunately, (36)a. is deviant; *together* does not combine felicitously (in its collectivizing use) with distributive predicates at all. On the contrary, it serves, in Schwarzschild's phrasing, as a "non-distributivity marker" — an effect which is lost if we try to solve the problem in this way.

5. Return to an Event-Based Analysis

At this point, it seems fair to say that neither the analysis of Lasersohn (1990) nor that of Schwarzschild (1992, 1994) seems entirely satisfactory. Ideally, what we would like is an analysis which generalizes to as many of the readings of *together* as possible, which does not give wrong results for examples involving downward entailing contexts or related problems, which maintains a collective/distributive ambiguity, and which does not require an unintuitive semantics for negation or generate spurious ambiguity.

As the first step in attempting such an analysis, let us reconsider one of the apparent problems with the Lasersohn (1990) analysis. Recall that it seemed to give wrong results for examples like those in (27).

Specifically, let us consider example (27)a., *John and Mary together lifted fewer than three pianos*, in more detail. What must an eventuality be like in order to qualify as one in which this sentence is true? The total number of pianos lifted by John and/or Mary must be less than three. For example the sentence is true if John lifts only one piano and Mary lifts only one piano. Suppose we have an event e' consisting of of a smaller event e'' of John lifting one piano, and another smaller event e''' of Mary lifting one piano. (To keep things simple, assume that no pianos are otherwise lifted.)

Now, according to the definition for *together* in (19), what's required for e' (or a larger event of which e' is a part) to be an event in which John and Mary together lift fewer than three pianos, is that the set of lifters of fewer than three pianos in e' be equal to the set of lifters of fewer than three pianos in e'', and to the set of lifters of fewer than three pianos in e'''.

In fact, I think this is pretty obviously the case (though it would not have been, if we had defined *together* as in (18)). John lifts fewer than three pianos in all of these events; so does Mary; so does the group of John and Mary collectively; so, in fact, does the entire universe of discourse, since zero is less than three, and most things don't lift any pianos at all. (Only two pianos get lifted, so nothing lifts three or more.)

Therefore, despite the fact that e' has a part in which John lifts fewer than three pianos, and a part in which Mary lifts three pianos, the analysis still predicts that the sentence *John and Mary together lift fewer than three pianos* is true in e'. It really just is not the case that the Lasersohn (1990) analysis prohibited the members of a group from having a property if the group as a whole was to count as having that property together. It had that effect in certain cases, particularly non-quantificational ones, but in the case of quantifiers like *fewer than three* the effect is somewhat different, and not problematic in the way suggested.[4]

[4]Some readers might be troubled by the fact that (19) guarantees that the truth of sentences containing *together* will be persistent on the part/whole relation for events, while the truth of sentences sentences containing monotone decreasing quantifiers does not seem intuitively to be

Unfortunately, we need not go far to find a related class of examples which do prove to be problematic for the definition of *together* in (19). Consider sentence (37), for example.

(37) John and Mary together lifted between two and four pianos, inclusive.

Suppose $e' = e''+e'''$, where John lifts exactly two pianos in e'' and Mary lifts exactly two additional pianos in e''' (and no pianos otherwise lifted). In this kind of situation, we want to say that in e', John and Mary lift between two and four pianos inclusive, since in fact they lift four. But, it is not the case that the set of lifters of between two and four pianos for e' is the same as for e'', or for e''', since John lifts between two and four pianos in e' but not in e''', and Mary lifts between two and four pianos in e' but not in e''. So the analysis wrongly predicts that the sentence *John and Mary together lift between two and four pianos* should be false of e'.

We must conclude that the definition in (19) is incorrect, and should be replaced.

Our first task in finding a more satisfactory analysis of *together* is to find some way around the problem posed by examples like (37). I believe we can avoid this problem if we revise the final clause in the definition for *together* in terms of the notion of **overlap**, where we understand two sets to overlap iff they have a non-empty intersection. This yields the definition in (38):

(38) $\textbf{together}' = \lambda P \lambda e \lambda g[\exists e' \leq e[g \in P(e') \;\&\; \forall e'',e''' \leq e'[[\exists x\, x \in P(e'') \;\&\; \exists x\, x \in P(e''')] \rightarrow P(e'') \circ P(e''')]]$

Informally: A group g together has property P in eventuality e iff e has a part e' such that g has P in e', and in any two parts e'', e''' of e' in which something has property P, the set of things which have P in e'' overlaps the set of things that have P in e'''.

persistent in this way. Space limitations prevent us from considering this issue here, but it is addressed in Lasersohn (forthcoming), where a persistent semantics for monotone decreasing quantifiers is presented. In any case, this is a separate question from that posed by Schwarz-schild.

The effect of this definition is probably best understood by working through an example. Suppose e has a part e', which exhausts all the piano-lifting in e. Moreover, e' itself has parts e'' and e'''. John lifts two pianos in e'' and Mary lifts two more in e'''. Because the total number of pianos lifted by John and/or Mary in e'' is two, and the total number of pianos lifted by John and/or Mary in e''' is also two, the group {John, Mary} is an element both of ⟦*lift between two and four pianos, inclusive*⟧(e'') and of ⟦*lift between two and four pianos, inclusive*⟧(e'''), so these sets will overlap.

In fact, in any other part of e' where something lifts between two and four pianos, the group {John, Mary} will also be in the set of lifters of between two and four pianos. Therefore, any two such parts will produce an overlap, and sentence (37) will be true in e.

Now consider the other examples that were put forth as problems for the analysis of Section 3, such as (27)b., *p and q together entail r*. We don't want this sentence to rule out the possibility that p entails r on its own.

I will assume that the relevant notion of entailment is monotonic, which we can define as in (39).

(39) $\vdash$ is monotonic iff for any eventuality e, proposition r and sets of propositions Γ, Γ': if $\vdash(\Gamma, r, e)$ and $\Gamma \subseteq \Gamma'$, then $\vdash(\Gamma', r, e)$.

It may seem strange to talk about a set of propositions entailing another proposition "in an eventuality," since entailment is a mathematical relation that holds independently of space and time; but I don't think this is a problem. We may either assume that if a set Γ entails a proposition r in an eventuality e, then it entails r in every eventuality e'; or, as I prefer, we may take the term *eventuality* not to imply anything about space and time. In this case, we may distinguish an eventuality (that is, a state) of p entailing r from one of q entailing r, even though both states obtain at all times in all locations. On this conception of how entailment relates to states, let us assume (40):

(40) If $\vdash(\Gamma, r, e)$, then e has a part e' such that $\vdash(\Gamma, r, e')$ and for all e'', $e'' \leq e'$ only if for some subset Γ' of Γ, $\vdash(\Gamma', r, e'')$.

From here it is easy to show that if p entails r in some eventuality, then p and q together must entail r in that same eventuality: Suppose that p entails r in some eventuality e. Then it automatically follows that $\{p, q\}$ entails r in e, by monotonicity. Moreover, e must have a part e', such that $\{p, q\}$ entails r in e', and any subpart e'' of e' must be a state of some subset of $\{p, q\}$ entailing r. But by monotonicity, it follows that $\{p, q\}$ entails r in e''. The conditions imposed by the definition of *together* are satisfied: for any two parts e'', e''' of e', there will be overlap between the set of entailers of r in e'' and the set of entailers of r in e''', since $\{p, q\}$ will be in both sets.

Another example we should consider is (27)c. This example was given as a counterexample to the analysis of Lasersohn (1990) under the assumption that an eventuality of the box and the axe together being light enough to carry must have as parts an eventuality of the box being light enough to carry, and one of the axe being light enough to carry.

However, it is by no means clear (at least to me) that this assumption is correct. Although it will normally be the case that if there is an eventuality of the axe and the box together being light enough to carry, there will also be an eventuality of the axe being light enough to carry and an eventuality of the box being light enough to carry, I see no reason to assume that these latter eventualities must be parts of the first.

In support of this idea, consider statements identifying a complex event with its parts. Suppose John lifts one piano and Mary lifts another one. In this case, (41) seems true.

(41) John's lifting one piano and Mary's lifting one piano are the same thing as John and Mary's together lifting two pianos.

Even if the box and the axe are both light enough to carry, however, (42) does not seem to me to be intuitively true.

(42) The box's being light enough to carry and the axe's being light enough to carry are the same thing as the box and the axe's together being light enough to carry.

One of the advantages of defining *together* in terms of overlap as I've suggested comes in extending the analysis to cover the spatial reading. Our earlier semantics for the spatial reading incorrectly predicted that being together spatially (for example, sitting together) should be a transitive relation. This is because the analysis imposed a condition of identity among the locations of the members of a group who were sitting together. But this is wrong. One can easily imagine the case of a group of people sitting in a long row in a theater, for example; we might say of any two people who are adjacent in the row that they are sitting together, but this wouldn't automatically commit us to claiming that the two people at the extreme ends of the row are sitting together.

An easy solution to this problem presents itself under the new analysis. As before, to obtain the locative reading for *together*, we simply substitute the spatio-temporal trace function in place of the predicate denotation in the last clause of the definition, as in (43). (We understand a location/time pair $\langle l, t\rangle$ to overlap with another pair $\langle l', t'\rangle$ iff l and l' have a part in common and t and t' have a part in common.)

(43) $\mathbf{together}'_{\text{loc}} = \lambda P\lambda e\lambda g[\exists e'\leq e[g \in P(e') \;\&\; \forall e'',e'''\leq e'[[\exists x\, x \in P(e'') \;\&\; \exists x\, x \in P(e''')] \rightarrow K(e'') \circ K(e''')]]$

Now all that's required for John and Mary to sit together is for the times and locations of their sitting events to overlap, not for them to be identical. Since John's location can overlap with Mary's, and Mary's with Bill's, without John's necessarily overlapping Bill's, we no longer get a prediction that sitting together is a transitive relation.

This sort of analysis also extends fairly straightforwardly to readings of *together* other than the collectivizing, locative and temporal, which are the only ones covered in our earlier analysis. Here, I want to consider two more: the social accompaniment reading exemplified by sentences such as *John and Mary went to the movies together*, and the coordinated action reading exemplified by such sentences as *John and Mary work together*. Social accompaniment is a non-logical notion which is not amenable to a formal definition in model-theoretic terms. We may take it simply as primitive. Let us suppose that a distinguished subclass of events occur “in the company” of one or more groups of individuals. Now, if e occurs in the company of g, let us say that g is a “party” of e. We assume that for any given event e and group g, if g is a party of e, then g must include at least one participant in e itself. Let π be a partial function from events to sets of groups; we understand `$g \in \pi(e)$' to mean that g is a party of e. Now we substitute π into the same position in the definition of *together* as P or K in our earlier definitions, to get (44):

(44) $\mathbf{together}'_{soc} = \lambda P \lambda e \lambda g[\exists e' \leq e[g \in P(e') \;\&\; \forall e'',e''' \leq e'[[\exists x\, x \in P(e'') \;\&\; \exists x\, x \in P(e''')] \rightarrow \pi(e'') \circ \pi(e''')]]$

The idea is that if John and Mary accompany each other socially to the movies, for example, then {John, Mary} is a party both for the event e'' of John going to the movies and the event e''' of Mary going to the movies. Since these two events share a party, $\pi(e'')$ and $\pi(e''')$ overlap. Therefore the sentence *John and Mary went to the movies together* is true in such a situation.

We may use this analysis of the social accompaniment reading as a model for the coordinated action reading. Rather than attempt a model-theoretic definition of coordinated action, let us just suppose that a distinguished class of events occur "in coordination" with other events. We assume that any set of coordinated events share a "team," that is, a group of individuals whose actions are coordinated. Now let T be a partial function from events to sets of groups; we understand `$g \in T(e)$' to mean that g is a team of e. We require that e be in coordination with e' iff $\exists g[g \in T(e) \;\&\; g \in T(e')]$. Now we substitute T into the usual position in the definition of *together* to get (45):

(45) $\mathbf{together}'_{coord} = \lambda P \lambda e \lambda g[\exists e' \leq e[g \in P(e') \;\&\; \forall e'',e''' \leq e'\; [[\exists x\, x \in P(e'') \;\&\; \exists x\, x \in P(e''')] \rightarrow T(e'') \circ T(e''')]]$

Thus in order for it to be true that John and Mary work together, the group {John, Mary} will have to be a team both of the event e'' of John working and the event e''' of Mary working.

Perhaps some examples which were taken as involving a collectivizing reading in Lasersohn (1990) should instead be taken as involving a coordinated action reading. For example, *John and Mary lifted the piano together* seems to imply some sort of coordination between John and Mary, and not merely collective predication. In fact, I think that probably Schwarzschild is correct in claiming postverbal *together* never really takes the purely collectivizing reading; examples of this sort really involve the coordinated action reading. This is the source of the oddity of (25)b. and

(26)b. We can explain the anomoly of such examples by stipulating that every member of a "team" for a given event *e* must be an agent of one of the events with which *e* is coordinated. It is this sense of agentivity that makes (25)b. and (26)b. sound odd, since the actions described in these examples are not normally agentive.

To conclude, I believe that there definitely is a role for events in the semantics of collectivizing elements like *together*. It is the use of events that allow us to give a unified semantics for the various readings that words like this tend to show, since it is the substitution of various "trace" functions on events that results in the different readings — whether the spatial trace, the temporal trace, or what we might think of as various "participant trace" functions, as in the collectivizing, social, and coordinated action readings. We can give an event-based analysis that isn't subject to the problems of earlier event-based analyses, and which also avoids what I take to be problems with their main event-free competitor.

REFERENCES

Bartsch, Renate (1973) `The Semantics and Syntax of Number and Numbers'. In: *Syntax and Semantics* vol. 2, J.P. Kimball, ed. Seminar Press, New York.

Bennett, Michael (1975) *Some Extensions of a Montague Fragment of English*, revised version. Indiana University Linguistics Club, Bloomington.

Cooper, Robin (1983) *Quantification and Syntactic Theory*. Kluwer, Dordrecht.

Harnish, Robert (1976) `Logical Form and Implicature'. In: *An Integrated Theory of Linguistic Ability*, T. Bever, et al., eds. Thomas Cromwell, New York.

Higginbotham, James and Barry Schein (1989) `Plurals'. In: *Proceedings of NELS 19*, J. Carter and R.-M. Déchaine, eds. GLSA, Amherst.

Hoeksema, Jack (1983) `Plurality and Conjunction'. In: *Studies in Modeltheoretic Semantics*, A. ter Meulen, ed. Foris, Dordrecht.

Krifka, Manfred (1989) `Nominal Reference, Temporal Constitution and Quantification in Event Semantics'. In: *Semantics and Contextual Expression*, R. Bartsch, et al., eds. Foris, Dordrecht.

Lasersohn, Peter (1990) `Group Action and Spatio-Temporal Proximity'. *Linguistics and Philosophy* 13.2.179-206.

Lasersohn, Peter (forthcoming) *Plurality, Conjunction and Events*. Kluwer, Dordrecht.

Link, Godehard (1987) `Generalized Quantifiers and Plurals'. In: *Generalized Quantifiers: Logical and Linguistic Approaches*, P. Gärdenfors, ed. Kluwer, Dordrecht.

McCawley, James (1968) `The Role of Semantics in a Grammar'. In: *Universals in Linguistic Theory*, E. Bach and R.T. Harms, eds. Holt, Rinehart and Winston, New York.

Roberts, Craige (1987) *Modal Subordination, Anaphora and Distributivity.* University of Massachusetts dissertation. Published (1991) by Garland Publishing, New York.

Scha, Remko (1981) `Distributive, Collective and Cumulative Quantification'. In: *Formal Methods in the Study of Language*, J. Groenendijk, et al., Mathematical Center, Amsterdam.

Schein, Barry (1992) `Conjunction Reduction Redux'. Unpublished manuscript, University of Southern California.

Schein, Barry (1993) *Plurals and Events*. MIT Press, Cambridge, Mass.

Schwarzschild, Roger (1992) `*Together* as a Non-Distributivity Marker'. *Proceedings of the Eighth Amsterdam Colloquium*, P. Dekker and M. Stokhof, eds. Institute for Language, Logic and Computation, Amsterdam.

Schwarzschild, Roger (1994) `Plurals, Presuppositions and the Sources of Distributivity'. *Natural Language Semantics* 2.3.201-248.

Thomason, Richmond and Robert Stalnaker (1973) `A Semantic Theory of Adverbs'. *Linguistic Inquiry* 4.2.195-220.