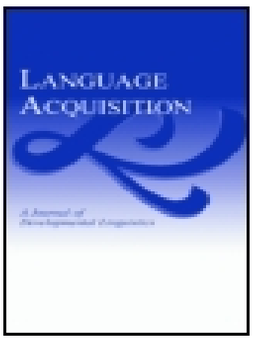

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# All together now: disentangling semantics and pragmatics with *together* in child and adult language

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**ABSTRACT**

The way in which an event is packaged linguistically can be informative about the number of participants in the event and the nature of their participation. At times, however, a sentence is ambiguous, and pragmatic information weighs in to favor one interpretation over another. Whereas adults may readily know how to pick up on such cues to meaning, children—who are generally naïve to such pragmatic nuances—may diverge and access a broader range of interpretations or one disfavored by adults. A number of cases come to us from a now well-established body of research on scalar implicatures and scopal ambiguity. Here, we complement this previous work with a previously uninvestigated example of the semantic-pragmatic divide in language development arising from the interpretation of sentences with pluralities and *together*. Sentences such as *Two boys lifted a block (together)* allow for either a Collective or a Distributive interpretation (one pushing event vs. two spatiotemporally coordinated events). We show experimentally that children allow both interpretations in sentences with *together*, whereas adults rule out the Distributive interpretation without further contextual motivation. However, children appear to be guided by their semantics in the readings they access, since they do not allow readings that are semantically barred. We argue that they are unaware of the pragmatic information adults have at their fingertips, such as the conversational implicatures arising from the presence of a modifier, the probability of its occurrence being used to signal a particular interpretation among a set of alternatives, and knowledge of the possible lexical alternatives.

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## 1. Introduction

The way that we describe events that occur in the world can capture important information about these events, such as the manner in which they unfolded, the temporal relation among the events, the number of event participants, and the interaction among the participants. Across languages, this information about events can be packaged in different ways. Even within a language, the way in which we describe a single event may vary depending on factors such as the speaker's perspective, the common ground between the speaker and hearer, or the topic of conversation. At the same time, while the descriptions for a single event may vary, a single description may be used to describe multiple events.

For example, sentences such as (1) are ambiguous. Under one interpretation, the two boys worked in concert to lift one block, and there is one "block lifting" event. This interpretation is known as the *Collective* one. Under a second interpretation, the two boys *each* lifted a block (either each lifting the same one at different times, or each lifting his own block). This interpretation is known as the *Distributive* one.

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(1) Two boys lifted a block.

The collective/distributive distinction has fueled much discussion over the years in the semantics literature (Brisson 2003; Champollion 2011; Dowty 1986; Gillon 1984, 1987, 1990; Heim, Lasnik & May 1991; Lasersohn 1988, 1990, 1995, 1998; Landman 1989a, 1989b, 1996; Link 1983, 1987, 1991; Moltmann 1997; Peres 1998; Schwarzschild 1994, 1996; Berg 1994; Does 1993; Verkuyl & van der Does 1991; Winter 2002) and has become a recent topic of interest in the field of language acquisition (Brooks & Braine 1996; Musolino 2009; Pagliarini, Fiorin, & Dotlačil 2012; Pérez-Leroux & Roeper 1999; Syrett & Musolino 2013).

The core question from the semantics perspective is the following: What is the proper treatment of sentences with pluralities such as *two boys* such that we can allow for predication of both the group of boys and the individual boys precisely when a predicate allows for this and block predication at one of those levels when the predicate or modifier targets only the group or individual level? For example, a group of boys can *gather* or *scatter*, while individual boys cannot. And individual boys can *have brown eyes*, while the group cannot. Relatedly, semanticists have asked what the proper representation of a plurality is and whether that representation is consistent among instances in the world and in sentences, in addition to how different predicates either allow for or force different interpretations (as in the previous predicates).

The core questions from a language acquisition perspective derive from these semantic issues. Do children have whatever representation it takes to access these various readings, and how do they acquire this representation? In the case where children ostensibly veer away from an adultlike interpretation, what accounts for this divergence? Moreover, to be fully adultlike in their interpretation of these sentences, children must not only be able to *access* both the collective and distributive interpretations, but they must also know what constrains the truth conditions of these sentences and affects their acceptability and/or preference in a given context.

Take, for example, the sentence in (2). The intuition echoed in the semantic literature (see Bartsch 1973; Brisson 2003; Dowty 1986; Hoeksema 1983; Lasersohn 1990, 1995; Parsons 1980; Schwarzschild 1994, 1996; Does 1993; Verkuyl 1998) is that the presence of *together* in sentences such as the following heavily favors a collective reading, in which the two boys jointly lift the same block in one event of lifting.

(2) Two boys lifted a block together.

However, Lasersohn (1995) has observed that the collective reading is only one of the many readings allowed by *together*. For example, the two boys could also coordinate their respective block-lifting events. Thus, the semantics generates multiple possible interpretations of this sentence, licensed by the lexical representation of the adverbial modifier and other lexical information in the sentence. Then something else (pragmatic) steps in to filter out the readings that are not supported in a given context and highlight those that are favored. The idea that the collective reading is pragmatically favored is also promoted by Brisson (2003:181, footnote 22).

Thus, a speaker's ability to access a collective reading for this particular sentence does not reflect his/her ability to access the only possible reading for this sentence; rather, it reflects a preference or a bias, which is determined not by lexical meaning and logical representation, but by knowledge of how language is used by a speaker in a given context—that is, by pragmatics. Knowing which of the many readings available is the one intended by the speaker is dependent on linguistic knowledge, such as knowledge of the distribution of *together*, the (favored) interpretation of the sentence without this modifier, and knowledge of alternative modifiers that could have appeared in the sentence in its place. It is also dependent on extralinguistic world knowledge, such as the typical weight of a block, the capacity of an individual boy to lift it, and so on.

If sentences with *together* are ambiguous, but one of the possible readings is heavily favored by pragmatics, then we might expect that young children—who are not as pragmatically savvy as and

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typically more "logical" than their adult counterparts, and who have not yet acquired the requisite world knowledge mentioned—would access a wider range of readings than adults, permitting those that are pragmatically disfavored by the older age group. Such an example would therefore provide evidence independent of the existing literature on the calculation of scalar implicatures (see Barner, Brooks & Bale 2010; Katsos & Bishop 2011; Noveck 2001; Papafragou & Musolino 2003; Papafragou & Tantalou 2004; among others [a.o.]) and scopal ambiguity (Gualmini et al. 2008; Miller & Schmitt 2003; Viau, Musolino, & Lidz 2010), which shows that children's semantic knowledge often aligns with that of adults, and what distinguishes them in their performance in experimental tasks is either a lack of, or their inability to recruit, certain pragmatic knowledge.

In fact, this is precisely what Syrett & Musolino (2013) found: While adults appear to only allow the collective reading for sentences like (2), children allow both the collective and the distributive readings. While this pattern might appear on the surface to indicate that children overgenerate readings for this sentence relative to adults, we argue instead that children are driven by the semantics but fail to recruit pragmatic information to constrain the readings to the ones intended in a given context. The current research therefore complements this previous line of work to provide us with a more complete understanding of the developing path to adult linguistic competence.

In this article, we test the hypothesis that children's overgeneration of interpretations of sentences with *together* is the result of pragmatic naïvete rather than immature representations. At the same time, we also ask whether the interpretations children *do* generate are indeed constrained by the semantics. We begin by reviewing the background literature demonstrating that children and adults diverge in their interpretation of these sentences in a way that suggests that children are unaware of the intended and favored collective interpretation. We then show in Experiment 1 that when a distributive reading is not supported by the semantics (because the events are not temporally coordinated), children no longer accept the target sentences, demonstrating that they are constrained by a semantic representation that is presumably adultlike. Moreover, a between-subject manipulation targeting conversational interaction shows that their willingness to accept the sentence decreases significantly when key aspects of the context and interpretation are highlighted. We then move on to a set of experiments targeting adults' interpretations of these sentences, to further show that children's acceptance of sentences such as (2) in a distributive context is semantically licensed, although the reading accessed is dispreferred.

To highlight the pragmatic nature of the collective bias demonstrated by adults, we show in Experiment 2 that adults can be led to accept the *together* sentences (as children do) in a context in which they previously robustly rejected it, as long as the presence of *together* in that context is made felicitous by highlighting social interaction and coordinated action among event participants. Thus, their rejection of the *together* sentences in distributive contexts appears to result from a robust pragmatically based bias in favor of a collective interpretation of *together*. We pair this binary judgment task with a more extensive timed scalar rating task presented in Experiment 3, demonstrating that adults do not systematically rule out the distributive reading of sentences with *together*. They display a quantitative difference between semantically licensed, but pragmatically dispreferred, contexts and those that are *not* licensed by the semantics—precisely the conditions under which children rejected the sentences: where the temporal link is broken and the semantics does not license the presence of *together* in the context.

Finally, in Experiment 4, we seek to pin down the source of the pragmatic knowledge in order to specify more clearly the nature of our adult knowledge of *together* and the surface-level cues implicated in favoring particular readings. In doing so, we therefore seek to identify what the learning process entails in order for children to become adultlike in their response patterns. The results of the cloze task reported in Experiment 4 show that given the opportunity to provide their own descriptions of the contexts, adults are significantly more likely to use *together* to describe collective contexts and have other lexical alternatives at their disposal for describing distributive contexts. Moreover, *together* or other modifiers are not always employed to describe the collective

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contexts, demonstrating a preexisting preference for the bare sentences with a singular indefinite to describe a collective context.

Given these findings, we argue that children must become aware of the possible alternatives, their relative weighting and informativity, and the probability with which they and sentences in which they can appear favor one interpretation or another—an argument that meshes well with recent approaches to children's developing capacity to compute scalar implicatures (see, for example, Barner, Brooks, & Bale 2010). Thus, we take the combined findings from the previous research on this topic and the current set of experiments with children and adults to contribute additional evidence that children share a core semantic representation with adults but lack the ability to readily deploy pragmatic expertise because they have yet to acquire key information about interpretational alternatives. The task of the language learner, we propose, is to acquire the lexical semantics of modifiers such as *together* against the backdrop of their developing knowledge of the range of alternative linguistic expressions, the syntax-semantics mapping for ambiguous sentences, and events that take place in the world—and use this knowledge to identify the most likely interpretation of an utterance in a given context, even though other interpretations may be semantically compatible.

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## 2. Background

In order to understand the problem the learner faces in the interpretation of the target sentences, we first must understand the semantics behind the linguistic expression of interest (*together*). In this section, we present a semantic analysis for the post-VP adverbial appearance of *together* following Lasersohn (1995, 1998).[1] Lasersohn (1995) observes that in the abstract, a sentence with a post-VP *together* could give rise to multiple interpretations, illustrating the wide variety of meanings supported by *together* with a series of examples in (3) (his 12.21). In each example, the predicate helps to highlight (perhaps unambiguously) one particular interpretation. He notes that in most of these examples, *together* appears as an adverbial, although it might also be considered an adjective in examples such as (f).

| | | | |
|---|---|---|---|
| (3) | a. | John and Mary lifted the piano together. | (nondistributive, collective) |
| | b. | John and Mary sat together. | (social proximity) |
| | c. | John and Mary stood up together. | (temporal) |
| | d. | John and Mary went to the movies together. | (social accompaniment) |
| | e. | John and Mary danced together. | (coordinated action) |
| | f. | John put the bicycle together. | (assembly) |
| | g. | John and Mary are together. | (other) |

Lasersohn points out that while it is in theory possible to consider a set of homophones (different lexical entries with the same phonological form) that individually account for these various readings, and consequently attribute the pattern to synonymy, it is much more plausible to argue that the different readings derive from a single word *together*, which has a core meaning of coordination, or overlap, and which composes with the other elements of the sentence to give rise to one of the readings in (3).

Revising earlier proposals by Lasersohn (1988, 1990) and Schwarzschild (1992), Lasersohn (1995) proposes an analysis of *together* that appeals to eventualities (or events), thereby allowing him to generate readings beyond the nondistributive, collective one (3a). The basic idea of Lasersohn's

[1]We restrict our attention to the post-VP use of this modifier for the following reason. Referencing Lasersohn (1990) and earlier work by Bennett (1974), Schwarzschild (1994) argues that the post-NP and post-VP uses of *together* (e.g., *John and Mary together lifted a block* vs. *John and Mary lifted a block together*) should be treated distinctly, pointing out that differences in syntactic position are correlated with differences in meaning (see §3.1 and §3.3, and pp. 245–247). For example, post-VP *together* attaches to the right of the VP and modifies the event, giving rise to multiple interpretations, while post-NP *together* attaches to the left of the VP and *requires* the predicate in question to apply to the plurality (e.g., *John and Mary*), giving rise to an obligatorily collective reading.

analysis is the following. Given an eventuality *e*, a sentence with *together* is true if that eventuality has subparts of it that *overlap* in space and time. This differs from his earlier definition, which required there to be spatial and temporal *identity* among events. Overlap allows for events to share something in common (like the running time or the location) without them being identical.

The notion of *overlap* is defined in the following way, using temporal overlap ( ∘ ) as an example. This definition says that there is an overlap between the times $t$ and $t'$ (of two events).

(4) For all $t, t' \in T$: $t \circ t'$ iff $\exists t'' [t'' \leq_T t \ \& \ t'' \leq_T t']$

This overlap is then fed into the definition of *together*, so that *together* can pick out how certain aspects of the eventualities overlap with each other. Formalized, Lasersohn (1995)'s definition of collective *together* is as in (5), applying a predicate $P$ (such as "lift a piano") to a group $g$ (such as "John and Mary" or "the boys").

(5) $[[together_{coll}]](P)(g) = \{ e \in E \mid \exists e' \leq e [g \in P(e') \ \& \ \forall e'', e''' \leq e' [[\exists x\, x \in P(e'') \ \& \ \exists x\, x \in P(e''')] \cdot P(e'') \circ P(e''')]]\}$

This definition says that given an eventuality $e$ there is an eventuality $e'$ that is part of it, and a group $g$ that has a predicate $P$ applied to it in $e'$, and for every eventuality $e''$ and $e'''$ that are part of that eventuality $e'$, where an entity $x$ in each of those eventualities has the same predicate applied to it, there is an overlap, resulting in each event sharing the predicate and therefore the collective reading. For a typical collective event like "lifting a piano," the entities in the group, and therefore their corresponding events, share the property of lifting the piano in $e'$.

However, we want to generate readings beyond the collective one. In order to revise this definition to generate additional meanings of *together*, another function is substituted in for the last two occurrences of $P$ ($P(e'') \circ P(e''')$), to highlight what the events share in common (e.g., spatial location, running time). For example, for the *temporal overlap* reading in (3c), which also corresponds to a distributive reading, in which the events take place at the same time, a temporal trace function $\tau$ is substituted for $P$ ($\tau(e'') \circ \tau(e''')$), indicating that the running time of the two eventualities coincides. However fine-grained this overlap is may depend on pragmatics or world knowledge of the type of events in question, but there must be temporal overlap for the sentence to be considered true in that situation. Which of the various meanings of a sentence with *together* is intended (and semantically licensed) in a given situation can be determined from the meaning of the other elements in the sentences, one's knowledge of events in the world, and/or how space and/or time (or another function) typically or possibly overlap.

In sum, a language learner must be aware of the semantic representation not only of the modifier *together* but also the other lexical elements in the sentence, real-world knowledge about the events in question, and which of the various meanings is possible in principle and favored by the speaker in a given context. Given that multiple readings are available for sentences with *together*, a child who accesses readings beyond the collective one in (3a) may be said to possess the semantic wherewithal to generate the other readings (e.g., the spatiotemporal one). However, we must also show that their semantics properly constrains these readings by demonstrating that when the relevant overlap does not hold, they reject the sentence with *together*. Likewise, adults who appear to only access the collective reading in (3a) and reject other readings (e.g., [3c]) in contexts that permit them may be said to generate the relevant readings via their semantics but filter them out for nonsemantic (i.e., pragmatic) reasons. We must therefore show that there are circumstances under which adults will accept these readings.

## 3. The acquisition puzzle

To resolve these issues, we begin by turning to previous work reported by Syrett & Musolino (2013). There, participants—both preschoolers and adults—were tested for their understanding of sentences

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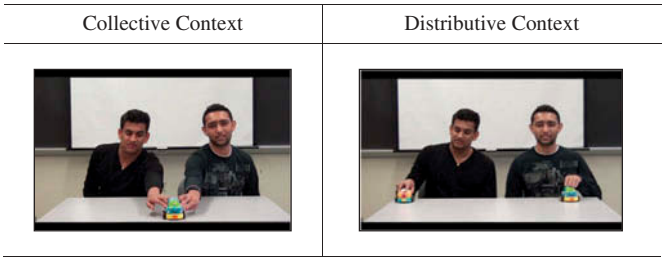


**Figure 1.** Freeze frame of the Collective and Distributive contexts for the target sentence *Two boys pushed a car* presented in Syrett & Musolino (2013).

such as the one in (1) and (6a–b). Participants were shown a series of brief videos of actors performing child-friendly actions (e.g., lifting a block, completing a puzzle, pushing a toy car) and were asked to judge whether a target sentence involving a plurality in subject position and an indefinite in object position could describe the event they had seen. Still images from two versions of one video are presented in Figure 1. Participants heard either a bare ambiguous sentence, as in (6a), or a sentence with *together*, as in (6b). (We leave aside the test sentences involving *each*.)

(6) a. Two boys pushed a car.
b. Two boys pushed a car together.

Syrett & Musolino (2013) found that 4-year-olds and adults alike accepted sentences such as (6a) in both the Collective and Distributive contexts, demonstrating that children can predicate both of the whole group and its subparts (the individuals in the plurality). When the sentences included the modifier *together*, as in (6b), however, the two age groups diverged. Children (but not adults) accepted the sentences in the Distributive context (approximately 83% vs. 24% acceptance respectively).

At first blush, these findings seem to indicate that the children were simply being overly lenient in their acceptances. However, as we discussed in section 2, there are reasons to think that they were using the semantics of the sentences to make their decisions and failed to deploy the pragmatic knowledge to filter out readings as adults did. First, Syrett & Musolino (2013) reported that many children provided reasonable justifications in support of their acceptance of the target sentence in the given context. Second, in a separate sentence-to-picture preference task using still images similar to the ones in Figure 1, children were asked to indicate their choice of either the Collective or the Distributive context as a *better match* for the sentences in (6). When responding to the bare, ambiguous sentences, children demonstrated a slight preference for the Distributive context (in contrast to their adults, who strongly preferred the Collective context). However, when children were given the same forced choice with sentences involving *together*, they opted for the Collective context over 70% of the time. Thus, while children *accept* sentences with *together* in a wider range of contexts than do adults, they nevertheless demonstrate awareness of its collectivizing force in their *preferences*, thereby showing that they realized that among the possible interpretations supported by *together*, the one most likely intended by the speaker is the collective one, as in (3a).

These results raise two questions relevant to our current research question. First, how can we reconcile the child and adult patterns in Syrett & Musolino's (2013) judgment task, in which adults rejected—but children accepted—the sentences with *together* in the Distributive context? Second, what does the coupling of the judgment and preference tasks reveal about the nature of children's semantic knowledge? That is, what exactly does it mean for children to accept the sentences with *together* in both contexts and yet display a preference for the Collective context when given the choice between the two contexts? The answers to these questions speak not only to children's understanding of the semantics of this particular modifier but to the way in which its meaning is

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recruited in conjunction with other knowledge in the service of resolving the potential ambiguity of the target sentences. The background we reviewed in the previous section allows us to generate the hypothesis that children and adult share semantic knowledge but diverge in their ability to appeal to pragmatic information when rendering judgments about the target sentences. The experiments presented here serve to test this hypothesis. Previewing our results, we show that while children have seemed to be overly lenient in their acceptance of the target sentences such as (6b) in the Distributive contexts, where adults have resisted it, they are nevertheless guided by appropriate semantic representations. Specifically, when the context no longer supports use of *together*, because there is no temporal overlap, children cease to accept the target sentences, as predicted. These results, paired with those from a set of experiments targeting adult participants alone, support our claim that the major source of the difference between child and adult participants lies in pragmatic knowledge, and not semantics.

## 4. Experiments

### 4.1. *Experiment 1: judgment task with* together *sentences (children)*

The motivation behind this experiment was to determine whether children's previous (over)acceptance of sentences with *together* (relative to adults) in distributive contexts is guided by the semantics but unconstrained by pragmatics. Our strategy was to appeal to a distributive version of the semantic representation provided in (5) (where a spatiotemporal trace function is substituted in for *P*) and pinpoint a way in which the Distributive context from Syrett & Musolino (2013) would no longer support use of *together*. To that end, we sought to sever the temporal link between the subevents in this context (e.g., the singular "car-pushing events") so that they no longer took place simultaneously; the events now transpired sequentially under the umbrella of the larger event, thus allowing us to remove the temporal overlap of the parallel subevents. We predicted that if children are indeed guided by the semantics when interpreting these sentences, they should no longer accept them as they previously did in Syrett & Musolino. We further introduced a between-subject manipulation highlighting the importance of children's ability to recognize a speaker's intentions to favor one reading over another, in order to emphasize the pragmatic component of filtering out the distributive reading.

#### 4.1.1. *Participants*

Twenty children (11 boys, 9 girls; range: 3;09–5;03, M: 4;06) participated. They were randomly assigned into two between-subject conditions (10 in each). Distribution of gender and age was comparable across the conditions. Four additional children who exhibited a "yes" bias by responding "yes" to the majority of test items and more than half of the control items were excluded from analysis.

#### 4.1.2. *Stimuli and procedure*

Participants were shown a series of 13 short events, each involving one to three agents performing a child-friendly action. Events were filmed using a Sony HD Handycam, edited in iMovie, and presented on a Macbook Pro. Collective and Distributive contexts of the same event type were created, each with a comparable length to its counterpart and modeled after events in Syrett & Musolino (2013). There were four events in Distributive contexts and four similar events in Collective contexts. The events were lifting a block, pushing a toy car, building a tower, and reading a book. In the Collective context (the same appearing in Syrett & Musolino), the two participants performed a single action together, resulting in one atomic event, in which the agents' participation was equivalent. In the Distributive context, two participants performed the action side by side at a table, yielding two distinct subevents within a larger event.

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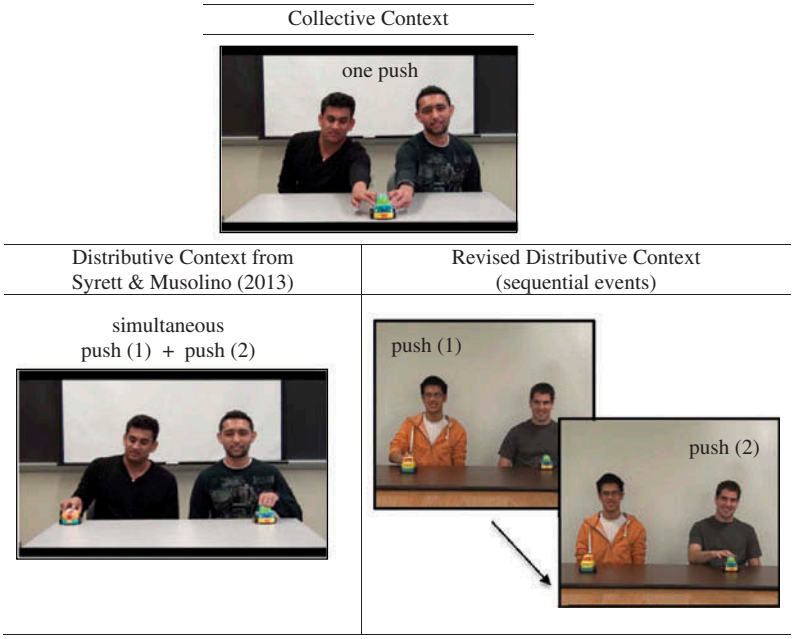


**Figure 2.** Freeze frames of the Collective (top) and two Distributive contexts (bottom) for the test sentence *Two boys pushed a car together*.

Unlike in Syrett & Musolino (2013), in this experiment the main focus was on the Distributive contexts, with the specific goal of eliciting rejections from children when sentences with *together* appeared in these contexts. Thus, in contrast to that study, the Distributive context was manipulated to sever the temporal overlap of the two subevents. In this version of the Distributive contexts, the two subevents were sequential, with one subevent beginning as soon as the other ended, such that there was no overlap in the running time of the events. Screenshots from the Collective and Distributive contexts for the different "push a car" events are presented in Figure 2.

To further probe the pragmatic component of children's willingness to reject the target sentences in the Distributive context, we included two between-subject experimental conditions, which differed in the level of engagement between the child and the utterer of the target sentence and the extent to which the temporal aspect of the events was highlighted by items *other than* the Distributive context (and specifically, the Collective contexts).

In Condition 1, the Collective contexts and associated sentences were identical to those appearing in Syrett & Musolino (2013). Sentences accompanying the Collective contexts in this condition were similar to (1) (e.g., *Two boys pushed a car*). In Condition 1, the target sentences were prerecorded in a sound-attenuated recording booth by a female experimenter (a native speaker of American English), using child-directed speech prosody. They were later edited for comparable length and intensity using Praat software (Boersma & Weenink 2010) and subsequently paired with the visual stimuli in iMovie. An exclamation (e.g., *Look!, Let's watch what's happening!*) occurred toward the beginning of each video to direct participants' attention to the event on screen, and an occasional exclamation punctuated the events to maintain participants' attention. Following the conclusion of each event, there was an 8-second pause. At the beginning of the pause, the prerecorded voice of a female experimenter delivered the target sentence. Children had the rest of the pause to accept or reject the utterance. For those children who occasionally required additional time to render a judgment and/or justification, the experimenter paused the video briefly to allow the child to respond. In this condition, children were thus more passive participants, viewing the videos and responding to a recorded sentence following each event.

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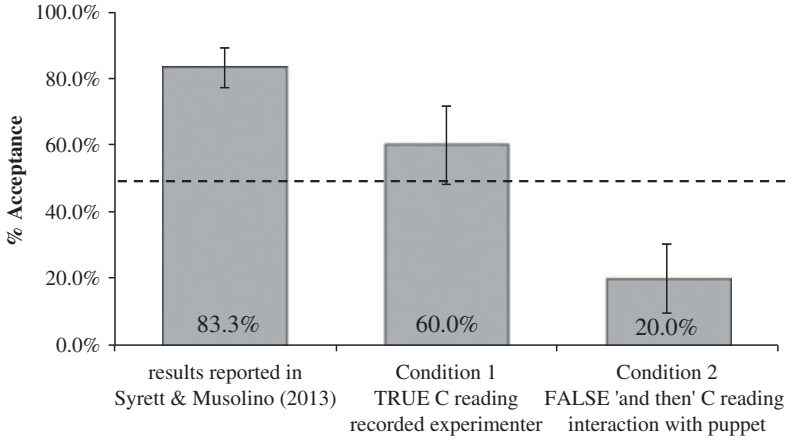


**Figure 3.** Children's acceptance rates of statements with *together* accompanying the Distributive contexts in Syrett & Musolino (2013) (far left) and the two conditions of Experiment 1 (middle and right).

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Condition 2 differed from Condition 1 in two ways: the level of engagement of the child with the speaker in the task and the sentence accompanying the Collective contexts. In this condition, the children interacted with a puppet, who watched the videos alongside them. The experimenter paused the video immediately after the event's end for each trial, and the puppet (one of the experimenters) delivered the target sentence.[2] We hypothesized that since children are not as adept as adults at identifying a speaker's intentions, and consequently at calculating conversational implicatures, their engagement with the puppet would facilitate the creation of a more naturalistic discourse context, thereby allowing them to recognize his intentions and appeal to pragmatic information to access the intended interpretation.

The Collective contexts in this condition were also manipulated so that they were accompanied by an erroneous statement. The sentence recapping the event in the Collective context in this condition was, "*This* $x_1$ VPed, and then *this* $x_2$ VPed!" (e.g., *This girl read a book, and then this girl read a book!*). This description was inaccurate, since the event was a truly collective one, and there was only one event in which both individuals were participants. We predicted that by referring inaccurately to a sequence of events, this statement would serve to highlight the temporal variable for the child participants and would have an effect on their attention to this variable when responding to the test sentences with *together*, thereby making them more likely to reject the *together* test sentences in the Distributive context where there was no temporal overlap.[3]

In each condition, the Collective and Distributive events were pseudorandomized along with five filler events, for a total of 13 items. The purpose of the fillers was to keep participants' attention, to ensure that they were paying attention to the semantic content, and to maintain a relative balance of "yes" and "no" responses within each condition. The test session was also preceded by a three-item training session, composed of two true utterance-video pairings, and one false utterance-video pairing. The entire experimental session took approximately 10–12 minutes.

[2]We employed a puppet rather than a live female experimenter, given children's success in other experimental paradigms, such as the TVJT (Crain & Thornton 1998), in which they interact with a puppet.

[3]An anonymous reviewer observes that an additional possible influence of the sentences accompanying the Collective contexts is that they might make children aware that the indefinite (e.g., *a book*) could have narrow scope relative to the subject and/or that each occurrence of the indefinite in the utterance makes reference to a new entity in the discourse. If this is so, then these sentences might also further facilitate children's accessing the Distributive reading, which they were already eager to accept, and remind them of the temporal overlap that should hold among subevents in the Distributive context.

#### 4.1.3. *Results*

The results are presented in Figure 3, with the results from Syrett & Musolino (2013) to the far left for comparison.[4] The two bars to the right from the current study illustrate that when there is no temporal overlap between the two subevents in the Distributive context, children are significantly less likely to accept the target sentence with *together*.

The overall percentage of acceptance in Condition 1 of the current study was no different from chance, but the percentage of acceptance in Condition 2 of the current study was different from chance (binomial probability, $p < .0001$). Post hoc two-tailed Mann-Whitney comparisons revealed significant differences in acceptance rates between the previous results and Condition 1 ($U_A = 920$, $z = 1.97$, $p < .05$), the previous results and Condition 2 ($U_A = 440$, $z = 5.34$, $p < .0001$), and Condition 1 and Condition 2 ($U_A = 480$, $z = 3.07$, $p = .002$). Thus, interaction with a live interlocutor (the puppet) and the erroneous temporal sentence accompanying the Collective contexts worked in concert to pull children away from accepting the *together* sentences in the new Distributive context.[5]

When children *rejected* the statement with *together* in the Distributive context, they offered justifications such as the following.

(7) The boys pushed their car by theirselves [sic]. (child 20)
(8) Two boys were pushing two cars. (child 26)
(9) Both the boys pushed one car … but not the same. (child 18)
(10) The girls and the girl read books separately! (child 27)[6]
(11) A girl read one and then a other girl read one. (child 28)
(12) They both built their own tower. (child 16)

It may seem surprising that children *accepted* the statement with *together* at all in the Distributive context (as captured by the 60% acceptance rate in Condition 1). However, many of the justifications provided by children when they accepted the recorded statement reflect the fact that children found a way to reconcile the occurrence of *together* with the event that they viewed, explaining that the characters "shared," or that the characters "loved each other," or that they did it together, because "when one boy does it, the other does it." Other responses (e.g., "Because they each had blocks," "Because I'm smart," "I just know," "They just did") were less informative about children's reasoning process.

#### 4.1.4. *Discussion*

Experiment 1 demonstrated that given the manipulation of the Distributive context leading to a severing of the temporal overlap of the subevents, children are no longer as likely to accept the target statement with *together* in the Distributive context—particularly in Condition 2, in which they interacted with their interlocutor, and the temporal variable was highlighted in other items. Thus, making more salient the variable of interest and making children more active participants in the experiment produced an effect that illuminates children's underlying semantic representations. These findings, complemented by the justifications children provided in their rejections here, suggest that children's earlier acceptance of the sentences with *together* in the Distributive context as reported by Syrett & Musolino (2013) was supported by the semantics but not filtered out by their pragmatic knowledge: Children appear to have been accessing a semantically plausible, but pragmatically dispreferred, reading of the *together* sentences in which there was spatiotemporal overlap of events.

[4]All conditions presented in Figure 3, along with those represented by "previous results," were run in succession as part of a unified research project, with the same representative population of children.

[5]In Condition 1, five of the children accepted 75% or 100% of the time, while five of the children accepted at 50% or 0% of the time. This is in contrast to Condition 2, in which only two children accepted 75% of the time, one accepted 50% of the time, and the rest accepted 0% of the time.

[6]This astute linguist-in-training shares with Schwarzschild (1994) the observation that post-VP *together* contrasts with *separately*.

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### 4.2. *Experiment 2: judgment task with* together *sentences (adults)*

Children's rejection of the *together* sentences in the Distributive context in Experiment 1 lends support to our hypothesis that where children diverge from adults is in their pragmatic knowledge, rather than in their semantic representations. To complete this picture, we turn now to adult participants in Experiment 2 to determine whether adults' rejection is driven by pragmatic factors and a bias toward a collective reading of *together* that makes them unwilling (but not unable) to accept the *together* sentences in the Distributive context. To this end, our strategy was to provide support for an interpretation of the *together* sentences in the Distributive context that highlighted coordination of events in order to make these utterances seem felicitous. As in Experiment 1, we introduced two conditions, which manipulated the level of coordination between the agents in the two subevents, with the hypothesis that a greater degree of engagement among agents would lead to a greater willingness on the part of the adults to accept the *together* sentences in the Distributive context, since this aspect highlighted a semantically available, but otherwise dispreferred, interpretation of these sentences.

#### 4.2.1. *Participants*

Twenty-four undergraduates participated (12 in each condition).

#### 4.2.2. *Stimuli and procedure*

Visual and auditory stimuli were similar to those used in the previous experiments, with the addition of two new events (stacking a set of stacking rings and drawing a circle), yielding 6 event types, each in Collective and Distributive contexts, pseudorandomized with 12 fillers. Adults were therefore shown 24 total events, 6 of which were the key Distributive contexts in which the subevents always took place in parallel, paired with a *together* sentence. The Collective contexts were paired with a bare, ambiguous sentence, as in (1). We made sure to not have *together* modify the events in the Collective context because of adults' clear preference for the collective reading of the *together* sentences; we were concerned that presenting *together* sentences in their "ideal" context would negatively impact adults' willingness to accept comparable sentences in the Distributive context.

There were two conditions, each of which involved a manipulation of the agents' actions and coordination with each other prior to the target event. In Condition 1, the two agents sat side by side. Before the events commenced, they looked at each other and nodded, as if coordinating with each other. In Condition 2, the agents entered the room (and the screen) together, talking to each other. They then showed each other their respective toys and nodded before commencing their actions, as in Condition 1. These conditions are presented in Figure 4.

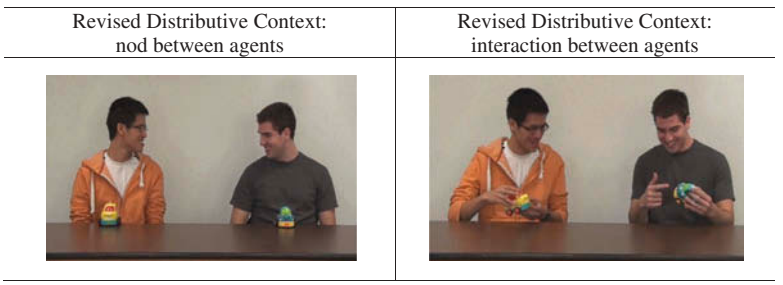


**Figure 4.** Freeze frames depicting the two conditions of the Distributive context in Experiment 2 with adult participants, prior to the start of the coordinated subevents.

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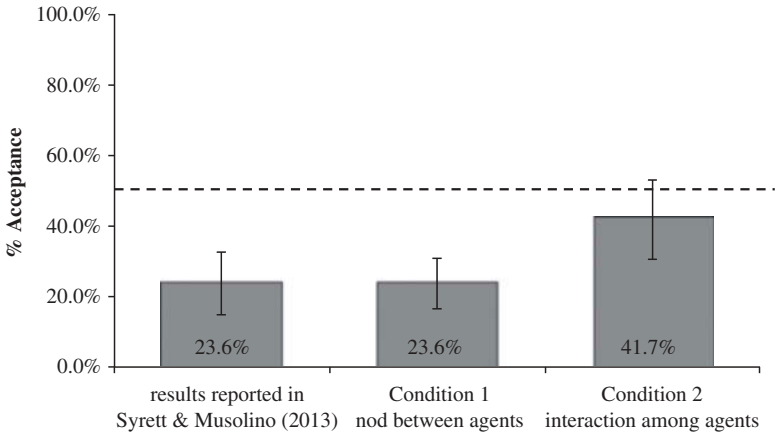


**Figure 5.** Adults' acceptance rates of statements with *together* accompanying the Distributive contexts in Syrett & Musolino (2013) (far left) and the two conditions of Experiment 2 (middle and right).

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#### 4.2.3. *Results*

The results are presented in Figure 5. A Kruskal-Wallis test revealed that there was a marginally significant difference between the acceptance patterns of the three conditions (the two conditions from this experiment and the condition from Syrett & Musolino [2013], as depicted in Figure 5), $H(2) = 4.67$, $p = .10$. Two-tailed Mann-Whitney comparisons revealed that the overall percentage of acceptance in the "nod" condition was no different from the original condition (two-tailed Mann-Whitney: $U_A = 2592$, $z = 0$, $p < 1$), with both significantly below chance (binomial probability, $p < .0001$); but the percentage of acceptance in the "interaction" condition was at chance (binomial probability, $p = .19$) and differed from both the original condition and Condition 1 (both, two-tailed: $U_A = 3060$, $z = -1.87$, $p = .06$). Thus, the manipulation of the conditions revealed that adults were willing to accept the sentences in the Distributive context, as long as the context supported a reading in which the agents of the events coordinated their actions (as in 3b–e).

#### 4.2.4. *Discussion*

Overall, adults remained reluctant to accept the *together* sentences in the Distributive context; however, our manipulation of agent interaction in the two experimental conditions revealed that adults became more willing to accept the test sentences as the coordination between the agents increased. If we return to our target sentences, as in (2), we can entertain two possible accounts of the low percentage of acceptance exhibited by adults across the previous and current experiments. The first is that the Distributive reading is simply unavailable to adult participants. However, it is hard to reconcile this position with the pattern of results exhibited by children across experiments, with the increase in acceptance exhibited by adults in Experiment 2, and with our own intuitions and natural language occurrences that indicate that such an interpretation is indeed available.

This brings us to a second possible conclusion: Adults have a robust bias against the Distributive reading of the *together* sentences, but their semantics does not disallow it. If this is so, then the picture that emerges is the following. Adults can in principle entertain multiple interpretations of sentences with *together*. However, among these alternative interpretations generated by compositional semantics paired with real-world knowledge there is some sort of weighting or assignment of probabilities that ranks the "collective" interpretation higher than all of the others. This ranking translates to a bias toward the collective interpretation and against other interpretations, such that adults are inclined not to allow other interpretations unless there is good enough reason or ample enough evidence to do so (as indicated in the discourse context at hand). That is, semantics

generates the interpretations, and pragmatics weighs in to adjudicate among them. What the combination of Experiment 1 and Experiment 2 suggests, then, is that children are capable of accessing a reading that is pragmatically dispreferred for adults—a reading that is nevertheless licensed semantically.

Now, in a *yes/no* judgment task, such as Experiments 1 and 2, a reading that is highly dispreferred may not be accepted at all, giving one the appearance that it is simply not available. However, a scalar rating task that presents participants with more options than just *yes* and *no* provides us with the opportunity to glean a more fine-grained understanding of these interpretive possibilities, teasing apart the categories of "semantically unavailable" and "pragmatically dispreferred." We therefore designed a rating task in order to probe how adults treat the target Distributive contexts relative to other theoretically possible contexts (including the Collective one) in which the target sentences may or may not be acceptable.

### 4.3. *Experiment 3: rating task with bare and* together *sentences (adults)*

#### 4.3.1. *Participants*

Eighty undergraduates participated. They were randomly assigned to one of four conditions, 20 per condition. The four conditions differed with respect to the type of context (Collective or Distributive) and the type of sentence (with and without *together*, as in [1] vs. [2]).

#### 4.3.2. *Stimuli and procedure*

The visual stimuli included 25 test events, among which were 5 event types comparable to those seen in the previous experiments: pushing a car, reading a book, building a tower, completing a puzzle, and lifting a block. Each of these event types was filmed in five different versions for each of the Collective and Distributive contexts, highlighting different levels of participant interaction and subevent coordination: (a) the original unmodified contexts (see the two Collective and Distributive contexts in Figure 1, (b) a "same place, different time" context (see the lower right scene of Figure 2 for the Distributive version),[7] (c) an event preceded by a nod between agents (see the left scene of Figure 4 for the Distributive version), (d) interaction between agents (see the right scene of Figure 4 for the Distributive version), and (e) a "group leader" context in which a third participant performed a "3–2–1" visual countdown with her fingers and pointed to the agents to begin the event (not pictured). The five versions of each event type were distributed into five blocks.

These 25 test items were pseudorandomized along with 22 control items (10 true and 12 false in total). The control items were events that had appeared in previous experiments (Syrett & Musolino [2013], and Experiments 1 and 2). These included, for example, a boy giving a girl a present, a girl kicking a ball to a boy, a boy putting a bow on a present, a girl drawing a circle on a chalkboard, and so forth. Stimuli were presented using Superlab software (Cedrus Corporation, www.cedrus.com).

For each item, participants first viewed the event, then saw the corresponding target sentence on the following screen and heard it read aloud. As in Experiment 1's Condition 1, all target sentences were prerecorded by a female native speaker of English and edited for intensity and length in Praat (Boersma & Weenink, 2010). Following this, participants proceeded to the next screen, where they were asked to rate how good of a match the sentence was for the event they had viewed, using a 5-point scale: 1 (*not at all*), 2 (*poor*), 3 (*moderate*), 4 (*good*), 5 (*great*). Participants' ratings, along with the time they took to register a rating (the reaction time, RT), were recorded automatically. The true and false control items were designed to anchor the ratings on the end of the scale.

Based on the findings from adult participants in Syrett & Musolino (2013) and the results of Experiment 2, we predicted that participants would judge the bare sentences without *together* as suitable descriptions (i.e., rate them as 3 or above) for all of the contexts in the Collective and Distributive conditions, since the truth conditions for these sentences licensed by the semantics

[7]Abbreviated as "Sm Pl, Df Tm" in the legends of Figures 6 and 7.

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allows them to be true in all of these contexts, even if all of the contexts are not on par with acceptability. Furthermore, given the results of the preference task reported in Syrett & Musolino, which showed that adults overwhelmingly preferred the Collective context as a match for sentences with *together*, we predicted participants would rate the target sentence with *together* higher when it is paired with a context in the Collective condition than when it is paired with one in the Distributive condition. Likewise, we predicted that the *together* sentences should be rated as high, if not higher, than the bare sentences in the Collective condition, given the bias toward a collectivizing interpretation of *together*.

The notable exception to "acceptable" 3+ ratings, we predicted, would be the ratings for the *together* version of the sentences in the "same place, different time" version of each context type. We predicted that the rating for this pairing would be lower than 3, and lower than the ratings for the other pairings, reflecting the fact that severing the temporal overlap in this version of the contexts meant that the *together* sentence was no longer an accurate or acceptable description of the context. With pairings that were acceptable, however, we predicted that we might see a difference in RT among the judgments for these sentences, in that semantically possible, but pragmatically dispreferred, interpretations might result in a longer RT than fully acceptable and felicitous ones.

The key question is whether the presence of *together* will have an effect on the ratings in the Distributive condition. If adults do not allow the *together* sentences to describe the Distributive context—that is, if the depressed acceptance rates in Experiment 2 reflect a lack of availability of that reading—then these sentences should receive an average rating significantly lower than 3. However, if adults are simply biased against the distributive interpretation of these sentences but can generate it, the average rating for *together* sentences paired with contexts in the Distributive condition should be at least a 3, while still lower than the ratings for contexts in the Collective condition.

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### 4.3.3. *Results*

The results are presented in the following figures. Figures 6 and 7 present scatterplots of the average ratings (*x*-axis) and reaction times to generate these ratings (*y*-axis) for the sentence-context pairings in each of the four conditions (Collective vs. Distributive context; sentence with and without *together*). Figures 8 and 9 present the average normalized ratings for the sentence-context pairings in each of the four conditions. We present the normalized ratings to further highlight the differences among ratings for the different context-sentence pairings within each event type. A table with further details is presented in the appendix.

Two one-way MANOVAs with a Bonferroni correction were run on the results, with the condition (Collective, Collective-*together*, Distributive, Distributive-*together*) as the independent variable and the seven contexts (including the five test contexts and the two control contexts) as the dependent variable. We first analyzed the ratings. There was no effect for the control contexts—false: $F(3) = .47$, $p = .70$, true:

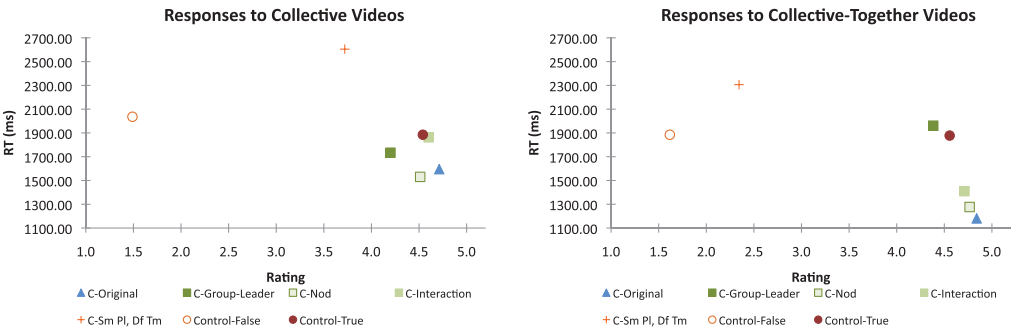


**Figure 6.** Average ratings and RTs for Collective contexts accompanied by ambiguous sentence (left) and sentence with *together* (right) in Experiment 3.

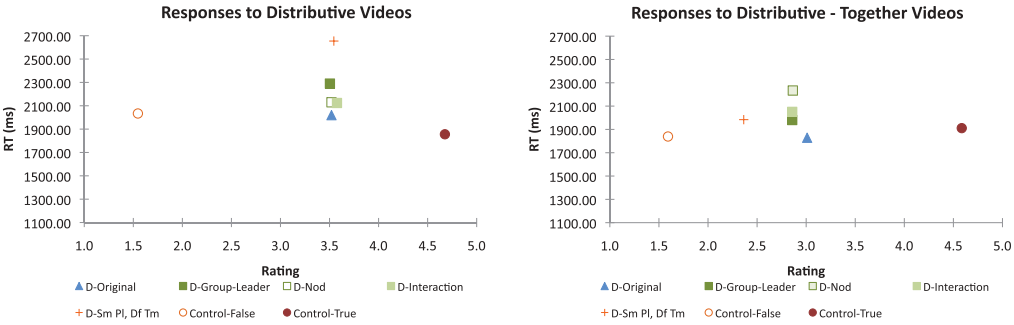


**Figure 7.** Average ratings and RTs for Distributive contexts accompanied by ambiguous sentence (left) and sentence with *together* (right) in Experiment 3.

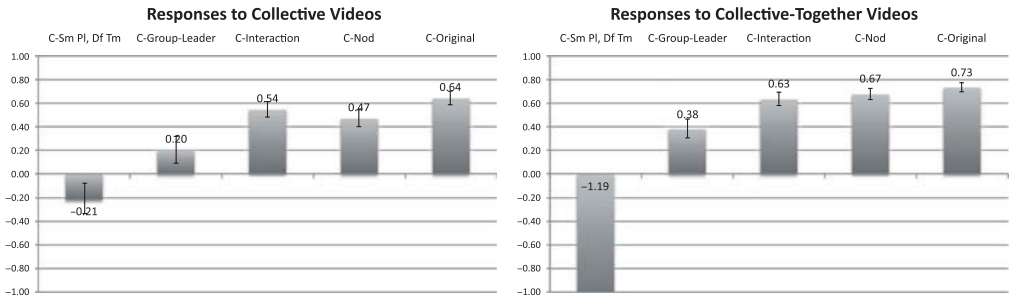


**Figure 8.** Average z scores for target Collective contexts accompanied by ambiguous sentence (left) and sentence with *together* (right) in Experiment 3.

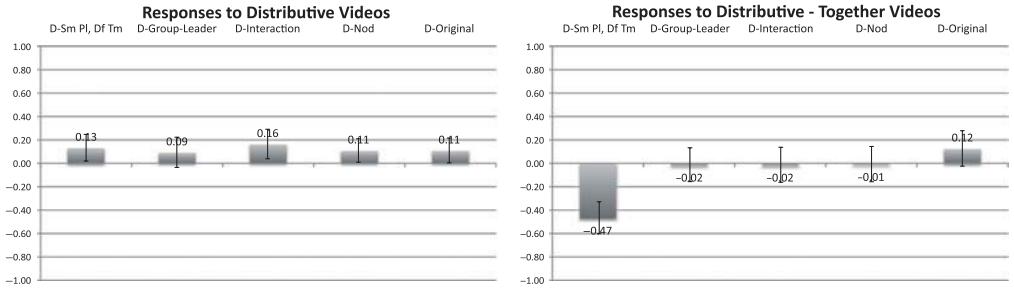


**Figure 9.** Average z scores for rating target Distributive contexts accompanied by ambiguous sentence (left) and sentence with *together* (right) in Experiment 3.

$F(3) = .66$, $p = .58$. However, each of the test conditions was highly significant at $p < .0001$—"original": $F(3) = 70.2$, partial eta squared = .69; "nod": $F(3) = 64.59$, partial eta squared = .67; "interaction": $F(3) = 57.03$, partial eta squared = .64; "group leader": $F(3) = 27.54$, partial eta squared = .46; "same place, different time": $F(3) = 30.13$, partial eta squared = .49.

Pairwise comparisons supported the distinction among the test contexts for the four conditions. In the "original" context, ratings in the Collective condition and ratings in the Collective-*together* condition were significantly higher than those in the Distributive and the Distributive-*together* conditions ($p < .0001$), but ratings for the Collective and Collective-*together* conditions did not differ significantly from each other ($p = 1.0$). Ratings for the Distributive condition were higher than those for the Distributive-*together* condition ($p < .01$). The same pattern held for the "nod,"

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"interaction," "group leader" contexts (Collective and Collective-*together* vs. Distributive and Distributive-*together:* $p < .0001$, and Distributive vs. Distributive-*together,* $p < .05$, $p < .001$, $p < .01$ respectively).

For the key "same place, different time" condition, there was no difference between the Collective and Distributive conditions ($p = 1.0$), which were both rated above 3, or between the Collective-*together* and Distributive-*together* conditions ($p = 1.0$), which were both rated below 3. However, ratings for the Collective condition were significantly higher than those in the Collective-*together* and Distributive–*together* conditions ($p < .0001$), as were the ratings in the Distributive condition ($p < .0001$). Thus, the presence of *together* in the sentences caused participants' ratings to plunge for both the Collective and Distributive conditions when there was no temporal overlap.

A pattern along similar lines holds for an analysis conducted on the normed ratings. Zeroing in on the "original" and the "same place, different time" contexts, we find that for the "original" context, the Collective and Collective-*together* conditions did not differ significantly from each other ($p = 1.0$), nor did the Distributive and Distributive-*together* conditions ($p = 1.0$). However, ratings for the Collective condition were higher than those for the Distributive and the Distributive-*together* conditions (both $p < .01$), and ratings for the Collective-*together* condition were higher than those for the Distributive and Distributive-*together* conditions (both $p < .001$).

By contrast, in the "same place, different time" context, there was no difference between the Collective and Distributive conditions ($p = .28$), or between Collective and Distributive-*together* ($p = .79$). However, there were significant differences between Collective and Collective-together ($p < .0001$), between Distributive and Distributive-*together* ($p < .01$), and between Distributive and Collective-*together* ($p < .0001$). Thus, this additional analysis reinforces the finding that the presence of *together* where it is not licensed causes a significant decrease in acceptability ratings relative to the unambiguously acceptable counterparts.

Complementing our analysis of the sentence ratings, we analyzed participants' RTs to render their judgments. There was no effect for the control contexts—false: $F(3) = .22$, $p = .88$, true: $F(3) = .02$, $p = 1.0$; for "same place, different time" $F(3) = 1.36$, $p = .26$; or for "group leader" $F(3) = 1.20$, $p = .31$. There was a marginal effect of "interaction"—$F(3) = 2.48$ $p = .07$. Both the "nod" and "original" contexts showed an effect—$F(3) = 6.29$, $p = .001$, partial eta squared = .16; and $F(3) = 3.87$, $p = .01$, partial eta squared = .11 respectively. For these last three contexts ("interaction," "nod," and "original"), pairwise comparisons revealed marginal or significant differences among conditions, which supported a distinction between the Collective and Distributive contexts. For the "original" context, RTs for the Collective-*together* condition were significantly lower than for the Distributive condition ($p = .01$) and marginally significantly lower than for the Distributive-*together* condition ($p = .09$). For the "interaction" context, RTs for the Collective-*together* condition were marginally lower than for the Distributive condition: $p = .09$. In the "nod" context, RTs for the Collective condition were significantly lower than for the Distributive-*together* condition ($p = .05$), and RTs for the Collective-*together* condition were significantly lower than for the Distributive ($p < .01$) and Distributive-*together* conditions ($p < .01$). In addition, for the "same time, different place" context in the two Collective conditions, participants took more time to rate the sentences without *together* above 3 than it did for them to assign the sentences with *together* a rating *below* 3, $t(41) = 1.75$, $p < .05$. Thus, the bias for the collective reading manifested itself not only in the ratings but also in the RTs, and the results supported a difference between those sentences that are semantically licensed, but pragmatically infelicitous, and those that are ruled out in the semantics.

#### 4.3.4. *Discussion*

The results of Experiment 3 support a baseline bias in adults toward the Collective contexts, which generally exhibited higher overall ratings and lower RTs. However, we note that the Distributive contexts were still rated above 3 (a "moderate" rating), demonstrating that although adults are inclined to see the Collective contexts as a better match, the Distributive contexts are still acceptable—a finding that complements the results reported by Syrett & Musolino (2013) and those of Experiment 2. The

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current experiment elaborates upon and enriches the previous findings, however, by providing a more fine-grained picture arising from a comparison of adults' interpretations of these sentences and how the semantics and pragmatics interact to allow or suppress acceptability judgments.

Given the combined results of Experiments 2 and 3, we are now able to say with confidence that adults can access both the collective and distributive readings of sentences such as (1) and (2) and further that their willingness to access one or the other reading depends on how much contextual support there is for the reading in question. Thus far, we have presented participants with the selected target sentence and asked them to judge its compatibility with a chosen context, in light of the truth conditions of the sentence. To arrive at a better understanding both of the linguistic cues adults take to signal a particular reading and what enables children to become adultlike in their interpretation of these sentences (not just in accessing readings but also in suppressing them), we need to also consider how adult participants themselves describe these contexts. Experiment 4 was designed to accomplish this goal.

### 4.4. *Experiment 4: cloze task (adults)*

In Experiment 4, we sought to determine how adults independently describe the events in the Collective and Distributive contexts in order to see what kind of surface-level cues they recruit to disambiguate the target sentences and therefore which cues might be available to the learner to arrive at the speaker's intended interpretation. We reasoned that this information would in turn be informative about the baseline of interpretation for the sentences themselves and the meaning of our target modifier *together*.

#### 4.4.1. *Participants*

Twenty undergraduates (all native speakers of English) participated. Participants were run up to three at a time in a laboratory setting at computers separated by consoles.

#### 4.4.2. *Stimuli and procedure*

Visual stimuli were taken from the set of those appearing in the previous experiments (see previous "Stimuli and Procedure" sections). However, for the purposes of this experiment, all sound was removed from the videos. There were eight test event types within the experimental session (stacking a set of rings, pushing a toy car, completing a puzzle, reading a book, stacking a tower, drawing a circle, lifting a block), each with a basic Collective and Distributive context, for a total of 16 test items. Versions of the same event were separated into two blocks. These test items were then interspersed with six control events, which were similar in structure to the test events but which all involved one agent (e.g., a girl petting a duck, a boy kicking a ball, etc.). Participants were randomly assigned to one of two experimental orders, created by reversing the order of events. The test session was preceded by a three-item training session with a video similar to the control events. The entire experimental session lasted between 10 and 15 minutes.

Participants were told that they would be shown a series of short videos involving some people doing child-friendly activities. At the end of each video, there was a 15-second freeze frame capturing the completion of the activity. They were told that during this time, they should describe the previous video using the words that were provided on their response sheet. For each video, they were given a list of lexical items corresponding to the participants in the event and the verb, with optional plural marking on the nouns (e.g., for a video of two girls each reading a book, they were given the terms *girl(s), book(s), read*). Participants were told that they had been given the nouns and the verb for each sentence and that they should generate a description of the video, limiting their description to one sentence, while using all of the words provided and putting the verb in the past tense. They were also told that in order to make a descriptive, grammatical sentence, they should also include additional words.

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### 4.4.3. *Results*

**4.4.3.1. *Coding.*** Sentences were entered into a Microsoft Excel spreadsheet and categorized based on the information that participants included in each of the test sentences. Given eight event types, each with a Collective and Distributive context, each participant provided responses for 16 test events within a session. There were therefore 320 sentences describing the test events, pooled across participants, divided evenly into 160 responses for both collective and distributive contexts.[8] We first categorized participants' descriptions of the contexts, based on their choice of lexical items and use of the plural marking in the object position, as well as their use of additional modifiers (e.g., *together, each, simultaneously*, etc.). We then performed a comparison of these items *across* both Collective and the Distributive contexts and also calculated the number of times such items appeared *within* each context, given the total number of possible occurrences across participants.

**4.4.3.2. *Results.*** The results are presented in Table 1. In the table, percentage to the right of the raw number of hits indicates the percentage of time the item appeared in that context, as opposed to the other one (i.e., Collective rather than Distributive context and vice versa). The percentages in the top row for each category therefore sum to 100%. Percentage on the second row for each category indicates percentage of appearance within the context.

Relevant to our research questions, participants were more likely to use the structure of the unmodified test sentence in (1) (e.g., *Two boys lifted a block*) to describe events in the Collective context. One quarter of the time, they also used *together* as a modifier for sentences paired with this context. *Together* was never used to describe events in the Distributive context, while modifiers such as *each, both*, and others such as *simultaneously* were. The vast majority of the occurrences of plural objects were (unsurprisingly, perhaps) used to describe the Distributive context, but only a little over half of the descriptions of the Distributive contexts featured a plural object. Thus, adults appealed to morphosyntactic marking (i.e., plural marking), number, and modifiers to unambiguously refer to the events in the Collective and Distributive contexts, but their relative use of these cues depended on which context they wished to describe.

**Table 1.** Comparison of items across Collective and Distributive contexts.

| Item | Collective context | Distributive context |
|---|---|---|
| Object | | |
| Singular object | 158 (67.5%) | 76 (32.5%) |
| | 98.8% of C | 47.5% of D |
| Plural object | 2 (2.4%) | 83 (97.6%) |
| | 1.3% of C | 51.9% of D |
| *two* | 0 (0%) | 15 (100%) |
| | 0% of C | 9.4% of D |
| Modifiers | | |
| *together* (all post-VP) | 40 (100%) | 0 (0%) |
| | 25.0% of C | 0% of D |
| *each* | 1 (2.1%) | 46 (97.9%) |
| | 0.6% of C | 28.8% of D |
| *both* | 1 (20%) | 4 (80%) |
| | 0.6% of C | 2.5% of D |
| *their (own), (a) different, the same* | 1 (3.8%) | 25 (96.2%) |
| | 0.6% of C | 15.6% of D |
| *simultaneously, at the same time* | 0 (0%) | 4 (100%) |
| (all co-occurring with *each*) | 0% of C | 2.5% of D |

[8]One participant described the "book reading" event in the distributive context as *The girls pretended to read*. This item was not counted because the participant did not use the verb *read* as the main verb in the sentence. Thus, the total number for this context is 159, rather than 160.

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#### 4.4.4. *Discussion*

When adults were asked to describe events depicted in Collective and Distributive contexts, they employed two main strategies for favoring the reading supported by the context: plural marking (or lack of it) on the direct object and NP- and VP-level modifiers. These results serve to demonstrate that adults provide surface-level cues to the disambiguation of these sentences—cues that the language learner must become sensitive to when assigning interpretations to these sentences. Note here, though, that these results implicate two components in the learning process beyond mere recognition that surface-level cues can favor one reading or another.

First, they show that children must not only know what the presence of a particular cue indicates but must also know what its *absence* indicates. For example, the target sentences with *each* favor a distributive interpretation, sentences with *together* favor a collective interpretation, and sentences without any explicit modifier with a singular object favor a collective reading by default. While *together* is, in principle, compatible with multiple interpretations, as shown in (3), for adults, its presence heavily favors a collective reading and not a distributive one. Accordingly, this adverbial modifier was used exclusively to describe the Collective context. It makes sense, then, that it takes sufficient contextual support for adults to overcome this association between *together* and the collective reading in order to access others. Second, in addition to learning the cues and knowing what their presence or absence indicates, children must also learn something about the reliability and weighting among the cues. For example, (for adults) the presence of *together* or a singular object is a fairly reliable signal that the collective reading is favored, and the presence of *each, both*, or plural marking is a fairly reliable signal that the distributive reading is favored. However, among these cues, since morphosyntactic marking on the nouns is obligatory, this is a more reliable cue than an optional adjunct, such as an adverbial modifier. But recall that the learner must still integrate this linguistic knowledge with extralinguistic knowledge about the world and the discourse context at hand.

## 5. General discussion

We began this study by asking whether children's apparent overacceptance of ambiguous sentences such as *Two boys pushed a car* could be accounted for by appealing to a distinction between semantics and pragmatics. Specifically, we asked whether their acceptance of such sentences in which adults reject them is licensed by the semantics, while their failure to reject where adults do can be accounted for by a lack of the pragmatic information that adults possess. The answers to these questions speak to the nature of linguistic information that children have to acquire when learning to interpret event descriptions and describe events themselves, and to answer them, we needed to turn both to children and adults to probe their interpretations further.

In Syrett & Musolino (2013), children accepted sentences with *together* in both the Collective and Distributive contexts but displayed a preference for the Collective context when presented with a forced choice between the scenes. This was the first piece of evidence suggesting that acceptance patterns in a judgment task masked children's full linguistic competence. Perhaps more compelling, however, were the results of Experiment 1, which demonstrated that when the temporal overlap encoded in the semantics of the spatiotemporal reading of *together* is severed in the Distributive context, children ceased to accept these sentences—even more so when the temporal variable was highlighted by Collective trials described erroneously with an appeal to sequential events and when children dynamically engaged with their conversational partner, the puppet.

A series of tasks with adults shed further light on the pattern observed in children. Adults—who robustly rejected sentences with *together* in the Distributive context in Syrett & Musolino (2013)—were slightly more inclined to accept them in Experiment 2 when the event participants appeared to coordinate the timing of the subevents, and even more so, when these agents had an increased level of interaction with each other. Given this set of results, we sought to probe adults' interpretations further. In the timed scalar rating task reported in Experiment 3, when adults were asked to rate sentences with and without *together* in different versions of Collective and Distributive contexts, they

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assigned sentences with *together* an acceptable rating in Distributive contexts but rated them significantly lower when the Distributive context had no temporal overlap. Finally, in Experiment 4, adults demonstrated in their own descriptions of the events that they appealed to multiple cues, such as morphosyntactic marking on the nouns and optional descriptors such as the adverbial modifier *together*, to disambiguate contexts.

What we are led to conclude, then, is that children's understanding of the target sentences is guided by the semantics—semantics they appear to share with adults. Where they diverge from adults is in not yet having acquired the requisite knowledge of what cues the different readings. What exactly does this entail? The previous theoretical semantic research indicates that this involves knowing the range of interpretations that are licensed by the target sentences (based on the compositionality of the subparts). For example, sentences with *together* reflect at least the range of readings listed in (3). However, as theoreticians have noted, the available readings for any given sentence are pared down by pragmatic knowledge: knowing which readings are likely and/or plausible in a given context. For example, one surely does not expect to encounter a Distributive context for a sentence describing a piano lifting event! The experimental results from adult participants indicate that the knowledge of what cues various readings also involves acquiring the morphosyntactic, lexical, and syntactic cues that speakers employ to favor one reading over the other, along with some sort of weighting or probability derived from their usage, which indicates how informative they are. Thus, while children's semantics allows sentences with *together* to be compatible with multiple readings, they differ from adults in possessing or deploying nonsemantic (i.e., pragmatic) knowledge to compare alternatives, filter, and constrain these readings.

This research thus provides us with a unique example of a pragmatic/semantic difference between children and adults that complements similar observations related to children's and adults' calculations of scalar implicatures. Interestingly, both involve Grice's (1989) Maxim of Quantity, stated in (13).

(13) Maxim of Quantity
a. Make your contribution as informative as is required for the current purposes of the exchange.
b. Do not make your contribution more informative than is required.

With scalar implicatures, when a speaker asserts a weaker term on a scale (e.g., *some* or *a*) s/he implicates that a higher, or stronger, value does not hold—or, epistemically modified, that s/he does not know whether or not it holds. Thus, knowing that a speaker who delivers an assertion with *some* is implicating "not *all*" or that *might* implicates "not *must*" derives from pragmatic knowledge. Children by and large tend to disregard this implicature (Barner, Brooks, & Bale 2011; Huang & Snedeker 2009; Noveck 2001; Papafragou & Musolino 2003) and allow the weaker term to be compatible with the stronger term that entails it, as semantics allows—unless they are given additional contextual support for calculating the implicature (Guasti et al. 2005; Papafragou & Musolino 2003) or presented with nonentailment based scales (Papafragou & Tantalou 2004; Stiller, Goodman & Frank 2015).

Children appear to be unaware—without additional contextual support—that a speaker who delivers the utterance *Two boys pushed a car together* is using the modifier *together* to either disambiguate an otherwise ambiguous sentence (because the predicate permits multiple readings) or else signal with certainty to the listener that a sentence that already favors a collective reading should indeed be interpreted in that manner. This may be because children are unaware of the range of interpretations the unmodified sentence could have because they have yet to learn about certain predicates or recruit their real-world knowledge of specific event types to bear on sentential interpretation. Or they may be unaware of the interpretational preference speakers have for a given unmodified sentence, the range of lexical alternatives that contrast with *together* (e.g., *each, both, separately*, etc.), the possibilities for morphosyntactic marking on the lexical elements

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appearing in the sentence (e.g., plural morphology on the verb's direct object), the extent to which modifiers like *together* interact with certain linguistic aspects of the sentence in which they appear, and so on. Children are thus demonstrating an initial insensitivity to a variety of linguistic and extralinguistic factors beyond the core semantic representation, at least as they bear on sentence disambiguation. What is also relevant here, then, is the application of Grice's Maxim of Manner, which warns us against being ambiguous and being over prolix.

The path to becoming adultlike, then, involves using key aspects of the speaker's utterance to arrive at the intended meaning but also knowing that if a speaker is being cooperative, then s/he is adhering to these maxims. We must assume that the speaker is saying as much as is needed at the moment that it is required in the discourse and is attempting to be as brief and clear as possible. Of course, this is not always the case, but it is an assumption we learn to make in the course of language development when we are interpreting utterances made about events in the world.

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## Appendix

**Table A1.** Mean Ratings of Sentence-Context Pairings, and Mean Reaction Times for Rendering the Rating, for Seven Contexts across Four Between-Subject Conditions (*N* of Participants in Each Condition: 20); Scale: 1 (*not at all*), 2 (*poor*), 3 (*moderate*), 4 (*good*), 5 (*great*)

| | Collective | | Collective-together | | Distributive | | Distributive-together | |
|---|---|---|---|---|---|---|---|---|
| Condition/context | Avg. rating | Avg. RT | Avg. rating | Avg. RT | Avg. rating | Avg. RT | Avg. rating | Avg. RT |
| Original | 4.71 | 1595.19 | 4.84 | 1180.88 | 3.52 | 2019.48 | 3.01 | 1828.40 |
| Nod | 4.51 | 1530.44 | 4.77 | 1276.93 | 3.52 | 2129.74 | 2.86 | 2233.78 |
| Interaction | 4.60 | 1862.90 | 4.71 | 1409.87 | 3.58 | 2123.86 | 2.86 | 2050.70 |
| Group leader | 4.20 | 1733.50 | 4.38 | 1961.14 | 3.50 | 2289.95 | 2.86 | 1980.29 |
| Same place, different time | 3.72 | 2604.90 | 2.34 | 2306.41 | 3.54 | 2654.27 | 2.36 | 1983.78 |
| Control (true) | 4.54 | 1884.99 | 4.56 | 1877.78 | 4.68 | 1855.82 | 4.59 | 1910.91 |
| Control (false) | 1.49 | 2036.15 | 1.62 | 1884.69 | 1.55 | 2033.89 | 1.59 | 1839.18 |

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