Published in final edited form as:

Q J Exp Psychol (Hove). 2012 September ; 65(9): 1760–1776. doi:10.1080/17470218.2012.667425.

Interpreting Conjoined Noun Phrases and Conjoined Clauses: Collective vs. Distributive Preferences

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Abstract

Two experiments are reported that show that introducing event participants in a conjoined noun phrase (NP) favors a single event (collective) interpretation while introducing them in separate clauses favors a separate events (distributive) interpretation. In Experiment 1, acceptability judgments were speeded when the bias of a predicate toward separate events vs. a single event matched the presumed bias of how the subjects' referents were introduced (as conjoined noun phrases or in conjoined clauses). In Experiment 2, reading of a phrase containing an anaphor following conjoined noun phrases was facilitated when the anaphor was *they*, relative to when it was *neither/each of them*; the opposite pattern was found when the anaphor followed conjoined clauses. We argue that comprehension was facilitated when the form of an anaphor was appropriate for how its antecedents were introduced. These results address the very general problem of how we individuate entities and events when presented with a complex situation, and show that different linguistic forms can guide how we construe a situation.. The results also indicate that there is no *general* penalty for introducing the entities or events separately – in distinct clauses as 'split' antecedents.

Keywords

collective interpretation; distributive interpretation; conjoined noun phrases; conjoined clauses; split antecedents; underspecification

One of the central problems in cognitive science is the problem of 'individuation' -- how to assemble various properties into a stable whole which can be thought about or referred to. To relate language to whatever it is about, such as entities, events or eventualities, one must carve out pieces of the world from the endless flux of properties. For animate entities with properties that cohere across time and space, the problem may not be particularly complex, at least when picking out individuals at the basic level of categorization. But for non-atomic entities and eventualities (events and states of affairs) it is quite unclear how speakers and comprehenders manage to exploit partial descriptions to pick out eventualities of the appropriate sort, with the requisite level of detail.

In the present paper we deal with this problem in terms of the representation of conjoined subjects and predicates that can be given single event ('collective') or multiple event ('distributive') interpretations. In particular, it considers sentences that introduce two (or possibly more) individuals and predicates some eventuality (state or event) (e.g., *The boy and the girl played marbles*). The ambiguity concerns whether the eventuality was true of the two individuals acting jointly, in a single event, a 'collective' relation, or true of the two

individuals separately, in distinct events, a ‘distributive’ relation. At times speakers may be particularly interested in emphasizing whether an event is collective or distributive and thus may include an appropriate adverb in the sentence specifying this feature explicitly, and could say, e.g., *The boy and the girl played marbles together* or *The boy and the girl played marbles separately*. But often speakers are not particularly concerned with this feature of an event even though they may have information about the detailed properties of the event that transpired. In such cases no explicit adverb may be included in a description of the event, even though the speaker may have a particular set of circumstances in mind. Even without explicit information about whether a described event is collective or distributive, apparently listeners choose whether to compute a collective or distributive interpretation rather than remaining neutral (see discussion of Frazier, Pacht & Rayner, 1999, below).

The present paper investigates how interpretation of collective-distributive ambiguities takes place. The collective interpretation can be seen as applying a predicate to what has been called a “sum” of individuals (Link, 1983; see Moxey, Sanford, Wood, & Ginter, 2011, for psycholinguistic application of the concept). The distributive interpretation involves applying the predicate separately to each individual (Heim, Lasnik & May, 1991). There is already some evidence on the processing of collective-distributive interpretations and how such decisions are made on-line. Moxey et al. (2011) showed that readers were more likely to use a plural pronoun (like *they*) to continue sentence fragments that introduced two individuals in a conjoined noun phrase (NP) than fragments that introduced the individuals in separate phrases (e.g., to continue the example above, *The boy played marbles with the girl*). Related evidence comes from the observation that readers experience less comprehension difficulty when the members of an ‘NP and NP’ phrase are referred to as a sum (e.g., with the plural pronoun *they*) than when just one member of the group is referred to (perhaps by name, or by a singular pronoun) (Albrecht & Clifton, 1998; Garrod & Sanford, 1982; Gordon, Hendrick, Ledoux, & Yang, 1999). Moxey, Sanford, Sturt, and Morrow (2004) provided a similar demonstration, and also provided some evidence that sentences with a plural pronoun were read more slowly when the antecedents had been introduced in separate phrases than when they had appeared as conjoined NPs. Kaup, Kelter, and Habel (2002) presented data that suggest that the German equivalent of *they* favors a collective interpretation. They measured reading time for sentences containing an anaphoric expression referring to NP antecedents that were introduced as being spatially far removed from each other vs. being introduced in the same situation. When the antecedents were spatially far from each other, an anaphor that was the German equivalent of *they* (*sie*) was read slowly relative to *both* (*beide*), which Kaup et al. had independently shown to favor predicates that involve multiple events (and thus a distributive interpretation). The difference tended to reverse when the antecedents were introduced in the same situation.¹

It is possible in principle that the reader could initially adopt a neutral or an underspecified interpretation that does not indicate whether an eventuality is collective or distributive. Frazier, Pacht, and Rayner (1999) investigated whether an underspecified representation of an event could simply be further specified if and when biasing information is encountered, or whether even in the absence of disambiguating information the reader nevertheless makes a commitment to one reading. If a neutral interpretation could be assigned, then late disambiguation should not be particularly difficult: the reader would further specify the already available representation in the appropriate way. On the other hand, if the reader must make a commitment to one interpretation even in the absence of evidence (as in the case of lexical ambiguities), then late disambiguation to the unpreferred interpretation should be costly since it will involve recomputation of the meaning.

¹The Kaup et al. finding suggests that factors other than the form of an expression can influence the preference for a collective vs. a distributive interpretation. In the Conclusions, we briefly review some other evidence that supports the same point.

Frazier et al. (1999) measured eye movements while reading sentences like those in (1). The sentence-final particle *together* in (1a) forces it to have a collective interpretation, while *each* in (1b) results in a distributive interpretation.

- (1) a. John and Mary weigh 200 lbs. together.
- b. John and Mary weigh 200 lbs. each.

They found that late disambiguation to the distributive interpretation (as in 1b) was costly in terms of first pass reading times, total times, and regressions. The authors concluded from these data that a conjoined NP plus predicate like *John and Mary weigh 200 lbs.* is initially given a collective interpretation about which a single eventuality is predicated. This interpretation must be revised when the following particle *each* is read. There was also a hint in length-corrected reading times that the distributive sentences may have been more complex even in the unambiguous examples. The present research goes beyond the Frazier et al. findings in several ways, including asking whether the ambiguity is resolved upon reading the conjoined NP *John and Mary* itself or only upon reading the predicate, and asking whether sentences in which the two individuals are introduced in different clauses or sentences (S) has the opposite bias, favoring a distributive interpretation.

A possible limitation to the hypothesis that conjoined NPs preferably receive a collective interpretation comes from Patson and Ferreira (2009). These researchers showed that if a conjoined NP is the subject of a potentially reciprocal verb (e.g., *The man and the woman kissed*), the conjoined NP is taken as a complex reference object whose separate members play both agent and theme roles in a reciprocal action. In contrast, a plural NP (*The lovers*) seems to be treated as a whole, resulting in disruption of reading of sentences like *After the lovers kissed the baby cried in the crib*. This disruption presumably reflects the initial misanalysis of *baby* as direct object of *kissed*, a misanalysis that is avoided when the subject had been the conjoined NP. To be sure, the relation between a reciprocal and a distributive interpretation is hardly clear, so this finding does not directly impugn the suggestion that a conjoined NP expression favors a collective over a distributive interpretation, but it does suggest caution in accepting it.

Here we will be concerned not only with the question of whether there is a general preference for a collective interpretation of conjoined subjects contrasted with a preference for a distributive interpretation of individuals introduced in different clauses, but also with the complexity of various types of interpretations. In principle, complexity could be determined by the number of events described, by the language/linguistic form used to describe the event or events, or by the relation between the events and the language used to describe them. In Experiment 1, we tested whether a collective or distributive interpretation is preferred for individuals introduced in a conjoined NP subject vs. individuals introduced in separate clauses or sentences. The experiment diagnoses the preference by using predicates that have an intrinsic bias toward acts performed separately by distinct individuals (given the nature of the subject referent) and thus favor a distributive interpretation, and predicates that could equally well be used to describe individual or joint acts and thus may not favor collective or distributive interpretations (see (2) and (3), below, for examples). Predicates with biases toward individual acts should be read slower if a collective interpretation of the individuals had been made than if a distributive interpretation had been made. Predicates without a clear bias serve as a control for any differences in reading speed between sentences where individuals are introduced in conjoined NPs vs. in separate clauses. This procedure contrasts with studies like Frazier et al. (1999) where predicates were marked explicitly with an unambiguous particle or adverb. Arguably the implicit biases contained in predicates lacking explicit disambiguators is more representative of the general individuation problem speakers/authors and listeners/readers encounter since

it is when some feature of an event is not specifically at issue that the speaker/author and listener/reader must cope with the partial descriptions of events that give rise to the problem. In particular, while a speaker or author who intends to emphasize the collective or distributive nature of an event can provide the listener or reader with an unambiguous full description, doing so repeatedly throughout an experiment (as Frazier et al., 1999, did) might influence the listeners' or readers' commitments. Experiment 2 contrasts the interpretation of sentences that introduce individuals in a conjoined NP vs. in separate clauses by measuring the time to read phrases containing an anaphor that is appropriate only for a distributive interpretation vs. one that permits, and possibly favors, a collective interpretation.

Experiment 1

The first experiment was an acceptability judgment study which examined the preference for a collective vs. distributive interpretation of the subject by manipulating whether the predicate is most naturally interpreted as denoting a single event with multiple participants or multiple events. The distributivity bias of the predicate reflects properties of the verb itself, or the verb plus its complement; the materials used in Experiment 1 manipulated bias in both ways. Consider the sentences in (2). The verb *resigned* is constrained pragmatically. An individual may only resign from his or her own position. Typically this is an individual act. If a conjoined NP subject is initially interpreted collectively, as the sum of the atomic entities, *the accountant* and *the bookkeeper* in (2a), then the verb *resigned* will conflict with the preferred interpretation of the subject. A comparable problem will not arise in (2b), with conjoined clauses, or (2c), with two distinct sentences. We hypothesize that such cases will favor a distributive interpretation, which is consistent with the distributive bias of the verb.

- (2) Individual act predicates: Biased toward distributive
 - a. The accountant and the bookkeeper resigned. (Conjoined subject NP)
 - b. The accountant resigned and the bookkeeper did too. (Conjoined sentences)
 - c. The accountant resigned. The bookkeeper did too. (Separate sentences)
- (3) Ambiguously individual/joint act predicates
 - a. Jenny and David called. (Conjoined subject NP)
 - b. Jenny called and David did too. (Conjoined sentences)
 - c. Jenny called. David did too. (Separate sentences)

Now consider (3), with the verb *call*, which can denote either a single (collective) event or multiple (distributive) events. Jenny and David may make a joint call or they may each make a separate call. Readers should easily interpret (3a) as describing a single event. By contrast, the (b) and (c) forms may be biased toward a distributive interpretation, but to the extent that the predicate *call* is truly ambiguous, readers should experience no conflict with this distributive bias.

To summarize, we propose that readers will be biased in favor of a collective interpretation of the entities introduced in a conjoined-NP subject, relative to entities introduced in separate clauses. Sentences with a distributive predicate, like (2a), clash with this bias, hindering acceptability and acceptability judgment time, relative to sentences like (3a) with an ambiguously-collective predicate. In contrast, sentences like (2b, c; 3b, c), which introduce the entities in separate clauses, by hypothesis favor a distributive interpretation. This is explicitly congruent with the distributive predicate of (2b, c), potentially resulting in facilitated acceptability judgments for distributive predicates compared to sentences with

ambiguously-collective predicates (3b, c). However, because the experiment did not test predicates with a strong collective bias, the main value of the separate-clause sentences is as a control for possible differences in acceptability between sentences with different predicates, permitting a comparison of the (2a) and (3a) conjoined-NP forms.²

Method

Materials—Twelve sets of sentences like (2) and 12 sets of sentences like (3) were constructed for an acceptability judgment study. Appendix A contains all experimental materials. Each sentence had three forms: (a) a conjoined NP subject form, (b) a conjoined clause form with VP ellipsis in clause two, and (c) a separate sentences form with VP ellipsis in sentence two. The predicates of the first set of sentences were chosen to be constrained in that the prototypical situation they describe would, in the judgment of the experimenters, involve separate events. By contrast, the predicates in the second set were unconstrained and might easily describe an event performed by a group of individuals. As indicated earlier, in some cases the verb itself carried the distributivity bias; in others, the bias was carried by the verb plus its complement, and could be dependent upon the nature of the subjects. The experimenters' judgments were checked in a normative study in which 48 subjects indicated their interpretation of the experimental sentences (described in Appendix B.) The mean length of all sentences and discourses was 40 characters for the multiple-event items and only 33 characters for the single-event items. This difference was dealt with in two ways: first, by searching for an interaction between type of verb phrase and sentence form, and second, by statistically adjusting for the length of the item.

The 24 experimental sentences were included in a list of 34 other grammatical sentences or short two-sentence discourses comparing definite and indefinite NPs in several different constructions and 36 sentences and discourses that were unacceptable in a variety of ways (subject-verb number agreement, missing or extra arguments, gender or number agreement errors involving pronouns, anomalous arguments, etc.). Each set of twelve experimental items was counterbalanced across three experimental lists, so that each sentence appeared equally often in each version and each subject saw four sentences from each set in each version.

Procedure and subjects—Forty-eight University of Massachusetts undergraduates participated in a half-hour session for course credit. Each received a six-item practice list and then was tested on the 72-item experimental list, with items presented in an individually-randomized order. On each trial, the word *ready* appeared until the subject pulled a response trigger, and then the whole sentence appeared with no delay. The subject was to pull the right-hand trigger if the sentence was acceptable and the left-hand trigger if the sentence was unacceptable. Subjects were instructed to classify any good, ordinary, acceptable English sentence as “acceptable” even if it sounded colloquial or informal, and they were instructed that their reaction time would be measured.

Results

Table 1 presents the mean acceptance percentages. Logistic regression (logit) analyses (Jaeger, 2008) were performed on these data, with random subject and item intercepts. The conjoined NP/ambiguously distributive predicate condition (3a) used as a baseline received more judgments of “acceptable” than the conjoined-S/ambiguously-distributive predicate condition (3b) and the separate-sentence/ambiguously-distributive predicate condition (3c)

²The conjoined-sentence vs. two-sentence manipulation was included in an attempt to investigate within-sentence vs. cross-sentence ellipsis and to explore different ways of expressing propositions about multiple events. Since no important differences were observed, the contrast will not be emphasized further.

($z = 2.64$ and 5.63 , $p < .01$ and $p < .001$, respectively). The baseline condition did not differ from the conjoined NP/distributive-bias predicate condition (2a), and the interactions between type of predicate and type of sentence did not approach significance ($p > .20$). Thus, the relation between type of sentence and type of predicate did not affect the acceptability judgment that was eventually made. We interpret the percentage acceptance effects as showing only that the syntactically simplest, conjoined-NP, sentences were most acceptable across the board, and that either distributive or collective interpretations were ultimately acceptable.

Table 2 presents mean reaction times (pooled over responses of “acceptable” and “unacceptable”³) for the six conditions of the experiment, after truncating the 5% of all responses that were 2 SD above or below the subject’s mean RT. The data were analyzed using the *lm* and *lmer* packages in R Development Core Team (2007). RTs were first modeled as a function of the length of the sentence and its ordinal position in the sequence of trials a subject saw. The best-fitting model indicated that RTs increased by 50 ms for each added character, and decreased by 6.6 ms for each trial in the experiment, with an intercept of 2114 ms. Residual RTs were extracted from this model (after taking out the effects of length and position) and appear in the lower panel of Table 1, and were the subject of further statistical analyses.

These residual RTs were analyzed in linear mixed models with two interacting fixed effect factors (type of sentence and type of predicate). Models with random slopes for subjects and items were compared with models that had only random intercepts (Baayen, 2008; Baayen, Davidson, & Bates, 2008) and the simplest model was chosen that was not significantly worse than a more complex model (the chosen model had interacting random slopes for subjects and random intercepts for items). Treatment contrasts (the default in R) were used, so that each condition was compared to the baseline condition of conjoined NP, ambiguously collective/distributive predicates, like (3a). Because of the difficulty of specifying df for fixed effects in models with random slopes (Baayen, 2008), we treat a t value of 2.0 or greater as statistically significant.

Residual acceptability judgment times were faster to conjoined NP sentences with an ambiguously collective/distributive predicate (3a) than to such sentences with a biased distributive predicate (2a) -377 vs $+282$ ms, $b = 649$, $t = 3.52$. Conjoined NP sentences with ambiguously collective/distributive predicates were also faster than both conjoined sentences (3b) and separate sentences (3c) with such predicates ($+13$ and -6 ms; $b = 419$ and 352 ; $t = 3.02$ and 2.48 , respectively). Finally, the interaction of type of predicate with each type of sentence contrast was significant (type of predicate X conjoined-NP/conjoined-S $b = -592$, $t = 2.33$; type of predicate X conjoined-NP/separate-S $b = -605$, $t = 2.89$). These interactions reflected the fact that while sentences in which the two referential NPs were introduced in separate clauses were slowed compared to sentences with conjoined NPs when the predicate was ambiguously distributive, they were speeded when the predicate had a distributive bias. It is possible that the separate-clause items were actually favored by the distributive-bias predicate (see Discussion).

Discussion

While the eventual acceptability of sentences was not affected by type of predicate or its relation to sentence form, the time to decide about the sentences was affected. Sentences like

³Residual RTs for “acceptable” responses only were also analyzed, and they showed the same pattern of results – very fast times for conjoined-NP sentences with ambiguously-distributive predicates – and comparable levels of significance, except for the contrasts involving the two sentence condition, where significance levels were marginal, presumably because of the data lost because of the relatively high rejection rate in the two sentence condition.

(3a), where the predicate readily permits a collective interpretation of the conjoined subject NP, produced the fastest acceptability decisions of all sentence forms. After adjustment for length and ordinal position in the experiment, these sentences were judged significantly faster than their conjoined-sentence and two-sentence counterparts (perhaps reflecting the greater complexity of these latter items). By contrast, sentences like (2a), with a conflict between a collective subject and the distributive bias in the predicate, were judged significantly more slowly than (3a). While readers realized that a conjoined NP was acceptable with a distributive interpretation, the conflict between the presumed collective bias of the NP and the distributive bias of the predicate slowed the decision.

The significant interactions indicated that the conjoined-S and separate-S counterparts of the conjoined-NP items with distributive-bias predicates were read more quickly than predicted by the additive combination of the effects of type of conjunct and predicate bias. This interaction could mean that the conjoined/separate sentence conditions encouraged a distributive interpretation and favored reading of a distributive predicate. However, it could simply indicate that having a distributive-biased predicate specifically inhibited reading of sentences with a conjoined NP without inhibiting reading of conjoined-S sentences (an interpretation encouraged by the relatively similar adjusted times for conjoined-S sentences with both types of predicate). Experiment 2 used a different methodology and design to further explore the possibility that conjoined sentences are biased toward a distributive interpretation as well as the observation that conjoined NPs are biased toward a collective interpretation.

Experiment 2

Experiment 1 showed that acceptability judgments of sentences with conjoined NP subjects were facilitated when their predicate permitted a collective interpretation, compared to when the predicate required a distributive interpretation. It provided some evidence that acceptability judgments were relatively speeded when conjoined or separate sentences were used with distributive-biased predicates. In Experiment 2, eye movements were measured while subjects read sentences with conjoined NP objects or conjoined sentences (conjoined clauses) followed by a clause whose subject contained an anaphoric reference to the two entities mentioned in the conjuncts. The type of subject (*they*, *neither/each of them*) was varied. The phrases *neither of them* and *each of them* clearly carry a strong distributive bias (similar to Kaup et al.'s, 2002, observations concerning German *beide*), and should slow reading following sentences with conjoined NPs compared to conjoined clauses, if the former are biased toward a collective interpretation and the latter, a distributive interpretation. The simple pronoun *they* permits either a collective or a distributive interpretation of a plural NP, but previous work suggests that it may have a collective bias. Moxey et al.'s (2004) evidence that continuations with such a pronoun were read more slowly when its antecedents were introduced in separate phrases than when they were introduced as conjoined NPs can be taken to support such a claim, as can the Moxey et al. (2011) finding that readers were more likely to continue a fragment with a plural pronoun when the fragment introduced two individuals in a conjoined NP than in separate phrases. If *they* does have such a bias, and if sentences in which two individuals are introduced in separate clauses leads readers to form a distributive interpretation, then reading of continuations with *they* should be slowed compared to when the individuals were introduced as conjoined NPs.

Method

Materials—24 sentences like (4) were constructed (the ^ symbols and numbers indicate analysis regions, described below). The antecedent clause(s) contained either two conjoined clauses with like-gender objects as in (4a, b) or it consisted of a single clause with a

conjoined object (4c, d). The antecedent clause or clauses were conjoined to a following *but*-clause which contained a subject that was either the plural pronoun *they* plus a negative predicate (4a, c) or *neither of them* and the corresponding positive predicate. A follow-on clause appeared after the critical clause to insure that a critical analysis region did not coincide with the end of the sentence where long ‘wrap-up’ times are found.

- (4)
- a. Paul wrote to Stacey and he called Lisa,^{^1} but they^{^2} didn’t respond,^{^3} though nobody^{^4} knows why.^{^5}
 - b. Paul wrote to Stacey and he called Lisa,^{^1} but neither of them^{^2} responded,^{^3} though nobody^{^4} knows why.^{^5}
 - c. Paul wrote to Stacey and Lisa,^{^1} but they^{^2} didn’t respond,^{^3} though nobody^{^4} knows why.^{^5}
 - d. Paul wrote to Stacey and Lisa,^{^1} but neither of them^{^2} responded,^{^3} though nobody^{^4} knows why.^{^5}

The expectation was that *neither of them* or *each of them* would conflict with a conjoined NP antecedent (4d) since at the point of originally processing the conjoined NP antecedent there is no clear need to set up a distributive representation. By contrast, in the corresponding conjoined clause example (4b), each of the individual objects will have its own syntactic, semantic and discourse representation and thus the pre-existing representation of the antecedent clauses will support a distributive interpretation. If *they* favors a collective interpretation, it may be read more fluently following a conjoined NP antecedent (4c) than following a split antecedent (4a).

The 24 experimental sentences were assigned to four counterbalanced lists, each containing 6 sentences in each of the four forms illustrated in (4). These sentences were combined with 8 practice sentences and a total of 128 sentences from other unrelated experiments together with filler sentences and 2-sentence discourses (including sentences with comparative constructions, discourses that manipulated focus by asking different kinds of questions, and sentences with combinations of an adverb followed by a simple vs. a derived adjective).

Participants and procedures—Forty-seven University of Massachusetts undergraduates were tested in individual 45-minute sessions. Of these, eight were unable to track or had more than 25% track losses, resulting in 39 useable subjects.⁴ The practice items were presented, followed by the 152 tested sentences in individually-randomized order. Subjects’ eye movements were recorded while reading the sentence. Subjects were seated 55 cm from a CRT monitor that displayed the sentences. Their eye movements were recorded using an EyeLink 1000 (SR Research, Toronto, Ontario, Canada) eyetracker controlled by a PC running the University of Massachusetts EyeTrack software (<http://www.psych.umass.edu/eyelab>). Eye position was sampled at 1 kHz. Although participants viewed the stimuli with both eyes, only data from the right eye were collected.

After the eyetracker was calibrated, the experiment began. A trial was initiated when the participant fixated on a box located where the first letter of the question would appear. All items were presented in one or two lines, in a fixed-width font (Monaco). Each character subtended a visual angle of 0.36 degrees. When they had finished reading an item, subjects were instructed to look to a colored square affixed to the right edge of the monitor and to pull a trigger on a game controller. A two-choice comprehension question then appeared on the screen after 1/4 of the sentences (e.g., *Did Paul get an answer back? Yes...No*), which

⁴Four subjects were eliminated from condition 4, while only one or two were eliminated from the other conditions. Since the linear mixed model analysis we use is robust under conditions of missing data (Baayen, 2008), we do not consider this to be a problem.

subjects answered by pulling the left or right trigger on a game controller to indicate whether the left or the right answer was correct. Questions were answered correctly 79% of the time, which we consider to indicate reasonably good comprehension given that the questions required some inferential work (e.g. following Stan disliked Fred and Randy, but they didn't seem to notice, even when it was obvious., the question was Was Stan always subtle?). Calibration was checked on each trial by checking the alignment with a single centered target. Errors led to recalibration.

Results

The eye movement data were cleaned of track losses, blinks, and long fixations over 800 ms using the program EyeDoctor (<http://www.psych.umass.edu/eyelab>). Following Rayner, Sereno, Morris, Schmauder, & Clifton (1989), we assume that short fixations, i.e., those under 80 ms, do not contribute useful information to the reader. Thus, short fixations were incorporated into the nearest neighboring fixation within three characters; otherwise, they were deleted. Fixations greater than 800 ms were also eliminated, on the assumption that these did not represent normal acquisition of information from the text (Rayner et al., 1989). Finally, trials with blinks or track losses on the critical word were eliminated, 9.4% of all trials.

The experimental sentences were divided into several regions for analysis purposes as illustrated by the ^ marks in (4). The regions of principal interest are Region 2, the region containing the anaphor, and Region 3, the region containing the predicate. A disruption observed for the Conjoined NP/Neither condition in Region 2 would indicate difficulty with a very fast attempt to find a distributive antecedent for *Neither of them* or *each of them*; difficulty in Region 3 could indicate a similar effect, but could also reflect difficulty integrating the predicated relation with the non-distributive antecedent. Since the results from the analyses of the separate regions were suggestive but not conclusive, a further analysis was done in which the two regions were combined into one.

The most informative eye-tracking measures (see Rayner et al., 1989) appear in Table 3. First pass time is the summed fixation time from first entering a region until leaving it, either to the right or the left. Go-past time (also termed 'regression path duration') is the summed fixation time from first entering a region until leaving to the right. It includes time spent re-reading earlier regions, and re-reading the target region from the left, and is a global measure of initial processing difficulty plus the time spent resolving the initial difficulty. Regressions out is the proportion of times a first-pass fixation in a region was followed by a regression to an earlier region, and also indicates early processing difficulty that the reader deals with not by lingering in a region but by regressing to an earlier region. A variety of other measures were examined, but none resulted in significant effects of interest.

The primary effect of interest is the interaction between type of antecedent (conjoined S vs conjoined NP) and type of anaphor (*they* vs. *neither/each of them*). We predict particular ease of reading in the *neither of them* or *each of them* condition following a conjoined S, on the assumption that the conjoined S provides the distributive antecedent that the anaphor needs. There may also be difficulty in the conjoined NP/*neither/each of them* condition if the conjoined NP provides an inappropriate collective antecedent. The data were analyzed as linear mixed models (Baayen, Davidson, & Bates, 2008; a logistic model was used for regressions out, Jaeger, 2008). Type of antecedent and type of anaphor and their interaction were the fixed effects and subjects and items as random effects. Model comparison (Baayen, 2008) was used to evaluate models with random intercepts and random slopes of the fixed effect factors, as in Experiment 1. A *t* value approximating 2.0 was taken to be significant when pMCMC was not available. Treatment contrasts (the default in R) were used to evaluate the simple effects of the type of antecedent and type of anaphor factor; baseline

conditions were NP conjunction and *they* anaphor. As was done in Experiment 1, residuals after regressing the effect of region length (and when its effect was significant, ordinal position in the experiment) were also analyzed.

Apart from the significant effect of type of anaphor in the analysis of the unadjusted reading times for Region 2⁵, and a marginally significant ($t = 1.80$) effect of type of antecedent phrase in the unadjusted times for Region 3 (both of which became nonsignificant in analyses of residual time), no effects or interactions approached significance for first pass time, raw or residual. In contrast, go-past time in Region 2, the anaphor, resulted in a marginally significant interaction between type of anaphor and type of antecedent ($t = 1.78$, $p < .10$) in the analysis of unadjusted time; a similarly marginal ($t = 1.68$) interaction was observed in Region 3. Adjusting for differences in region length did not improve levels of significance (analyzing the residual times) (interaction $t = 1.80$ for Region 2, 1.72 for Region 3).

However, combining Regions 2 (the anaphor) and 3 (the following predicate, or in some cases, its initial portion) into one larger region did result in a fully significant interaction: $t = 2.67$, $p\text{MCMC} = .008$, in the analysis of unadjusted times; $t = 2.60$ in the analysis of residual times. In both cases, relatively long times were observed for the conjoined NP/*neither/each* condition, and (especially clearly in the analysis of residual times), relatively fast times in the conjoined S/*neither/each* condition).

Finally, examination of Table 2 suggests that regressions out of Region 2 (and of the larger combined region) may have been particularly frequent for the Conjoined NP/*neither* condition. However, logistic regression analyses did not statistically confirm the apparent interaction ($z < 1.0$ for Region 2, $z = 1.49$, $p > .13$, for the combined region).

Discussion

Reading difficulty, reflected in go-past times, appeared in the conjoined NP antecedent condition when the following anaphoric subject was distributive (*neither of them*). Reading of a phrase containing such a distributive anaphor was relatively fluent when the antecedents were introduced in separate clauses, as a split antecedent. The difference in reading fluency may have started to emerge on the subject anaphor itself, even before the predicate of the critical clause is encountered, though this effect was not fully significant.

The observed reading difficulty appeared only in go-past times, not in first pass times. An effect specific to go-past time reflects some combination of differences in probability of regressing out of the region being analyzed and differences in time spent re-reading earlier material (and material in the region itself) given that a regression was made. Because of the nonsignificance of the effects of probability of regression out, it is tempting to attribute the effects on go-past time to ‘mopping-up’ processes rather than to an immediate effect of a clash between the form of an anaphor and how antecedents were introduced. It may be that readers have to spend time ‘unpacking’ a conjoined NP to find separate antecedents among which to distribute a distributive anaphor like *neither of them* (while, in contrast, a conjoined S provides appropriately separate antecedents).

Finally, reading times for sentences containing the plural pronoun anaphor *they* were not clearly affected by how its antecedents were introduced. This could mean that the plural pronoun does not have a clear bias toward a collective interpretation. Superficially, this seems to be inconsistent with the Moxey et al. (2004) results. However, in that experiment,

⁵Henceforth, effects of type of anaphor in raw times will not be reported, since they could simply reflect the difference in region lengths.

the two individuals were given different roles (e.g., the second one was introduced in a *for* phrase, and assigned a 'benefactive' role), while in our conjoined clause sentences, the two individuals played the same role. The Moxey et al. manipulation may have had interpretive effects that went beyond the collective/distributive contrast of the manipulation in our studies (Moxey et al., 2011, provide evidence supporting this suggestion).

Conclusions

A language often contains different linguistic forms that can express the same meanings, but differ in which meanings they favor. Introducing multiple participants in an event or events in conjoined noun phrases vs. in separate clauses is a case in point. Both forms can describe either a situation in which the multiple participants participate in a single event, or in which each participant participates in a separate event (collective vs. distributive interpretations). The experiments presented here show, in two different ways, that introducing the participants in conjoined noun phrases favors a collective interpretation, while introducing them in separate (possibly conjoined) clauses favors a distributive interpretation. Acceptability judgment and reading times were faster when the favored role of a predicate (Experiment 1) or an anaphor (Experiment 2) matched the preferred interpretation of its subject or its antecedent. These findings are compatible with preceding research (e.g., Frazier et al., 1999; Kaup et al., 2002) but extend it to cover cases where the processing of the predicate or anaphor itself is affected, rather than showing the effect of later material that corrects a presumed initial misinterpretation, and cases where the participants are introduced in conjoined clauses, not just conjoined noun phrases.

The present findings address some interesting possibilities beyond those discussed already. As suggested in our earlier discussion, it is possible that processing sentences with split antecedents would always be more difficult than processing sentences without split antecedents (i.e., sentences in which the participants are introduced in a single conjoined NP). It could be easier to relate a predicate or an anaphor to entities introduced in a single phrase than to entities introduced in separate phrases or clauses, or it could be more difficult to introduce multiple entities into a discourse model than to introduce a single sum of entities. The current results provide little support for this view, and suggest instead that it may be only the match between antecedent-type (split vs. conjoined) and anaphor that matters.

While the current results do indicate that the entities introduced in a conjoined NP preferably receive a collective interpretation, they do not unambiguously determine the correct explanation of this preference. Collective interpretations may be preferred only because they avoid the need to postulate multiple events (which is claimed to be cognitively costly by Harris, Clifton, & Frazier, submitted; Majewski, in preparation, a claim termed the 'no extra times' or NET hypothesis). Alternatively, the simplicity of the Logical Form (LF) representation of a conjoined NP, which lacks a distribution (D) operator (Heim, Lasnik, & May, 1991), might give rise to the initial collective preference. Both hypotheses are plausible and are not mutually exclusive. Turning to the separate clauses conditions, presumably one posits one event upon reading the first of two clauses and a second event upon reading the second, giving rise to an initial distributive preference.

Further, factors other than the syntactic form of their introduction may affect whether individuals are represented in a way that individuates them or treats them as a collective. The Kaup et al. (2002) research, discussed earlier, indicates that whether two individuals are introduced as being close or distant spatially affects this choice. Koh and Clifton (2002) showed that the ontological similarity of entities is important. The pronoun *they* was increasingly likely to be taken to refer to all of a set of separately-introduced individuals as

the individuals increased in ontological similarity. Moxey et al. (2011) provided evidence that individuals are more likely to be referred to with a plural pronoun if they play the same role in a scenario than if they play different roles. Similarly, Koh, Sanford, Clifton, and Dawydiak (2008) showed that if two individuals introduced in a conjoined NP are viewed as potentially ‘acting on behalf of one another,’ so that there is little reason to discriminate between one person doing the action and both doing it, readers find it easy to refer to one individual with a pronoun or a proper name. Clearly, factors other than the syntactic structure used to introduce entities into a discourse affect how they are individuated. Still, the present results extend our knowledge of how syntactic factors can guide comprehension. They reinforce the conclusion (Frazier et al., 1999) that readers confronted with a conjoined NP that could initially be taken to be either collective or distributive do not delay an interpretation, and do not assign an underspecified interpretation, but instead assign a determinate collective interpretation. The results also provide evidence that a determinate (distributive) interpretation is assigned to participants in multiple clauses. Readers do this quite early in processing, early enough to disrupt reading of or judgments about a following predicate or anaphor, if the predicate or anaphor clashes with the initially-assigned interpretation.

Acknowledgments

This project was supported in part by Grant Number HD18708 from NICHD to the University of Massachusetts. The contents of this paper are solely the responsibility of the authors and do not necessarily represent the official views of NICHD or NIH. We would like to thank Ashley Benatar, Maria Bonilla, Margaret Grant, David Taylor, and Zachary Waegell for assistance in collecting and analyzing the data.

References

- Albrecht J, Clifton C Jr. Accessing singular antecedents in conjoined phrases. *Memory & Cognition*. 1998; 26(3):599–610.
- Baayen, RH. *Analyzing linguistic data*. Cambridge: Cambridge University Press; 2008.
- Baayen RH, Davidson DJ, Bates DM. Mixed-effects modeling with crossed random effects for subjects and items. *Journal of Memory and Language*. 2008; 59:390–413.
- Frazier L, Pacht JM, Rayner K. Taking on semantic commitments, II: Collective versus distributive readings. *Cognition*. 1999; 70:87–104. [PubMed: 10193057]
- Garrod S, Sanford A. The mental representation of discourse in a focused memory system: Implications for the interpretation of anaphoric noun phrases. *Journal of Semantics*. 1982; 1:21–41.
- Gordon PC, Hendrick R, Lecoux K, Yang CL. Processing of reference and the structure of language: An analysis of complex noun phrases. *Language and Cognitive Processes*. 1999; 14:353–379.
- Harris JA, Clifton C Jr, Frazier L. Processing and domain selection: Quantificational variability effects. submitted.
- Heim I, Lasnik H, May R. Reciprocity and plurality. *Linguistic Inquiry*. 1991; 22:63–102.
- Jaeger TF. Categorical data analysis: Away from ANOVAs (transformation or not) and towards logit mixed models. *Journal of Memory and Language*. 2008; 59:434–446. [PubMed: 19884961]
- Kaup B, Kelter S, Habel C. Representing referents of plural expressions and resolving plural anaphors. *Language and Cognitive Processes*. 2002; 17:405–450.
- Koh S, Clifton C Jr. Resolution of the antecedent of a plural pronoun: Ontological categories and predicate symmetry. *Journal of Memory and Language*. 2002; 46:830–844.
- Koh, S.; Sanford, A.; Clifton, C., Jr; Dawydiak, EJ. Good-enough representation in plural and singular pronominal reference: Modulating the Conjunction Cost. In: Gundel, J.; Hedberg, N., editors. *Reference: Interdisciplinary perspectives*. Oxford: Oxford University Press; 2008. p. 123–142.
- Link, G. The logical analysis of plurals and mass terms: A lattice-theoretical approach. In: Bauerle, R., et al., editors. *Meaning, use and interpretation of language*. Berlin: de GruyterMajewski, H; 1983. p. 302–323. In preparation Doctoral dissertation. University of Massachusetts Amherst; Reciprocals and Processing.

- Moxey L, Sanford AJ, Wood AI, Ginter LMN. When do we use “they” to refer to two individuals? Scenario mapping as a basis for equivalence. *Language and Cognitive Processes*. 2011; 26:79–120.
- Moxey LM, Sanford AJ, Sturt P, Morrow LI. Constraints on the formation of plural reference objects: The influence of role, conjunction, and type of description. *Journal of Memory and Language*. 2004; 51:346–364.
- Patson ND, Ferreira F. Conceptual plural information is used to guide early parsing decisions: Evidence from garden-path sentences with reciprocal verbs. *Journal of Memory and Language*. 2009; 60:464–486. [PubMed: 20161247]
- R Development Core Team. A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing; 2007.
- Rayner K, Sereno S, Morris R, Schmauder R, Clifton C Jr. Eye movements and on-line language comprehension processes. *Language and Cognitive Processes*. 1989; 4:SI21–50.

Appendix A. Experimental materials used in Experiment 1

Set 1: Multiple-event (distributive-bias) predicates

- 1 Lucy and Susan put on makeup carefully. Lucy put on makeup carefully and Susan did too. Lucy put on makeup carefully. Susan did too.
- 2 Jeremy and Jason applied to graduate school. Jeremy applied to graduate school and Jason did too. Jeremy applied to graduate school. Jason did too.
- 3 Jessica and Lydia dressed formally. Jessica dressed formally and Lydia did too. Jessica dressed formally. Lydia did too.
- 4 Max and Matt broke the old college high jump record. Max broke the old college high jump record and Matt did too. Max broke the old college high jump record. Matt did too.
- 5 The teacher and the student coughed loudly. The teacher coughed loudly and the student did too. The teacher coughed loudly. The student did too.
- 6 Marcie and Martina got an A in Psych 100. Marcie got an A in Psych 100 and Martina did too. Marcie got an A in Psych 100. Martina did too.
- 7 Julie and Henrietta like to read the Boston Globe. Julie likes to read the Boston Globe and Henrietta does too. Julie likes to read the Boston Globe. Henrietta does too.
- 8 Jules and Anita ride a bicycle to work. Jules rides a bicycle to work and Anita does too. Jules rides a bicycle to work. Anita does too.
- 9 Lisa and Lucy use the University Health Center. Lisa uses the University Health Center and Lucy does too. Lisa uses the University Health Center. Lucy does too.
- 10 The sales clerk and the manager like sports. The sales manager likes sports and the manager does too. The sales clerk likes sports. The manager does too.
- 11 Jim and Jonathan work in investment banking. Jim works in investment banking and Jonathan does too. Jim works in investment banking. Jonathan does too.
- 12 Maxine and Ian eat red meat. Maxine eats red meat and Ian does too. Maxine eats red meat. Ian does too.

Set 2: Ambiguously distributive/collective predicates

- 13 Jenny and David called. Jenny called and David did too. Jenny called. David did too.
- 14 Jordana and Scott sang. Jordana sang and Scott did too. Jordana sang. Scott did too.
- 15 Lucy and Sam rehearsed a lot. Lucy rehearsed a lot and Sam did too. Lucy rehearsed a lot. Sam did too.
- 16 John and Barbara drove to the party. John drove to the party and Barbara did too. John drove to the party. Barbara did too.
- 17 Betty and Ben played tennis. Betty played tennis and Ben did too. Betty played tennis. Ben did too.
- 18 The husband and the neighbors ran screaming into the street. The husband ran screaming into the street and the neighbors did too. The husband ran screaming into the street. The neighbors did too.
- 19 Sally and Tom took the subway to work this morning. Sally took the subway to work this morning and Tom did too. Sally took the subway to work this morning. Tom did too.
- 20 Rita and Dave went to Ft. Lauderdale. Rita went to Ft. Lauderdale and Dave did too. Rita went to Ft. Lauderdale. Dave did too.
- 21 Martin and Sam arrived at seven. Martin arrived at seven and Sam did too. Martin arrived at seven. Sam did too.
- 22 Chuck and Katy grew tomatoes this year. Chuck grew tomatoes this year and Katy did too. Chuck grew tomatoes this year. Katy did too.
- 23 Peggy and Anne danced the tango. Peggy danced the tango and Anne did too. Peggy danced the tango. Anne did too.
- 24 Andy and Max built some bookshelves. Andy built some bookshelves and Max did too. Andy built some bookshelves. Max did too.

Appendix B: Normative evaluation of Experiment 1 materials

After Experiment 1 was conducted, we collected normative data on the presumed biases of the predicates used in that experiment. To that end, we presented 48 University of Massachusetts undergraduates with the conjoined NP versions of the 12 distributive biased and the 12 relatively unbiased sentences used in that experiment together with the rating scale described below. We included 8 more sentences of each type, plus four ‘check’ sentences that should be anomalous under the collective/single event reading. Participants who provided inappropriate answers to more than one of these four items would be discarded (but none did).

Four different random orders of the resulting 44 items were prepared. Each item was presented with a five-point rating scale, as in (I)

(I) Lucy and Susan put on makeup carefully

Certain that each person did the action separately	Suspect that each person did the action separately	No idea	Suspect that the Two people did the action as a single event	Certain that the two people did the action as a single event
1	2	3	4	5

The mean rating for the 12 distributive (multiple event) items used in Experiment 1 was 1.83 ($SD = 0.26$) and the mean rating for the 12 relatively unbiased (single event) items used in Experiment 1 was 3.56 ($SD = 0.56$). The ratings for only one unbiased sentence (*Jenny and David called*) was lower than the highest distributive-biased items; it was lower than three of them. Apart from this one item, it is clear that the intuitive classification of items in Experiment 1 was generally correct.

Appendix C: Materials used in Experiment 2, with comprehension questions

- Paul wrote to Stacey and he called Lisa, but they didn't respond, though nobody knows why.

Paul wrote to Stacey and he called Lisa, but neither of them responded, though nobody knows why.

Paul wrote to Stacey and Lisa, but they didn't respond, though nobody knows why.

Paul wrote to Stacey and Lisa, but neither of them responded, though nobody knows why.

Did Paul get a message back? No Yes
- Stan disliked Fred and he hated Randy, but they didn't seem to notice, even when it was obvious.

Stan disliked Fred and he hated Randy, but neither of them seemed to notice, even when it was obvious.

Stan disliked Fred and Randy, but they didn't seem to notice, even when it was obvious.

Stan disliked Fred and Randy, but neither of them seemed to notice, even when it was obvious.

Was Stan always subtle? No Yes
- Ian asked his teacher and he contacted his employer, but they wouldn't write a letter for him, ever.

Ian asked his teacher and he contacted his employer, but neither of them would write a letter for him, ever.

Ian contacted his favorite teacher and his employer, but they wouldn't write a letter for him, ever.

Ian contacted his favorite teacher and his employer, but neither of them would write a letter for him, ever.

Was Ian disappointed? No Yes
- Today Lena met Floris and yesterday she visited Hans, but they didn't remember her, or even find her face familiar.

Today Lena met Floris and yesterday she visited Hans, but neither of them remember her, or even find her face familiar.

Today Lena met Floris and Hans, but they didn't remember her, or even find her face familiar.

Today Lena met Floris and Hans, but neither of them remembered her, or even find her face familiar.

Did Lena get forgotten? No Yes

5. Last night Trisha tripped Sam and tonight she bumped into Max, but they didn't mind, since it wasn't on purpose.

Last night Trisha tripped Sam and tonight she bumped into Max, but neither of them minded, since it wasn't on purpose.

Last night Trisha tripped Sam and Max, but they didn't mind, since it wasn't on purpose.

Last night Trisha tripped Sam and Max, but neither of them minded, since it wasn't on purpose.

6. Tim was dating Andrea and he asked Fiona out, but then they got mad, and refused to talk to him.

Tim was dating Andrea and he asked Fiona out, but then each of them got mad, and refused to talk to him.

Tim was dating Andrea and Fiona, but then they got mad, and refused to talk to him.

Tim was dating Andrea and Fiona, but then each of them got mad, and refused to talk to him.

7. The producer sweet-talked the actress and he complimented the director, but they weren't impressed, at all.

The producer sweet-talked the actress and he complimented the director, but neither of them were impressed, at all.

The producer sweet-talked the actress and the director, but they weren't impressed, at all.

The producer sweet-talked the actress and the director, but neither of them were impressed, at all.

8. The chauffeur liked the bride and he tolerated the groom, but they didn't like him, maybe because they are snobs.

The chauffeur liked the bride and he tolerated the groom, but neither of them liked him, maybe because they are snobs.

The chauffeur liked the bride and the groom, but they didn't like him, maybe because they are snobs.

The chauffeur liked the bride and the groom, but neither of them liked him, maybe because they are snobs.

9. The babysitter neglected the older child and spanked the toddler, but they didn't complain, not to anyone.

The babysitter neglected the older child and spanked the toddler, but neither of them complained, not to anyone.

The babysitter neglected the older child and the toddler, but they didn't complain, not to anyone.

The babysitter neglected the older child and the toddler, but neither of them complained, not to anyone.

- 10.** The journalist questioned the politician and she contacted the campaign manager, but they weren't forthcoming, in the least.

The journalist questioned the politician and she contacted the campaign manager, but neither of them was forthcoming, in the least.

The journalist questioned the politician and the campaign manager, but they weren't forthcoming, in the least.

The journalist questioned the politician and the campaign manager, but neither of them was forthcoming, in the least.

- 11.** The old crank threw dirt at a kid and he screamed at the neighbor, but they didn't seem to mind, knowing he was nuts.

The old crank threw dirt at a kid and he screamed at the neighbor, but neither of them seemed to mind, knowing he was nuts.

The old crank threw dirt at the kid and at the neighbor, but they didn't seem to mind, knowing he was nuts.

The old crank threw dirt at the kid and at the neighbor, but neither of them seemed to mind, knowing he was nuts.

- 12.** The investigator tracked down a tourist and he found an eye witness, but they didn't know much, or notice anything strange.

The investigator tracked down a tourist and he found an eye witness, but neither of them knew much, or noticed anything strange.

The investigator tracked down a tourist and an eye witness, but they didn't know much, or notice anything strange.

The investigator tracked down a tourist and an eye witness, but neither of them knew much, or noticed anything strange.

- 13.** Trisha admired Briana and she also admired Julie, but they made fun of her, and were mean.

Trisha admired Briana and she also admired Julie, but each of them made fun of her, and were mean.

Trisha admired Briana and Julie, but they made fun of her, and were mean.

Trisha admired Briana and Julie, but each of them made fun of her, and were mean.

- 14.** Claire chastised Paul and she also chastised Richard, but they liked her anyway, and found her spunky.

Claire chastised Paul and she also chastised Richard, but each of them liked her anyway, and found her spunky.

Claire chastised Paul and Richard, but they liked her anyway, and found her spunky.

Claire chastised Paul and Richard, but each of them liked her anyway, and found her spunky.

15. Patty praised Josh and also praised Sam, but they ignored her, and paid attention to her sister.

Patty praised Josh and she also praised Sam, but each of them ignored her, and paid attention to her sister.

Patty praised Josh and Sam, but they ignored her, and paid attention to her sister.

Patty praised Josh and Sam, but each of them ignored her, and paid attention to her sister.

16. Stan was helping Anne and he was helping Tracy, but they didn't reciprocate, or even say thanks.

Stan was helping Anne and he was helping Tracy, but neither of them reciprocated, or even said thanks..

Stan was helping Anne and Tracy, but they didn't reciprocate, or even say thanks.

Stan was helping Anne and Tracy, but neither of them reciprocated, or even said thanks.

17. Once Janice cooked for Steven and twice she cooked for Martin, but they didn't notice, or help her.

Once Janice cooked for Steven and twice she cooked for Martin, but neither of them noticed, or helped her.

Once Janice cooked for Steven and Martin, but they didn't notice, or help her.

Once Janice cooked for Steven and Martin, but neither of them noticed, or helped her.

18. Liz invited Tom to the party and this evening she invited David home, but they didn't accept, or even acknowledge her.

Liz invited Tom to the party and this evening she invited David home, but neither of them accepted, or even acknowledged her.

Liz invited Tom and David to the party, but they didn't stay at the party, at least not for long.

Liz invited Tom and David to the party, but neither of them stayed at the party, at least not for long.

19. The driver cursed the pedestrian and he cursed the officer, but they didn't react, because he was obviously drunk.

The driver cursed the pedestrian and he cursed the officer, but neither of them reacted, because he was obviously drunk.

The driver cursed the pedestrian and the officer, but they didn't react, because he was obviously drunk.

The driver cursed the pedestrian and the officer, but neither of them reacted, because he was obviously drunk.

20. The librarian shushed Bill and she shushed Tom, but they brushed her off, and did as they pleased.

The librarian shushed Bill and she shushed Tom, but each of them brushed her off, and did as they pleased.

The librarian shushed Bill and Tom, but they brushed her off, and did as they pleased.

The librarian shushed Bill and Tom, but each of them brushed her off, and did as they pleased.

21. The auditor reported the accountant and she reported the banker, but they were unashamed, and won't face any charges.

The auditor reported the accountant and she reported the banker, but each of them was unashamed, and won't face any charges.

The auditor reported the accountant and the banker, but they were unashamed, and won't face any charges.

The auditor reported the accountant and the banker, but each of them was unashamed, and won't face any charges.

Did the accountant report the auditor? No Yes

22. The housewife flattered her daughter and then she flattered her husband, but they weren't aware of it, to our knowledge.

The housewife flattered her daughter and then she flattered her husband, but neither of them was aware of it, to our knowledge.

The housewife flattered her daughter and her husband, but they weren't aware of it, to our knowledge.

The housewife flattered her daughter and her husband, but neither of them was aware of it, to our knowledge.

Were the daughter and the husband pretty unaware of the flattery? No Yes

23. The schoolmaster grounded Susie and he grounded Carey too, but they were unmoved, and clearly unrepentant.

The schoolmaster grounded Susie and he grounded Carey too, but each of them was unmoved, and clearly unrepentant.

The schoolmaster grounded Susie and Carey, but they were unmoved, and clearly unrepentant.

The schoolmaster grounded Susie and Carey, but each of them was unmoved, and clearly unrepentant.

Were Susie and Carey in good standing at school? No Yes

24. The janitor questioned Bob and he questioned Charles as well, but they were unconcerned, and probably innocent.

The janitor questioned Bob and he questioned Charles as well, but each of them was unconcerned, and probably innocent.

The janitor questioned Bob and Charles, but they were unconcerned, and probably innocent.

The janitor questioned Bob and Charles, but each of them was unconcerned, and probably innocent.

Were Bob and Charles pretty cool about the questioning? No Yes

Table 1

Percentage Acceptance, Experiment 1 (with Standard Error)

Condition	Item Set	
	Distributive-bias Predicate (2)	Ambiguously-distributive Predicate (3)
Conjoined Subject NP (a)	93.8 (1.8)	94.8 (1.6)
Conjoined Sentences (b)	87.5 (2.4)	87.5 (2.4)
Separate Sentences (c)	80.7 (2.9)	74.5 (3.2)

Table 2

Mean RT, ms, with standard errors in parentheses

Condition	Item Set	
	Distributive-bias Predicate (2)	Ambiguously-distributive Predicate (3)
	Reaction Time	
Conjoined Subject NP (a)	4313 (204)	3037 (138)
Conjoined Sentences (b)	4098 (171)	3813 (161)
Separate Sentences (c)	4178 (190)	3673 (156)
	Residual Reaction Time	
Conjoined Subject NP (a)	282 (133)	−377 (116)
Conjoined Sentences (b)	122 (178)	13 (119)
Separate Sentences (c)	−16 (140)	−6 (140)

Table 3

Mean raw and residual times (ms) and proportions (with standard errors), Experiment 2

Condition	Region 2 Anaphor	Region 3 Predicate	Combined Region
First Pass Time			
Conjoined S/They	282 (11)	409 (18)	788 (25)
Conjoined S/Neither	480 (13)	402 (17)	886 (23)
Conjoined NP/They	284 (11)	454 (19)	800 (22)
Conjoined NP/Neither	473 (27)	429 (30)	872 (55)
Residual First Pass Time			
Conjoined S/They	-1.6 (11.3)	-26.8 (18)	23.5 (23.1)
Conjoined S/Neither	1.6 (13.3)	-2.4 (17)	-31.9 (21.5)
Conjoined NP/They	-1.6 (10.7)	19.3 (19)	25.1 (19.4)
Conjoined NP/Neither	4.2 (25.9)	29.4 (30)	-70.7 (49.0)
Go-Past Time			
Conjoined S/They	285 (12)	651 (24)	856 (33)
Conjoined S/Neither	512 (18)	461 (19)	955 (27)
Conjoined NP/They	296 (14)	619 (21)	849 (25)
Conjoined NP/Neither	596 (48)	553 (35)	1127 (80)
Residual Go-Past Time			
Conjoined S/They	-6.7 (11.8)	11.8 (33.8)	25.9 (30.4)
Conjoined S/Neither	-17.3 (17.7)	-14.8 (20.9)	-56.6 (25.1)
Conjoined NP/They	2.9 (13.4)	-19.2 (23.2)	5.6 (23.4)
Conjoined NP/Neither	71.8 (47.6)	85.5 (74.2)	87.6 (79.5)
Regressions Out			
Conjoined S/They	.01 (.01)	.27 (.03)	.03 (.01)
Conjoined S/Neither	.03 (.01)	.09 (.02)	.04 (.01)
Conjoined NP/They	.01 (.01)	.26 (.03)	.04 (.01)
Conjoined NP/Neither	.09 (.04)	.07 (.03)	.13 (.05)