Published in final edited form as:

J Exp Psychol Learn Mem Cogn. 2010 May ; 36(3): 782–789. doi:10.1037/a0018783.

Evidence for Distributivity Effects in Comprehension

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Abstract

In the current paper, we introduce a new methodology for detecting whether a word in a sentence is conceptually represented as plural and use it to shed light on a debate about whether comprehenders interpret singular indefinite noun phrases within a distributed predicate as plural during on-line reading. Experiment 1 extended a methodology previously used by Berent, Pinker, Tzelgov, Bibi, and Goldfarb (2005) to test individual words or word pairs by, at a critical word, having readers judge whether one or two words appeared on a computer screen while performing self-paced reading on a sentence presented in one- and two-word chunks. Consistent with Berent et al., Experiment 1 indicated that participants were slower to judge that one word was on the screen when the word was plural (e.g., cats) than when it was singular (e.g., cat). Experiment 2 used this paradigm to show that readers build different conceptual representations for distributed versus collective predicates, and interpret a singular indefinite noun phrase within a distributed predicate as plural (e.g., Kaup, Kelter, & Habel, 2002, but cf. Filik, Paterson, & Liversedge, 2004; Paterson, Filik, & Liversedge, 2008).

In order to understand how people comprehend sentences, it is important to determine what types of conceptual representations they build and when they build them. Plural predicates can be interpreted, and thus conceptually represented, in multiple ways (e.g., Schwarzschild, 1996). Two common interpretations for plural predicates are the collective and the distributed readings. A collective reading of a plural noun phrase is one in which the group, not the individuals making up the group, is the relevant referent. That means that when a predicate is applied to a plural collectively, it is assumed to be true of the group, not necessarily each of the individuals that comprise the group. For example:

(1) The boys carried a piano up the stairs.

When interpreted collectively, (1) means that all of the boys that make up the group “the boys” were involved in the action of carrying a single piano up a set of stairs, and it is their combined efforts that moved the piano up the stairs. Thus, the singular indefinite noun phrase *piano* in a collective predicate is both grammatically and conceptually singular.

In contrast, a distributed reading of a plural noun phrase is one in which the individuals that make up the group are the relevant referents rather than the group itself. This means that the predicate is taken to be true of each of the individuals within the group. A distributed interpretation can be introduced either by using a predicate that is inherently distributive (e.g.,

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sleep because only individuals can sleep, not groups) or by using a portioning quantifier (e.g., *each*, *both*). For example, (1) above can be forced into a distributed reading with the addition of a portioning quantifier as in (2):

(2) Each of the boys carried a piano up the stairs.

In this sentence, there are multiple piano-carrying events, one for each boy that makes up the group “the boys”. However, the sentence is ambiguous with respect to the scope of the quantifiers. If *each* takes wide scope, then there is a piano for each boy. The most common interpretation of this reading is that multiple different pianos are involved (Kurtzman & MacDonald, 1993). However, it is also possible that *each* could take wide scope but the pianos associated with the boys might happen to all be the same piano. Under an account like that of Heim, Lasnik, & May (1991), the logical representation of these wide scope *each* readings would be:

(3) $D_x \text{boy}(x) \exists y \text{piano}(y) D_e[x \text{ carry } y]_e D_e \text{carry}'(x,y,e)$

where D is a distributive operator associated with *each* that distributes over both boys and boy-carrying-piano events. It is also possible for *a* to take wide scope in this sentence. In that reading, there is a single piano that each boy has moved (note that the conceptual representation for this reading would be the same as for the reading in which *each* takes wide scope but all of the pianos happen to be the same one). Its logical representation would be:

(4) $\exists y \text{piano}(y) D_x \text{boy}(x) D_e[x \text{ carry } y]_e D_e \text{carry}'(x,y,e)$

Multiple sources of information such as real-world knowledge, verb semantics, and choice of quantifiers can influence what scope comprehenders assign to the distributivity (e.g., Schwarzschild, 1996).

Psycholinguistic results from production and offline comprehension paradigms suggest that language users build different conceptual representations for distributed versus collective predicates; they represent singular indefinite noun phrases inside distributed predicates, but not collective predicates, as conceptually plural (e.g., Humphreys & Bock, 2005; Kaup, Kelter, & Habel, 2002). However, evidence from recent eye movement experiments investigating quantifier scope resolution is inconsistent with this account (Filik, Paterson, & Liversedge, 2004; Paterson, Filik, & Liversedge, 2008). The current paper uses a new paradigm that directly indexes the plurality of a critical word to investigate the conceptual representations that comprehenders build, in an attempt to determine how they process scope and plurality on line.

Evidence from production studies suggests that language users are sensitive to subtle differences in semantic representations associated with distributivity and plurals. A few researchers have taken advantage of the distributivity and collectivity distinction to determine what types of information are used when computing agreement (subject-verb and anaphoric; Bock, Butterfield, Cutler, Cutting, Eberhard, & Humphreys 2006; Bock, Nicol, & Cutting, 1999; Eberhard, 1999; Humphreys & Bock, 2005; Vigliocco et al., 1995, Vigliocco, Butterworth, et al., 1996, Vigliocco, Hartsuiker, et al., 1996). This research suggests that distributed noun phrases are treated like semantic plurals. For example, Humphreys and Bock (2005) found more subject-verb agreement errors when the subject of the sentence to be produced was a conceptually distributed group (5a) rather than a conceptually collective group (5b).

(5a) The gang on the motorcycles

(5b) The gang near the motorcycles

When the group was conceptually distributed (5a), participants incorrectly (in American English) used a plural verb (*were*) more often in their continuations than when the group was conceptually collective (5b). This indicates that participants were more likely to treat *the gang* as a plural when its individuals were more salient (5a) rather than when the group was the relevant referent (5b). This suggests that distributivity can make grammatically singular lexical items that have plural referents (e.g., *gang*, *group*) functionally plural during language production.

There is also some evidence that distributivity can make singular referents (e.g., the word *label* in *label on the bottles*) semantically plural in Dutch and French (Vigliocco, Hartsuiker, Jarema, & Kolk, 1996) and in Spanish and Italian (Vigliocco, Butterworth, & Garrett, 1996; Vigliocco, Butterworth, & Semenza, 1995); however, these effects do not appear in English (Bock & Miller, 1991; Vigliocco, et al., 1996). These cross-linguistic differences have been hypothesized to arise from differences in the information that speakers of different languages take into account when producing agreement rather than differences in the conceptual representations associated with the noun phrases (Bock, et al., 2006). If this is the case, it would suggest that agreement may not be an ideal marker of conceptual plurality, calling the strength of this production evidence into question.

Comprehension studies also provide evidence that comprehenders build fully specified representations for distributed and collective predicates. Frazier, Pacht, and Rayner (1999) investigated whether readers have default preferences for collective or distributed representations. In their eye tracking study, participants read sentences that could either be assigned a collective or a distributed interpretation, such as (6).

(6) John and Mary ate one ice cream cone {each/together}.

The sentences were temporarily ambiguous until the disambiguating quantifier (e.g., *each* or *together*). Reading times were longer over the predicate (*ate one ice cream cone each* in 6), when it was disambiguated as distributed (*each*) rather than collective (*together*). Frazier et al. interpreted this as evidence that participants initially adopt a collective interpretation and that it takes some work to undo that interpretation if it turns out not to be correct. Kaup et al. (2002) reported offline data indicating that the conceptual representations of distributed predicates include multiple instances of the referents in the predicate. In their study, participants read sentences like (7) below, followed by either (a) or (b), and answered comprehension questions about how many referents the singular indefinite noun phrase in (a) or (b)'s predicate introduced.

(7) John and Mary went shopping.

a. They bought a gift.

b. Both bought a gift.

In condition (7a), in which there was no indication of whether the predicate should be applied to the group or to the individuals, participants indicated that the predicate should apply to the group by specifying that only one gift was purchased. However, in the condition with a distributing quantifier (7b), participants indicated that they believed two gifts were purchased. This means that in (7b) the word *gift* was conceptually represented as plural, with one gift purchased by John and one purchased by Mary. Unfortunately, because this data is offline, it is unclear whether this conceptual representation is built immediately or takes time to establish. Also, it is possible that participants' conceptual representations may have been influenced by the fact that their attention was drawn to the ambiguity (Swets, Desmet, Clifton, & Ferreira, 2008).

Similar to Kaup et al. (2002), Kurtzman and MacDonald (1993) report data from an acceptability judgment paradigm suggesting that comprehenders represent singular indefinite noun phrases as conceptually plural when they are inside distributed predicates. Kurtzman and MacDonald found that after reading sentences like *Every kid climbed a tree*, comprehenders preferred a continuation that began with a plural anaphor (*the trees*) as opposed to a singular anaphor (*the tree*). This suggests that comprehenders assigned wide scope to *every*, resulting in a distributed predicate with multiple instances of *tree*. The acceptability judgment paradigm had the advantage of not directly querying the number assigned to the indefinite, but the judgments were made to a subsequent anaphor rather than the critical noun phrase itself.

This production and off-line comprehension work suggests that readers build different conceptual representations for collective and distributed predicates, and is consistent with the hypothesis that singular indefinite noun phrases within distributed predicates are often treated as conceptually plural. However, recent eye-movement investigations into quantifier scope ambiguities call this hypothesis into question (Filik, Paterson, & Liversedge, 2005; Paterson, Filik, & Liversedge, 2008). Paterson et al. (2008) tracked readers' eye movements as they read ambiguous doubly quantified sentences like:

(8) The estate agent showed each apartment to a new client...

(9) The estate agent showed an apartment to each new client...

(10) ... but the apartment(s)/ client(s) was/were not very impressive/impressed.

Paterson et al.'s sentences were ambiguous with respect to scope—that is, does *each* take wide scope over *a* (e.g., in (8) are there multiple apartments, each viewed by a possibly different client) or does *a* take wide scope over *each* (e.g., in (8) is there a single client viewing multiple apartments)? To test which scope comprehenders preferred, ambiguous sentences (8 and 9) were followed with continuations (like 10) that contained either a plural or a singular anaphor referring to one of the referents in the sentence. The Filik et al. (2005) study was identical except that the quantifier *every* forced distributivity instead of *each*. Both studies found that plural anaphors (e.g., *clients*) referring to the indefinite noun phrase (e.g., *a new client*) took longer to process than singular anaphors no matter what condition they followed. This suggests that readers never interpreted the singular indefinite as plural, even when it was in a potentially distributed predicate. Filik et al. speculated that their results could mean that readers fail to fully specify quantifier scope, and instead rely on “good enough” representations. Alternatively, readers may have a preference for the singular analysis of an indefinite noun phrase, indicating that the indefinite always takes wide scope over the distributing quantifier (cf. Kurtzman & MacDonald, 1993).

The current experiments extend a methodology introduced by Berent, Pinker, Tzelgov, Bibi, and Goldfarb (2005) to sentence reading to test whether singular indefinite noun phrases in distributed predicates can be interpreted as conceptually plural. In the Berent et al. study, participants were shown either a single word or two words and asked how many words appeared on the screen. Participants were slower to judge that one word appeared when it was plural compared to when it was singular¹. Berent et al. hypothesized that this is because the semantic number information inherent to plural noun phrases interferes with the number judgment task. This methodology has multiple advantages over those that have been previously used to investigate conceptual plurality; it takes advantage of a relatively automatic phenomenon (i.e.

¹Interestingly, they did not find any interference when two singular words were on the screen. In that condition, participants were no slower to say “two” than when both words were plural.

interference) and directly probes the relevant features of the conceptual representation at the critical word.

Experiment 1

Experiment 1 was conducted to test whether the Berent et al. (2005) methodology could be extended to sentences. It is possible that the added complexity involved in building and maintaining a sentence representation during the number judgment task, or the task demands of simultaneously carrying out self-paced reading and number judgments, might make participants less sensitive to interference than they were in Berent et al. (2005). Experiment 1 is also important because in order to use the paradigm to test ambiguous cases (as in Experiment 2), we must first establish that the paradigm works on simple, unambiguous sentences.

Method

Participants—Fifty two University of Pittsburgh undergraduates participated in exchange for partial course credit. All were native speakers of American English.

Design and Stimuli—Experiment 1 had a single factor with two levels. The final word of the sentence was either singular (as in 11) or plural (as in 12).

(11) The bartender served the beer to the man.

(12) The bartender served the beer to the men.

Because plural noun phrases in English are typically longer than singular noun phrases (e.g., to make the plural an –s is added to the singular), we included 14 irregular noun phrases for which the plural is the same length or shorter than the singular noun phrase. These noun phrases provided a check as to whether length differences might be responsible for any differences observed between the singular and plural noun phrases. The 30 experimental sentences from Experiment 1 were embedded with the 36 experimental sentences for Experiment 2 and 66 unrelated filler sentences.

Apparatus—Stimuli were displayed at a resolution of 800 by 600 pixels by a 24-bit color on a 19-inch Dell P991 monitor driven by a NVIDIA GeForce3 video graphics card with a screen refresh rate of 100 Hz. Fluorescent overhead lighting illuminated the room.

Stimulus presentation and response collection were controlled by E-Prime experimental software (Schneider, Eschmann, & Zuccolotto, 2002). Responses were recorded via keyboard press. The display monitor was interfaced with a 2GHz, Pentium 4, desktop computer. The computer controlled the experiment and recorded time values for all button press events over the course of each trial.

Procedure—Participants were tested individually or in small groups of no more than three. After providing informed consent, participants read the instructions and participated in one practice block of eight trials before moving on to the experiment. An experimental trial consisted of the following events. A fixation cross appeared in the center of the computer screen. When participants were ready to begin the trial, they pressed the space bar. Sentences were presented in black font in a mix of one and two word centrally-presented chunks. Participants were instructed to read the chunk and then press the space bar to continue reading the sentence. Throughout the experiment, there were an approximately equal number of one and two word chunks. The last chunk of the sentence was presented in blue font. Participants were instructed that blue font was a cue for them to decide whether there were one or two words on the screen. They did so by pressing either the “1” key or the “2” key on the keyboard. All

critical trials ended with a single word and all fillers ended with two words, so that an equal number of one and two word judgments were made across the experiment. The final word of the sentence was always a noun. When there were two words there was a mixture of determiner-noun and adjective-noun combinations. After making the number judgment, a comprehension question appeared to which participants responded “yes” or “no” by pressing prespecified buttons.

Data Analysis—Data were subjected to repeated measures ANOVAs using participants ($F1$) and items ($F2$) as random factors.

Results

Comprehension rates for the yes/no questions were high. Participants answered 94% (5% SD) of the questions correctly. Additionally, participants were 97% (6% SD) accurate on the number judgment task.

The critical measure was the reaction time for the number judgment for correct number judgment trials only. There was a significant main effect of noun type such that “one” responses were slower when the target word was plural ($M=1133$ ms, $SD = 262$ ms) rather than singular ($M= 1075$ ms, $SD= 248$ ms), $F(1,51)=8.53$, $MSe=10241.37$, $p < .05$; $F(1,29)=7.25$, $MSe=8998.98$, $p < .05$. Separate analyses over the 14 irregular plural items and 16 regular plural items showed the same pattern of means across both groups: Participants were slower to indicate “one” when the critical word was plural (irregular: $M= 1177$ ms, $SD = 320$ ms; regular: $M= 1114$ ms, $SD= 277$ ms) than when it was singular (irregular: $M=1104$ ms, $SD = 276$ ms; regular: $M = 1059$ ms, $SD = 250$ ms). However, due to low power these differences were not fully reliable, irregular: $t_1(51)=1.55$, $p = .13$, $t_2(13) = 1.85$, $p = .09$; regular: $t_1(51)=2.57$, $p < .05$, $t_2(15) = 1.92$, $p = .07$.

Discussion

The results of Experiment 1 indicate that the Berent et al. (2005) methodology can be extended to sentential contexts. Indeed, participants were slower to judge that one word appeared on the screen when it was plural compared to when it was singular. This is consistent with the hypothesis that semantic plural information interferes with the ability to make singular number judgments during sentence comprehension. Experiment 2 uses this methodology to investigate cases where conceptual plurality is not accompanied by plural grammatical marking but must be assumed on the basis of collectivity or distributivity assigned by a previous quantifier.

Experiment 2

Experiment 1 confirmed that even in sentential contexts, semantic plural information on a word interferes with singular number judgments. The purpose of Experiment 2 was to determine whether, given Filik et al. (2005) and Paterson et al. (2008)’s findings, singular indefinite noun phrases in a distributed predicate can be interpreted as conceptually plural during on-line reading and whether this conceptual plurality interferes with number judgments in the same way as grammatical plurality. Specifically, if the distributing quantifier takes wide scope over the indefinite, and comprehenders build conceptual representations for distributed predicates that contain multiple exemplars of the referent introduced by the singular indefinite noun phrase, then one-word judgment times should be slower for indefinite noun phrases in distributed predicates than collective predicates.

Method

Participants—The same University of Pittsburgh undergraduates who participated in Experiment 1 participated in Experiment 2 in exchange for partial course credit.

Design and Stimuli—The experiment had a 2×2 within-participants design. The first factor was the quantifier type and was either distributed (a) or collective (b). The second factor was the marking on the critical word, which was either singular (as in 13 *box* below) or plural (as in 14 *boxes* below).

(13a) Each of the men carried a box.

(13b) Together the men carried a box.

(14a) Each of the men carried some boxes.

(14b) Together the men carried some boxes.

Experiment 2 consisted of 36 experimental sentences. The quantifier was either distributing (13a and 14a) or collective (13b and 14b). The final word was either singular (as in 13a,b) or plural (as in 14a,b). The plural-marked conditions (14a,b) were included to control for possible spill-over reading time differences from earlier in the sentence onto the critical word judgment times. Because sentences in the same distributivity conditions were identical up to the target word, any such spill-over should drive a main effect of distributivity. Number judgment interference should be similar in both plural-marked conditions. The experimental items were presented with the 30 items from Experiment 1 and 66 fillers, 38 of which began with a quantifier.

Because we were interested in determining whether singular indefinite noun phrases in distributed predicates are ever interpreted as conceptually plural during on-line reading, items were designed so that real-world knowledge either strongly biased or required a plural interpretation of the indefinite noun phrase. To ensure this was true of our items, we conducted a norming study. Twenty four participants from the University of Pittsburgh who did not participate in either Experiment 1 or Experiment 2 read the 36 items from Experiment 2 along with 9 filler items that began with “each” but were strongly biased toward a singular interpretation (e.g., *Each of the women admired the Hope Diamond*) and 12 items from another experiment. They were asked to rate on a scale of 1 – 5 (where 1 was “definitely one” and 5 was “definitely more than one”) whether the last word in the sentence referred to one or more than one object. Results indicated that the singular-marked distributed items were indeed biased toward a plural interpretation of the noun phrase. Participants rated the singular-marked distributed items as being closer to the “definitely more than one” end of the scale ($M=4.17$, $SD=.71$) than the singular-marked collective items ($M=1.09$, $SD=.16$, $t_1(23)=19.25$, $p<.001$; $t_2(35)=26.84$, $p<.001$). The plural-marked items were judged similarly likely to refer to multiple items (each: $M=4.93$, $SD=.13$; together: $M=4.82$, $SD=.27$, $ps>.05$).

Apparatus & Procedure—The same apparatus and procedure used in Experiment 1 were used in Experiment 2.

Data Analysis—Data were subjected to repeated measures ANOVAs using participants ($F1$) and items ($F2$) as random factors.

Results

Comprehension rates for the yes/no questions were high. Participants answered 96% (4% SD) of the questions correctly. Additionally, participants were 95% (4% SD) accurate on the number judgment task.

As in Experiment 1, the critical measure was the reaction time for the number judgment during the experiment for correct trials only. See Table 1 for means.

Replicating Experiment 1 and consistent with Berent et al. (2005), there was a main effect of marking such that “one” decisions took longer when the critical noun phrase was plural-marked ($M=1104$ ms, $SD=248$ ms) than when it was singular-marked ($M=1022$ ms, $SD=199$ ms), $F(1,51)=17.63$, $MSe=19828.20$, $p<.05$; $F(1,35)=13.04$, $MSe=13920.86$, $p<.05$. Critically, there was also a reliable interaction between noun marking and reading, $F(1,51)=4.07$, $MSe=16908.55$, $p<.05$; $F(1,35)=4.61$, $MSe=15081.02$, $p<.05$. The interaction was such that for the singular-marked conditions, as predicted, “one” decisions took longer when the critical noun phrase was in a distributed predicate compared to when it was in a collective predicate, $t_1(51)=2.43$, $p<.05$, $t_2(35)=3.14$, $p<.01$. In the plural-marked conditions there was a non-reliable difference between conditions in the opposite direction, $ps>.05$.

Discussion

The results of Experiment 2 confirm the hypothesis that singular indefinite noun phrases in distributed predicates can indeed be treated as conceptually plural during reading. Participants were slower to judge that one word appeared on the screen when it was singular and in a distributed predicate than when it was singular and in a collective predicate. There was no reliable effect of distributivity and no reliable difference between the plural-marked conditions, indicating that the difference in the singular-marked conditions was unlikely to be the result of one kind of predicate being more costly to compute than the other. These results indicate that in these items the distributing quantifier took wide scope over the indefinite. Furthermore, they suggest that the indefinite likely was not interpreted as happening to refer to the same entity distributed across events, given that the norming results suggest that the indefinite was represented as multiple different entities. However, because it is not yet known whether the current methodology will show number interference for distributed events, it is possible that the conceptual plurality that generated the number judgment interference on the indefinite could have been associated with either the representation of multiple different entities (e.g. multiple different boxes in (12a)) or the representation of multiple events (e.g. the multiple box-carrying-events in (12a)).

General Discussion

The experiments reported in this paper indicate that conceptual plurality interferes with number judgments during sentence comprehension. In Experiment 1, participants were slower to judge that one word was on the screen when the word was plural (e.g., cats) than when it was singular (e.g., cat). Experiment 2 extended this finding to conceptual plurals. Participants were slower to judge that one word was on the screen when that word was inside a distributed predicate (e.g., Each of the men carried a box) compared to when the same word was inside a collective predicate (e.g., Together the men carried a box).

Experiment 2 showed that comprehenders can represent noun phrases in distributed predicates as conceptually plural at an earlier point in sentence comprehension than had previously been shown (e.g., Kaup et al., 2002; Kurtzman, & MacDonald, 1993), using a more implicit yet still direct measure. Interestingly, the current findings are inconsistent with recent eye movement data regarding the interpretation of sentences with ambiguous quantifier scope. These findings (Filik et al., 2004; Paterson et al., 2008) indicate that comprehenders do not build conceptually plural referents on-line for indefinite noun phrases in distributed structures that off-line norming had indicated were likely to be interpreted as plural.

There are multiple potential explanations for the differences between the current results and the findings in Filik et al. (2005) and Paterson et al. (2008). One of the most likely is that whereas their items were designed to be fully ambiguous with respect to scope, our items were more biased towards the reading where the singular indefinite noun phrase fell under the scope of the distributive quantifier. It may also be important that in Experiment 2 the distributing

quantifier was on the subject noun phrase of a relatively simple and short sentence, but in the Filik et al. and Paterson et al. studies it was on one of the two object noun phrases in a relatively long and complex ditransitive or double object sentence. If comprehenders are more likely to generate a full interpretation for simple sentences but rely on “Good Enough” strategies for more complex sentences (e.g., Ferreira & Patson, 2007), they may have been more likely to disambiguate scope in the current experiment than in the Filik et al. and Paterson et al. studies.

In a related point, many of the critical singular indefinite noun phrases in the Filik et al. (2005) and Paterson et al. (2008) experiments had multiple senses. For example, the word *report* in The professor sent a research report to each academic journal... could refer to the physical paper item or to its content, meaning that even if quantifier scope is disambiguated, there remains considerable ambiguity; e.g., if *a research report* takes narrow scope, there remains ambiguity as to whether the multiple exemplars of stapled pages have the same or different content. This raises a number of concerns. First, comprehenders were often dealing with scope and sense ambiguities simultaneously. Given evidence that comprehenders do not commit to a particular sense unless forced to (Frazier & Rayner, 1990), participants in the quantifier scope studies may have only created vague representations for the indefinites and then perhaps been less likely to resolve the quantifier scope ambiguity on top of that vagueness. Second, this sense vagueness is a problem for the anaphor paradigm that was used in these studies. In some cases it may have been possible to interpret the singular anaphor as referring to a different sense than the antecedent (e.g. as referring to the content of multiple photocopied reports rather than to the photocopies themselves). If this was the case, then the preference for singular anaphors may not indicate that readers failed to distribute over the critical noun phrase.

The two experiments in the paper introduce an important new methodology for investigating the presence or absence of plural features on referents built during sentence comprehension. This methodology has multiple advantages over others currently in use. First, it does not require comprehenders to answer questions that specifically probe the conceptual representations they have built (e.g., Kaup et al., 2002), which has the potential disadvantage of spurring comprehenders to build more specific conceptual representations than they might otherwise have (Swets et al., 2008). Second, it measures interference on a task unrelated to comprehension, making it less likely to be affected by explicit comprehension strategies. Finally, it directly probes the number feature on the referent associated with the critical word.

Acknowledgments

The authors were partially supported by NIH-HD053639 while carrying out this work. We thank Charles Perfetti, Erik Reichle, Mike Dickey, Natasha Tokowicz, other members of the Pitt Reading and Language Lab, and the audience of the 22nd CUNY Sentence Processing Conference, Davis, CA.

Appendix

Stimuli for Experiments 1 and 2

Experiment 1

1. The hockey player knocked out his front tooth/teeth.
2. Jane did not recognize the woman/women.
3. The kitten was rescued by the fireman/firemen.
4. The couple at the park fed the goose/geese.
5. Stephanie sat out because she injured her foot/feet.
6. Jeff was uncomfortable talking to (an) unfamiliar person/people.

7. Claire was ignored by the saleswoman/saleswomen.
8. The waiter served lunch to the businesswoman/businesswomen.
9. The teenagers were stopped in traffic by the policeman/policemen.
10. The bartender served the beer to the man/men.
11. A large shark was reeled in by the fisherman/fishermen.
12. The children were outside building (a) snowman/snowmen.
13. The cat waited at the hole for the mouse/mice.
14. Because she always kills houseplants, Susie bought a small cactus/ some small cacti.
15. Before work, Cindy had to walk her dog/dogs.
16. On his way to class, Mike dropped his book/books.
17. Many students had a hard time interpreting the graph/graphs.
18. The boy delivered the small pizza/pizzas.
19. The child colored with the crayon/crayons.
20. The wedding couple admired the beautiful photo/photos.
21. The boy ate the vanilla swirl cupcake/cupcakes.
22. Amy brought out the cake and lit the tiny candle/candles.
23. Few tourists visited the remote monument/monuments.
24. Every boy was climbing the evergreen tree/trees.
25. On Thursday, the students completed the homework/homework.
26. Only one singer wrote her own song/songs.
27. The House passed the complicated bill/bills.
28. The housekeeper made the bed/beds.
29. The baby cuddled under the wool blanket/blankets.
30. Before the party the men set up the table/tables.

Experiment 2

1. {Together/Each of} the men carried {a large box/some boxes.}
2. {Together/Each of}the girls played with {a doll/some dolls.}
3. {Together/Each of}the children kicked {a ball/some balls.}
4. {Together/Each of}the teenagers ate {a large pizza/some large pizzas}.
5. {Together/Each of}the babies played on {a soft blanket/some soft blankets.}
6. {Together/Each of}the travelers rented {a fancy car/some fancy cars.}
7. {Together/Each of}the women prepared {an elaborate meal/some elaborate meals.}
8. {Together/Each of}the pirates examined {an ancient map/some ancient maps.}
9. {Together/Each of} the actors rehearsed {a dramatic scene/some dramatic scenes.}
10. {Together/Each of} the sisters wrote {a heartfelt letter/some heartfelt letters.}

11. {Together/Each of} the farmers built {a sturdy barn/some sturdy barns.}
12. {Together/Each of} the dogs ate {a juicy steak/some juicy steaks.}
13. {Together/Each of} the hikers pitched {a small tent/some small tents.}
14. {Together/Each of} the triplets bought {an expensive gift/some expensive gifts.}
15. {Together/Each of} the decorators hung {a yellow drape/some yellow drapes.}
16. {Together/Each of} the bakers decorated {a chocolate cake/some chocolate cakes.}
17. {Together/Each of} the clerks operated {a cash register/ some cash registers.}
18. {Together/Each of} the toddlers played with {a cute kitten/some cute kittens.}
19. {Together/Each of} the chefs stocked {an empty freezer/some empty freezers.}
20. {Together/Each of} the teaching assistants taught {a difficult lesson/some difficult lessons.}
21. {Together/Each of} the boys dug {a deep hole/some deep holes.}
22. {Together/Each of} the Wilson brothers waxed {a red truck/some red trucks.}
23. {Together/Each of} the scientists looked at {an interesting slide/some interesting slides.}
24. {Together/Each of} the students gave {a short presentation/some short presentations.}
25. {Together/Each of} the doctors advised {a tired patient/some tired patients.}
26. {Together/Each of} the maids cleaned {a dusty room/some dusty rooms.}
27. {Together/Each of} the lawyers won {a tough case/some tough cases.}
28. {Together/Each of} the firefighters picked up {a metal ladder/some metal ladders.}
29. {Together/Each of} the robbers stole {a flat-screen television/some flat-screen televisions.}
30. {Together/Each of} the kids pulled {a heavy wagon/some heavy wagons.}
31. {Together/Each of} the women made {a delicious salad/some delicious salads.}
32. {Together/Each of} the old ladies adopted {a striped cat/some striped cats.}
33. {Together/Each of} the researchers wrote {an interesting paper/some interesting papers.}
34. {Together/Each of} the producers produced {an entertaining movie/some entertaining movies.}
35. {Together/Each of} the singers sang {a beautiful song/some beautiful songs.}
36. {Together/Each of} the children carved {a spooky pumpkin/some spooky pumpkins.}

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Table 1
Means (standard deviations) in milliseconds for “one” judgment times in Experiment 2

	Distributed	Collective
<i>Marking</i>		
Singular	1048 (237)	996 (196)
Plural	1093 (247)	1114 (304)