Published in final edited form as:

Discourse Process. 2013 ; 50(4): 249–275. doi:10.1080/0163853X.2013.778167.

The Role of *Only* in Contrasts in and out of Context

Katy Carlson

Department of English, 419 Combs Building, Morehead State University, Morehead, KY 40351, 606-783-2782; (fax) 606-783-9112

Katy Carlson: k.carlson@moreheadstate.edu

Abstract

Three self-paced reading experiments explored the processing of “only” and its interaction with context. In isolated sentences, the focus particle “only” predicts an upcoming contrast. Ambiguous replacive sentences (e.g., “The curator embarrassed the gallery owner in public, not the artist”) with “only” on the subject or object showed faster reading of the contrast phrase (“not the artist”) than without it. The position of “only” also influenced the phrase’s meaning; despite a bias toward object contrasts, subject “only” increased subject interpretations. If preceding context provides another reason for the focus particle, it no longer predicts an upcoming contrast. In biasing contexts including indirect questions, there was no facilitation when “only” marked the argument which answered the question, while “only” on the other argument slowed processing. Both “only” and context influenced interpretation. The results show that focus particles and questions can each influence processing of an upcoming contrast on- and off-line.

This project explores the contrastive function of *only* in sentences with or without preceding context. To explain how *only* works requires an understanding of focus. In any sentence, at least one constituent bears focus, which is a syntactic/semantic form of emphasis related to the information structure of the sentence (e.g., Kadmon, 2001; Rooth, 1992; Schwarzschild, 1999). Focus can indicate new information or information which contrasts with context. For example, if it is known that John bought something, then sentence (1) will have focus on the object, *a dog*; if it is known that someone bought a dog, then the same sentence would have focus on *John*.

(1) John bought a dog.

If it is erroneously believed that John purchased an iguana, *a dog* would be focused then too, since it contrasts with previous information. And if all of the information in a sentence is new (or all is equally given), then focus in English usually appears on the object or late in the predicate (Cinque, 1991; Gussenhoven, 1994; Selkirk, 1984, 1995). Different languages can indicate focus in different ways, but English uses prosody (accents on focused words), syntactic structures such as clefting (*It was John who bought a dog*), and focus particles like *only*.

Only can appear in various positions in English sentences. It syntactically modifies NPs or VPs (Kadmon, 2001), as in (2).

- (2) a. [Only Bernice] arrived early.
 b. Beth [only napped briefly].
 c. Brittany ate [only beans].

The real interest for this project, however, is how *only* functions semantically. Rooth (1992)'s influential theory of focus interpretation states that focus on a sentence element produces additional semantic values for the sentence. Specifically, focus interpretation generates a set of propositions with the focused element replaced by alternatives (alternatives which may be narrowed down by context). In (2a), then, the focus which *only* places on the subject means that the interpretation of the sentence includes the contrast of the stated agent, Bernice, with other people who might have arrived early but didn't. In (2b), the focus on the predicate licenses the contrast of Beth's brief napping with other things she might have done, such as sleeping for a long time or going for a brisk walk. (2c) raises the contrast of beans with other things that Brittany might have eaten.

Kiss (1998), among others, claims that there are two distinct types of focus, informational and contrastive. Informational focus occurs on whatever in a sentence is new or informative. In her theory, *only* indicates strictly contrastive focus (also called identificational focus) on a phrase. This focus exhaustively identifies the individual for which a predicate holds, out of all possible individuals in a context or situation. Rooth's (1992) theory does not make a distinction between types of focus, but says that focus is usually required for elements that contrast within a sentence or with prior context. Rochemont and Culicover (1990) similarly state that focus is a single concept with different uses, one of which is contrastive. In any case, *only* either indicates contrastive focus or a contrastive use of focus.

What might this mean for processing? I hypothesize that the presence of *only* predicts an upcoming contrast within a sentence or short discourse, if a contrast to the phrase it marks has not already appeared. This prediction cannot be absolute, since a sentence with *only* may occur in a discourse without the contrast being spelled out either before or after it. But the presence of *only* should certainly make a contrast more likely, and thus ease its processing when it is encountered. Consider an analogy with wh-words, which lead to the prediction of an upcoming gap (Aoshima, Phillips, & Weinberg, 2004; Frazier & Clifton, 1989, among many others). When a wh-word is processed, it is grammatically guaranteed that there will be a gap (or trace) in its original position within the sentence. Frazier and Clifton (1989) and Frazier and Flores d'Arcais (1989) suggested that a wh-word initiates the active filler strategy, in which the processor predicts that the wh-word occupies the earliest possible site within the sentence. Aoshima, Phillips, and Weinberg (2004) expanded on this idea, claiming that the strategy is driven by the wh-phrase's need for thematic and scope requirements to be filled. *Only* is not as determinative as a wh-word, since its meaning can be accommodated with a contrast outside the sentence or even the discourse, but its presence should raise expectations of contrast over baseline levels.

Much of the previous processing work on *only* has looked at how it affects the main clause/reduced relative ambiguity. Sedivy (2002) studied sentences like (3).

- (3) (Only) the businessmen loaned money at low interest were told to record their expenses.

Sedivy followed up work by Ni, Crain, & Shankweiler (1996) suggesting that *only* made modification of a head noun (*businessmen*) by a relative clause more likely, because the relative clause provided a contrast between groups of businessmen. Thus the focus particle favored the less preferred reduced relative clause structure (*businessmen [who] loaned money...*). These findings were not always replicated (cf. Clifton, Bock, & Rado, 2000). Sedivy (2002)'s first self-paced reading experiment found that *only* facilitated reading the region which disambiguated the sentence toward the reduced relative structure. In the second study, a preceding context either provided a contrast set for the head noun, by introducing both secretaries and accountants before a sentence beginning (*Only the secretaries...*, or did not provide a contrast set (mentioning secretaries only). With the preceding contrast for the head noun, the reduced relative was dispreferred, despite *only*'s presence; without a preceding contrast, *only* favored the relative clause analysis. These studies show that *only* favors the interpretation which presents a contrast between subsets of the head noun, unless a preceding context provides a contrast for the noun already.

Filik, Paterson, & Liversedge (2005) placed main clause/reduced relative sentences with *only* in contexts ending with indirect questions. When the prior question targeted a subset of the head noun's reference, as with a question about *which builders* for a target beginning with *Only builders*, the relative clause analysis should be favored because it refers to a subset of builders. When the question used *who*, different sets of builders are not indicated, so the main clause analysis remains dominant. *Which*-contexts plus *only* lowered overall reading times and regressions for unambiguous and ambiguous relative clause sentences and led to more relative clause completions in a norming study, though the results were modulated by a difference between transitive and intransitive verbs. Filik et al. (also Liversedge, Paterson, & Claves, 2002; Paterson, Liversedge, & Underwood, 1999) differ from Sedivy in claiming that *only* and contrastive contexts did not guide the processing of reduced relative clause sentences when transitive verbs were present in the relative clause. But the reduced relative structure was still favored by the presence of *only* and/or contexts highlighting a contrast.

Paterson et al. (2007) used eye tracking to explore how *only* modulated preferences for the position of contrast in double object replacive sentences, as in (4).

- (4) a. ... Jane passed (only) the salt to (only) her mother, but not {the pepper/her father} ...
b. ... Jane passed (only) her mother (only) the salt, but not {the pepper/her father} ...

They found that readers of these unambiguous double object or prepositional dative sentences expected the contrastive phrase (*but not X*) to contrast with whichever NP was focused by *only*. Reading times were slower for incongruous contrasts: there was a

slowdown after *but not the pepper* when *only* marked *her mother*, and after *but not her father* when *only* marked *the salt*. When sentences like (4) were presented without *only*, in a further eye-tracking experiment, there was no preference in reading times for either contrast. In two written completion studies with *only*, Paterson et al. found a moderate bias towards contrasts with whichever argument came later in the sentence (*her mother* in (4a), and *the salt* in (4b)). These off-line results are consistent with a default focus effect, i.e. a preference to assume that focus appears on the last item in the predicate, leading to a preference for contrasts with this item (as suggested by Carlson, Dickey, Frazier, & Clifton, 2009 for sluicing sentences). This hypothesis is not supported by Paterson et al.'s on-line results, but all of their results do find that the position of *only* influences the preferred antecedent of a contrastive phrase.

In the current project, the effects of *only* are explored in a contrastive ellipsis sentence, sometimes called a replacive or stripping sentence (Drubig, 1994), as in (5). Unlike Paterson et al.'s sentences, these were ambiguous, so that instead of evaluating the surprise of readers at a given contrast, we evaluated people's choice of contrast.

- (5) (Only) the curator embarrassed (only) the gallery owner in public, not the artist.

First, the processing of these sentences is explored in isolation, with and without *only* in different positions. We hypothesize that the presence of *only* should facilitate processing of the contrastive phrase (*not the artist*), and the specific position of *only* should affect the interpretation of the contrastive phrase. Facilitation is expected if the focus particle induces the consideration of alternatives, making the contrastive phrase more predictable. Interpretation differences are expected if processors use *only* to help decide where focus is in the first clause, as focused elements are better antecedents for a contrast. Then the sentences are placed in contexts which use indirect questions to place focus on the subject or object. If these contexts satisfy the contrast needs of *only*, then it might no longer facilitate processing of the later contrastive phrase. Finally, the last study compares congruent contexts with conditions where the context and the focus particle pick out different arguments. This is expected to cause interference effects not seen in the congruent conditions.

Experiment 1: Only without Context

In the first study, replacive sentences were tested in three conditions, as shown in (6). Conditions (b) and (c) contained *only* on the subject or the object NP of the first clause, while (a) had no focus particles. The conditions were identical after the object.

- (6)
- a. On Monday/the curator/embarrassed/the gallery owner/in public,/not the artist,/though later everyone made up. (No Only)
 - b. On Monday/**only** the curator/embarrassed/the gallery owner/... (Subject Only)
 - c. On Monday/the curator/embarrassed/**only** the gallery owner ... (Object Only)

This was a self-paced reading experiment with an interpretation question following each item, providing on-line information as well as information about the ultimate interpretation participants reached. The focus provided by *only* was predicted to attract the contrast, leading to more subject interpretations in condition (b) and more object interpretations in condition (c) than in the baseline condition (a). That is, the artist would be interpreted as an unsuccessful claimant of the subject role in (b), contrasting with the curator as the actual subject. In addition, if the presence of *only* helps a processor predict an upcoming contrast, then the remnant phrase should be read faster in conditions with *only* than without.

In order to interpret the contrast phrase (*not the artist*), syntactic and semantic material from the complete first clause must be copied around it (Merchant, 2001; Sag, 1980). In these sentences, that means choosing whether the phrase contrasts with the first-clause subject or the object in order to generate the proper syntactic frame. An effect of the position of *only* here would be consistent with the focus-sensitivity of ellipsis sentences. In processing, effects of focus in ellipsis sentences have been shown by Frazier & Clifton (1998) and Carlson (2001, 2002), among others.

Method

Materials—There were 24 experimental items like (6) (see Appendix A for a list of items). These sentences were loosely based on translations of the German sentences from Stolterfoht, Friederici, Alter, & Steube (2007). All sentences began with an initial adverbial phrase (e.g., *On Monday*) and ended with a subordinated or coordinated clause (e.g., *though later everyone made up*) which added to or gave the consequences of the event in the main clause. In the main clause and the contrastive phrase (*not the artist*), the NPs were definite descriptions referring to humans, and in the same general thematic domain (e.g., politics, medicine, music, etc.). Parallelism, or similarity of the remnant to one of the previous NPs, has been shown to affect ellipsis sentence interpretations in previous work (Carlson, 2001, 2002). These sentences had neutral parallelism, since the remnant NP was equally similar to the first-clause subject and the object. The only differences between conditions were the presence and placement of *only*. Condition (b) had *only* on the subject, and condition (c) had *only* on the object.

The experiment also contained a number of other sentence types, including cleft sentences, comparatives, sentences with variation in adverbial time phrases, past perfect sentences, and VP ellipsis sentence pairs. The experiment contained 136 trials in total.

Participants—The participants in this study were 32 native English-speaking undergraduate students at Northwestern University enrolled in lower-division linguistics classes. They reported normal or corrected vision and received course credit for their participation.

Procedure and Equipment—This experiment was carried out on a PC running PCEXP software. Each trial began when a participant pressed the space bar. This brought a preview of the sentence on the screen, with underscores replacing each letter, but spaces and punctuation intact. The sentences were broken up into seven phrasal segments, as shown by the slashes in (6); the first-clause subject and object were each a separate segment, as was

the contrast phrase. Pressing the space bar again caused the letters of the first segment to appear on screen, and subsequent presses brought each following segment up. Participants were instructed to read at a comfortable pace that allowed them to comprehend the sentences, and a short practice session familiarized them with the procedure. The experimental and filler sentences appeared in one of four pseudo-randomized orders such that no two consecutive items were of the same type, and all items had similar segmentations. Each participant saw an equal number of items in each condition over the experiment in a Latin-square design.

After the final segment of each sentence, a question and two possible answers appeared on the screen, as in (7):

- (7) What did you find out about the artist?

The artist didn't embarrass the gallery owner. The artist wasn't embarrassed by the curator.

Participants were instructed to press a button on the left side of the keyboard (marked with a red sticker) for the answer on the left side of the screen, or a button on the right (marked with a blue sticker) for the answer on the right. The distribution of answers varied between items, so that answers with the remnant contrasting with the subject (e.g., *The artist didn't embarrass the gallery owner*) appeared on the right and left sides equally often over the experiment. The answer with the more difficult passive structure was the object contrast answer, as ambiguous replatives and other ellipsis sentences have routinely shown an object bias in processing (Carlson, 2001, 2002; Carlson, Dickey, & Kennedy, 2005; Carlson et al., 2009; Frazier & Clifton, 1998; Stolterfoht et al., 2007, etc.). So the answer corresponding to the less preferred interpretation involved a simpler structure, which would work against the bias. The experiment lasted between 30 and 60 minutes, with short breaks for stretching provided.

Results

There are two types of results to report from this experiment: the time information from the self-paced reading, and the end-of-sentence interpretation percentages. The reading times will be reported first. First, any reading times under 200 ms or over 4000 ms were dropped. In order to compensate for any length differences in segments, the raw times were subjected to a linear regression for each subject predicting reading times as a function of the characters in each segment. The residual reading times reported in Table 1 are the observed deviations from the predicted time for each segment (for comparison, raw reading times for each experiment are presented in Appendix C). Segments are numbered from the subject phrase, as no significant differences were found for the initial adverbial phrase.

For each segment, within-items and within-subjects ANOVAs were carried out with the single 3-level factor of *only*: not present, on the subject, or on the object. There were significant main effects of *only* at two positions: the segments containing the object and the contrast phrase. At segment 1, the subject NP, there was a hint of an effect of *only* by subjects: participants may have read sentences with *only* on the subject slower (main effect

of *only* significant by subjects, $F(2,62) = 4.2$, $p < .02$; not significant by items: $F(2,46) = 1.8$, $p = .17$). At segment 3, there was a significant main effect of *only*, as participants read sentences in the object *only* condition slower than the other two ($F(2,62) = 3.8$, $p < .03$; $F(2,46) = 5.6$, $p < .007$). These effects or tendencies are most likely the result of the additional word *only* in each segment, since although it is not a long word, it has important semantic consequences.

At segment 5, the contrastive remnant segment, there was a significant main effect of *only*, as participants read this phrase slowest in the condition without *only* (significant main effect of *only*, $F(2,62) = 4.2$, $p < .02$; $F(2,46) = 5.6$, $p < .01$). So without *only* in the previous clause to help determine the position of focus, participants spent more time on the contrast phrase. Having not been alerted to the contrast earlier by a focus particle, they most likely searched backwards from the remnant in their minds, trying to figure out what it contrasted with.

End-of-sentence interpretation questions showed that the baseline condition (a), without *only*, had under 50% subject responses. Subject responses rose to 63% with *only* on the subject (b), and fell to 23% with *only* on the object (c). In a within-items and within-subjects ANOVA with *only* as a 3-level factor, participants were more likely to choose a contrast with the subject in the subject *only* condition, and more likely to choose an object contrast in the object *only* condition (significant main effect of *only*: $F(2,62) = 33.2$, $p < .001$; $F(2,46) = 44.3$, $p < .001$). The percentages of subject responses in both conditions with *only* differed significantly from the neutral condition: ((a) vs. (b), $t(31) = 6.0$, $p < .001$, $t(23) = 5.3$, $p < .001$; (a) vs. (c), $t(31) = 3.1$, $p < .005$, $t(23) = 3.9$, $p < .005$).

Discussion

From the reading times, the most interesting result is that the contrastive phrase was read slower in the absence of *only* on some first-clause argument. This suggests that participants had more trouble deciding what the remnant should contrast with and were more surprised by the contrast when a contrast had not been predicted by the focus particle in the main clause. When *only* was present to convey focus on a first-clause argument, their faster reading of the contrast phrase reflected this earlier processing work. They might not have been sure that a contrast was coming, but they were better prepared when they encountered one.

These results harmonize with ERP research in German by Stolterfoht et al. (2007), who compared the processing of replacive sentences with *only* (*nur*, in German) on the subject or object to conditions without *only*. Their contrastive phrases were disambiguated by case information to the subject or object interpretation. ERP effects which they diagnosed as focus revision were seen in the conditions without *only*. In both languages, then, the presence of the focus particle in the first clause made a later contrast phrase easier, because it marked the position of contrastive focus in the first clause and initiated the postulation of alternatives to this argument.

The interpretation questions in Experiment 1 showed that placing *only* on the first-clause subject increased subject responses to 63%, while *only* on the object lowered subject

responses to 23%. These percentages show that *only* did not completely disambiguate the ellipsis sentences, since it was still possible to consider the contrast with another first-clause NP. But participants were strongly influenced to choose the argument focused by *only* as the contrast to the contrastive phrase.

The interpretation results also showed that replacive sentences have a mild object bias, since the baseline condition without *only* received 36% subject responses. This result is consistent with previous work on the processing of replacives (Carlson, 2002) and a body of work on ellipsis processing in general (Carlson, 2001, 2002; Carlson, Dickey, & Kennedy, 2005; Carlson et al., 2009; Frazier & Clifton, 1998; Hoeks, Redeker, & Hendriks, 2009; Stolterfoht et al., 2007, etc.). Carlson et al. (2009) explain this pattern as coming from the fact that the natural position of focus in an English sentence is on the last argument (e.g., Cinque, 1991; Selkirk, 1984), and so processors expect the object to be focused rather than the subject. That expectation affects their choice of interpretation in ellipsis sentences like these, because focused arguments are the most natural contrasts.

Experiments 2-3: Context and Only

Part of the function of focus is to relate sentences to the surrounding discourse by clarifying the status of information in a sentence. Therefore, contrastive focus indicators in single sentences out of the blue might be processed differently compared to indicators in sentences within contexts. In order to address this possibility, two experiments looked at *only* in ellipsis sentences placed in biased contexts. These contexts used indirect wh-questions to focus an NP within the target sentences by setting up a forward dependency with the upcoming answer.

Wh-question contexts can change the processing predictions for sentences. For example, Altmann, van Nice, Garnham, and Henstra (1998) found that a question context could cause usually optional adverbial phrases to be predicted in particular syntactic positions. Another demonstration of the effect of context questions comes from Hoeks, Redeker, and Hendriks (2009), who studied ambiguous gapping sentences.

- (8) a. Context: Wilma has bought a new house. What did Nathan and Tessa help her with?
- b. Nathan helped Wilma with painting and Tessa with wallpapering.

On the gapping reading, (8b) involves Tessa also helping Wilma; the nongapping reading has Nathan helping both Tessa and Wilma. The question in (8a) favors the gapping reading by setting up Nathan and Tessa as given topics and subjects of the verb *help*, which makes them natural as parallel subjects of conjoined gapped clauses instead of Tessa being the object of the verb. Along with a supportive prosodic contour, questions of this type made the usually dispreferred gapping interpretation the dominant meaning of sentences like (8b). Essentially, the question shifted which first-clause NP was contrasted with the remnant NP *Tessa*.

These results show how question contexts can lead to new structural predictions or increase the likelihood of uncommon structural alternatives. In replacive sentences, wh-question

contexts should influence processing because of the focus they give to the question's answer. This type of focus marking should interact with the process of determining the contrast within the sentence, as well as with the overt sentence-internal marking of focus provided by *only*. Experiments 2-3 explore different aspects of this interaction.

Experiment 2: Contexts and Matching Only

In Experiment 2, ambiguous replacive sentences with or without *only* were placed in contexts which favored a subject or object contrast, in order to see whether context-induced focus could produce differences in interpretation and processing of the sentences. The target sentences with *only* placed it on the same argument focused by context. If the contexts succeed in focusing a first-clause NP, then that phrase should be the most natural contrast in sentences without focus particles. If *only* marks focus independently and continues to favor an upcoming contrast, then the combination of context plus *only* should increase the ease of reading and interpreting the contrast phrase. If, instead, *only* is initially interpreted as simply harmonizing with the contextually provided focus, then *only* may be less helpful to processors in combination with context than it was alone.

Method

Materials—Two short contexts were created for each of the sentences used in Experiment 1 (contexts are in Appendix B). The sentences themselves had minor modifications (primarily shortened initial adverbial phrases, shown in Appendix A). Each of the contexts ended with an indirect question about the identity of either the subject or object of the target sentences as in (9), and the questions are shown underlined here for clarity.

- (9)
- a. Subject Context: Those Behind the Music shows can be addictive. There was one about Joe's favorite band last night, and what was particularly interesting was finding out who had respected the poor bassist.
 - b. Object Context: Those Behind the Music shows can be addictive. There was one about Joe's favorite band last night, and what was particularly interesting was finding out who that guitarist actually respected.
 - c. Target: Apparently/(only) the guitarist/respected/(only) the bassist/from the start,/not the drummer,/but eventually they all hated each other.

These contexts placed focus on the subject or object of the target sentence, respectively. The target sentences appeared in the same three conditions as Experiment 1, namely without *only*, or with *only* on the subject or the object.

There was a small amount of variation in which referents from the target sentences were mentioned in the contexts, but the majority of contexts matched Example (9). Specifically, the contexts had the following distribution of referents: in all 24 subject contexts, the object was mentioned (given), while the subject was mentioned in 3 and the contrasting remnant in 2; in 22 out of 24 object contexts, the subject was mentioned, while the object and the contrasting remnant were each mentioned in 3. This means that the contrasting remnant phrase was a new referent the majority of the time in both context types, and not predictable

from the context. In most subject contexts, the object was given and the subject was new; in most object contexts, the subject was given and the object was new.¹

There were 24 experimental items. The items were counterbalanced so that each participant saw an equal number of items in each condition across the experiment. The experiment also included sentences with multiple quantifiers in contexts, for a total of 58 items overall.

Participants—The participants in this study were 24 native English-speaking undergraduate students at Northwestern University enrolled in lower-division linguistics classes. They received course credit for their participation.

Procedure and Equipment—The procedure and equipment for this experiment were identical to that for Experiment 1, with the addition of the context paragraphs preceding each target sentence. The context paragraphs were read in several segments, with each context sentence cut roughly in half, while the target sentences were segmented as in Experiment 1. The items appeared in one of four pseudo-randomized orders such that no two consecutive items were of the same type. The interpretation questions following each sentence were the same as in Experiment 1, and the different answer choices appeared equally often on the left or right side. The experiment lasted between 30 and 60 minutes.

Results

The reading time results will be examined first. In Experiment 2, sentences with or without *only* appeared in matching contexts, and the residual reading times are shown in Table 2 (for comparison, raw times are shown in Appendix C). For each segment, a 2×2 within-subjects and within-items ANOVA was conducted with the factors of context (subject or object context) and presence of *only*. Segments are numbered starting from the subject phrase.

Participants read the subject segment slower in the subject context conditions, and the condition with *only* on the subject was especially slow. This is supported by a significant main effect of context in segment 1 ($F(1,23) = 7.6, p < .02$; $F(1,23) = 4.5, p < .05$), and a significant interaction between context and *only* ($F(1,23) = 10.2, p < .005$; $F(1,23) = 5.8, p < .05$). Both effects likely relate to the subject focus conveyed by the context or focus marker. In segment 2, the verb, participants continued to read the subject context conditions slower, so there was a significant main effect of context ($F(1,23) = 21.3, p < .001$; $F(1,23) = 18.2, p < .001$) but no other significant effects.

In segment 3, the object, participants read particularly slowly in the object context condition with *only* on the object, which raised the average reading times for object context conditions and conditions with *only*. There was a significant main effect of context type ($F(1,23) = 5.4, p < .05$, $F(1,23) = 5.8, p < .05$) and a significant main effect of the presence of *only* ($F(1,23) = 6.7, p < .05$; $F(1,23) = 8, p < .05$), but no significant interaction. Additionally, the subject context condition with subject *only* remained slower than the one without *only*.

¹When the few non-conforming items were removed from the by-items analysis of residual reading times, the results of both Experiments 2-3 remained the same. The same patterns of means were observed, and the significance of comparisons was reduced only slightly.

There were no significant effects in segment 4. To this point, then, the general pattern shows early effects of the focus provided by both *only* and context. Participants read segments containing *only* more slowly than those without, even in residual reading times; similarly, they read segments which the context focused on more slowly. This is consistent with the reading time results for Experiment 1, and suggests that some processing of focus takes place right away on a focused argument, regardless of the source of the focus.

In segment 5, the contrast phrase, participants read the conditions in subject contexts more slowly than those in object contexts, as shown in a significant main effect of context ($F(1,23) = 9.8, p = .005$; $F(1,23) = 4.9, p < .05$), but no other significant effects. Slower times for subject-biased sentences in this segment could come from the general bias towards object interpretations for ellipsis sentences. A numerical trend toward slower reading of the contrast segment without *only* did not approach significance ($p's > .3$). There were no significant effects in segment 6, the wrap-up clause.

The answers to the post-sentence interpretation questions are shown in Figure 1 for Experiments 2-3.

The conditions without *only* in Experiment 2 showed the effects of context alone in determining the contrast. Participants chose 50% subject interpretations in subject contexts, and only 18% in object contexts. With *only* focusing the same argument as each context, the results were slightly more extreme. A 2×2 within-subjects and within-items ANOVA with the factors of context and presence of *only* was conducted. Participants chose subject interpretations more often in subject contexts, as shown by a significant main effect of context ($F(1,23) = 76, p < .001$; $F(1,23) = 113, p < .001$). There was also a significant interaction between context and the presence of *only* ($F(1,23) = 6.2, p < .05$; $F(1,23) = 5.4, p < .05$). The main effect of *only* was significant by items but marginal by subjects ($F(1,23) = 3.6, p = .07$; $F(1,23) = 5.5, p < .05$). The interaction between context and *only* arises because the presence of *only* on the subject in the subject context increased subject interpretations, while *only* on the object in the object context decreased subject interpretations (i.e., led to more object interpretations).

Overall, *only* added to the bias provided by context when it was placed on the argument which the context question already focused, but its effect was smaller than the difference that context alone made to the interpretation or the difference that *only* made when alone. This was especially true for the object, which was already the preferred contrast, suggesting a floor effect.

Discussion

In this experiment, the sentences tested in isolation in Experiment 1 were placed into short context paragraphs. The contexts used a final indirect question to produce focus on a particular first-clause argument in the target sentences, and in the conditions without *only*, this focus resulted in a 32% shift in interpretations of the contrast phrase. This demonstrates that the contexts ending in indirect questions effectively placed focus on the relevant first-clause argument and affected the later choice of contrasts with the contrastive phrase. The addition of *only* on the same argument biased by context intensified the interpretation

difference, but did not facilitate processing of the contrastive phrase during reading. This suggests that *only* was interpreted as additionally focusing the answer to the question, playing a supportive role instead of independently presenting information. As such, its contrastive needs were satisfied by this preceding context, and it did not predict an upcoming contrast. During the early parts of the sentences, the primary effects were slowed reading for focused arguments, whether the focus was from context or the focus marker *only*. Like the similar effects in Experiment 1, this suggests that focus interpretation begins on the affected argument, as long as overt focus marking or previous context clarifies the position of focus.

The interpretation results also show an overall bias towards the object interpretation, since even in the subject context subject *only* condition, where both factors biased towards the subject, subject interpretation percentages were under 70%. Experiment 2 also showed an on-line subject dispreference at the contrastive phrase. These results, in line with previous ellipsis research (e.g., Carlson et al., 2009), suggest that general expectations about focus position remain active in processing even when overt focus indicators are present.

Experiment 3: Matching and Non-matching Context

In this experiment, the same contexts and items from Experiment 2 were used to explore what happens when different focus markers (context vs. *only*) indicate different arguments. It is perfectly possible for a sentence to have multiple focused arguments, and there is nothing unusual in that occurrence. In these sentences, though, the interpretation of the contrastive remnant is determined by its association with an earlier focused argument. Therefore, we might expect that the choice of interpretation would be more difficult, and the processing of the contrastive phrase might be slower, when the two cues to focus position do not indicate the same argument within the first clause.

Method

Materials—The experimental materials were the same as in Experiment 2. The subject and object contexts were used along with the target sentences with *only* on the subject or object. The neutral sentences without *only* were not used. In addition to the 24 experimental items, there were two additional sets of items with different arrangements of quantifiers, for a total of 52 items overall.

Participants—The participants in this study were 24 native English-speaking undergraduate students at Northwestern University enrolled in lower-division linguistics classes. They received course credit for their participation. These participants were distinct from those who completed Experiments 1 or 2.

Procedure and Equipment—The procedure and equipment for this experiment were identical to that for Experiment 2.

Results

Table 3 shows the residual reading time results for Experiment 3, which placed sentences with *only* in matching or conflicting contexts (raw times can be found in Appendix C).

For each segment, 2×2 within-subjects and within-items ANOVAs with the factors of context and *only* were conducted. In each case the factors had two possible values, subject or object, and both context and *only* were predicted to have similar effects (i.e., focusing that first-clause argument rather than the other one).

Early in the sentences, effects of *only* were in the same direction as earlier experiments. Participants read sentences with *only* on the subject marginally slower than those without in segment 1 and significantly slower in segment 2, the verb following the subject. The main effect of *only* in segment 1 was marginal by subjects and items ($F(1,23) = 3.2, p = .088$; $F(1,23) = 2.8, p = .109$) and no other effects were significant in segment 1. The main effect of *only* in segment 2 was significant ($F(1,23) = 25.5, p < .001$; $F(1,23) = 12.4, p < .005$) but no other effects were significant.

In segment 3, the object segment, participants read sentences in object contexts marginally slower than those in subject contexts (marginal main effect of context: $F(1,23) = 3.7, p = .066$; $F(1,23) = 2.9, p = .104$), and read especially slowly when items had a mismatch between context and *only* (significant interaction of context and *only*: $F(1,23) = 5.9, p < .05$; $F(1,23) = 9.2, p < .01$). Specifically, the two conditions with context and *only* focusing different arguments were the slowest at this segment, and the condition with subject context and subject *only* was the fastest. In segment 4, the PP, there was a continuing significant interaction between context and *only* ($F(1,23) = 5.0, p < .05$; $F(1,23) = 6.1, p < .05$) but no significant main effects. Again, the conditions with mismatches between context and *only* were read slowest. This is likely a spillover effect from the object position, as there were no differences between the conditions in this segment itself. Similarly, the effect of *only* on reading times for the verb in segment 2 is probably spillover from the subject position.

In this experiment, no significant differences appeared on the contrast phrase itself. Instead, there was a marginally significant interaction between context and *only* in segment 6, the wrap-up clause ($F(1,23) = 9.6, p < .01$, $F(1,23) = 3.3, p = .075$), but no other significant effects. As with the effects on the object and PP, this was driven by slower times for the two conditions with context and *only* focusing different arguments. For some reason, effects in Experiment 3 were delayed compared to the previous experiments.

Turning to the interpretation results (see Figure 1), *only* could mark focus on a different argument (conflicting) or the same one as the context did (matching). The matching conditions replicated the results of Experiment 2, with matching subject biases leading to over 60% subject interpretations and matching object biases leading to under 20%. The two conflicting conditions produced intermediate results, consistent with both arguments being focused. This is shown by significant main effects of both context ($F(1,23) = 19.8, p < .001$; $F(1,23) = 29.9, p < .001$) and *only* ($F(1,23) = 23.2, p < .001$; $F(1,23) = 89.4, p < .001$), with no significant interaction.

Discussion

As in Experiment 2, the sentences tested in isolation in Experiment 1 were placed into short context paragraphs. Here, though, all of the target sentences contained *only*, either on the same argument focused by context or not. In self-paced reading, there were hints of focus on

a segment slowing down its processing, either through context or the focus marker, though these were less clear than in earlier experiments. The general timing picture also showed slightly delayed processing in this experiment compared to the other two, with effects pushed one segment later than expected. Primarily, though, this experiment showed slowed processing when *only* appeared on the argument not focused by context, in several segments. This suggests that participants read slower when there was extra ambiguity in the sentences provided by the presentation of two focused choices for the remnant phrase to contrast with.

It is clear from the interpretation results that both methods of indicating focus affected the ultimate decision about the contrast. *Only* and context had relatively even and significant effects on the percentage of contrasts. The overall bias towards the object interpretation seen in the earlier experiments was replicated here as well. This harmonizes with the hypothesis that focus on the object remains a default expectation in processing.

Conclusions

In the first experiment, self-paced reading of sentences with a contrastive remnant phrase showed that the presence of *only* on an earlier NP eased the processing of the contrast. Because *only* focuses the phrase it marks, and this leads to the postulation of alternatives (Rooth, 1992), an instantiated contrast is less surprising than it otherwise would be. Specifically, processing of a focused phrase involves abstracting over its position to create an open proposition with a variable in place of the focused item: [*The guitarist*]_F *respected the bassist from the start* becomes [*x respected the bassist from the start*]. This open proposition allows contextually relevant alternative arguments to be considered in the focus position; it also provides a structure that can be copied into the ellipsis portion of the sentence for full interpretation (Merchant, 2001; Sag, 1980). This early highlighting of the position of focus made the later contrast easier to process, just as in Stolterfoht et al.'s (2007) research in German. It is unlikely that readers predicted the specific form and location of the contrast phrase, because a contrast with a focused phrase might occur in a separate clause, a separate sentence, or never be overtly stated at all. But the existence of a contrastively focused argument made the eventual search backwards from the remnant phrase to its contrast in the first clause easier.

The position of *only* was naturally important in interpretation of the sentences. Most often, the *only*-marked phrase was chosen as the first element in the contrast. But there remained a preference for contrasts with the object, even with *only* on the subject, as in many other ellipsis sentences (Carlson, 2001; Frazier & Clifton, 1998; Stolterfoht et al., 2007; etc.). Following Stolterfoht et al. (2007) and Carlson et al. (2009), I suggest this reflects the fact that focus usually occurs in the predicate in English and German. This general tendency or expectation influences interpretation even in the presence of overt focus indicators like *only*, making the object a more likely contrast than the subject overall. This last effect is consistent with the offline results of Paterson et al.'s (2007) double object research on *only*, though not their on-line results, surprisingly.

In the second pair of experiments, the sentences were placed in short contexts which ended with indirect questions. The questions focused the subject or object of the target sentences,

and the position of this focus also affected the interpretation of the contrast. When *only* focused the same argument as the question did, it had a smaller effect on the choice of the contrast than it did in isolation, and it failed to facilitate reading of the contrastive phrase. It seems that the question in prior context provided a sufficient reason for the presence of *only*, in that it could be simply helping the context to pick out the focused answer. This meant that *only* no longer predicted an upcoming contrast anymore. When *only* and the context focused different arguments, interpretation percentages were intermediate, showing that both types of focus marking successfully drew contrasts. Also, sentences were read slower in several segments with this conflicting information. Again, it is perfectly possible to have multiple foci within a sentence, but the sentence is thereby made more complicated, and resolution of the ambiguous contrast was more difficult.

Although in a different type of structure, the overall pattern of results is similar to those in Sedivy (2002). She found that *only* eased the interpretation of a reduced relative clause, as it provided a contrast between subsets of the head noun marked by *only*. But when a prior context provided a different contrast for the head noun and thus gave another reason for the presence of *only*, the particle no longer favored the reduced relative structure. The contrastive function of *only* could be satisfied by previous material instead of the upcoming structure. In addition, both projects show similarities in how different methods of overt focus marking, namely focus particles or contexts, affect sentence processing. This supports the idea that focus is a unified notion, despite different possible methods of expression.

In addition to the different reading time effects on or around the contrastive phrase, there were persistent effects on or around the subject and object, with greater time spent reading them when they were focused. In the case of *only*, these can be traced partly to the additional length of segments, though the residual reading times presented here partially correct for length differences. In the case of contexts, no such explanation is possible. The most natural possibility, then, seems to be that the overt signal to focus position and type (if contrastive focus is a specific type of focus) resulted in people more often beginning the process of focus interpretation. This extra work early in the sentences then could ease the processing of the later contrast phrase and influence its interpretation. While Birch and Rayner (1997) has long been an important reference suggesting that focused phrases are read more slowly than non-focused phrases, they have reinterpreted their results in light of later research in Birch and Rayner (2010), which finds focused and prominent phrases being read faster. Because they used eye-tracking, though, their readers were able to skip ahead, regress, and engage in a variety of reading processes not allowed in self-paced reading. The only strategy available to readers in this project would be to spend a longer time on a self-paced reading segment.

The processing effects of *only* shown here suggest that focus semantic values for a sentence, i.e. the alternative propositions proposed by Rooth (1992), can be and are calculated during the processing of the sentence. This allows a later contrast to be processed more easily than when it occurs without warning. Further, focus presented by means of a context question influences the resolution of the contrast in a similar way, and can mitigate the facilitative effects of the focus particle when it appears to make it redundant. Thus the focus particle *only* fulfills several purposes in sentence processing, both relating the sentence to preceding context and predicting upcoming contrasts.

Acknowledgments

The author wishes to thank Catherine Anderson and Michael Walsh Dickey for assistance in setting up and running the experiments, Chuck Clifton for assistance with the data analysis and revision of the paper, and several anonymous reviewers for their recommendations. All errors are the responsibility of the author. Portions of this research have been presented at the 2004 Annual CUNY Conference on Human Sentence Processing, the 2004 Annual Conference on Architectures and Mechanisms for Language Processing, and the 2005 Annual Meeting of the Linguistic Society of America. This research was partially supported by a KBRIN-AREA grant from the KBRIN-INBRE program funded by NIH.

References

- Altmann G, van Nice KY, Garnham A, Henstra JA. Late closure in context. *Journal of Memory and Language*. 1998; 38:459–484.
- Aoshima S, Phillips C, Weinberg A. Processing filler-gap dependencies in a head-final language. *Journal of Memory and Language*. 2004; 51:23–54.
- Birch S, Rayner K. Linguistic focus affects eye movements during reading. *Memory and Cognition*. 1997; 25:653–660. [PubMed: 9337583]
- Birch S, Rayner K. Effects of syntactic prominence on eye movements during reading. *Memory and Cognition*. 2010; 38:740–752. [PubMed: 20852237]
- Carlson K. The effects of parallelism and prosody on the processing of gapping structures. *Language and Speech*. 2001; 44:1–26. [PubMed: 11430186]
- Carlson, K. Outstanding Dissertations in Linguistics series. New York: Routledge; 2002. Parallelism and prosody in the processing of ellipsis sentences.
- Carlson K, Dickey MW, Kennedy C. Structural economy in the processing and representation of gapping sentences. *Syntax*. 2005; 8:208–228.
- Carlson K, Dickey MW, Frazier L, Clifton C Jr. Information structure expectations in sentence comprehension. *Quarterly Journal of Experimental Psychology*. 2009; 62:114–139.
- Cinque G. A null theory of phrase and compound stress. *Linguistic Inquiry*. 1991; 24:239–297.
- Clifton, C.; Bock, J.; Rado, J. Effects of the focus particle only and intrinsic contrast on comprehension of reduced relative clauses. In: Kennedy, A.; Radach, R.; Heller, D.; Pynte, J., editors. *Reading as a perceptual process*. Amsterdam: Elsevier; 2000. p. 591–619.
- Drubig, HB. Arbeitsbericht #51. University of Tuebingen; 1994. Island constraints and the syntactic nature of focus and association with focus.
- Filik R, Paterson KB, Liversedge SP. Parsing with focus particles in context: Eye movements during the processing of relative clause ambiguities. *Journal of Memory and Language*. 2005; 53:473–495.
- Frazier L, Clifton C Jr. Successive cyclicity in the grammar and the parser. *Language and Cognitive Processes*. 1989; 4:93–126.
- Frazier L, Clifton C Jr. Comprehension of sluiced constituents. *Language and Cognitive Processes*. 1998; 13:499–520.
- Frazier L, Flores d'Arcais GB. Filler driven parsing: A study of gap-filling in Dutch. *Journal of Memory and Language*. 1989; 28:331–344.
- Gussenhoven, C. Focus and sentence accents in English. In: Bosch, P.; van der Sandt, R., editors. *Focus and natural language processing*. Vol. 3. Heidelberg: IBM Deutschland; 1994. p. 83–92.
- Hoeks JCJ, Redeker G, Hendriks P. Fill the gap! Combining pragmatic and prosodic information to make gapping easy. *Journal of Psycholinguistic Research*. 2009; 38:221–235. [PubMed: 19347585]
- Kadmon, N. *Formal pragmatics: Semantics, pragmatics, presupposition, and focus*. Oxford: Blackwell; 2001.
- Kiss KE. Identificational focus vs. information focus. *Language*. 1998; 74:245–273.
- Liversedge SP, Paterson KB, Clayes EL. The influence of *only* on syntactic processing of “long” relative clause sentences. *The Quarterly Journal of Experimental Psychology*. 2002; 55A:225–240. [PubMed: 11873848]

- Merchant, J. The syntax of silence: Sluicing, islands, and identity in ellipsis. Oxford: Oxford University Press; 2001.
- Ni W, Crain S, Shankweiler D. Sidestepping garden paths: Assessing the contributions of syntax, semantics and plausibility in resolving ambiguities. *Language and Cognitive Processes*. 1996; 11:283–334.
- Paterson KB, Liversedge SP, Underwood G. The influence of focus operators on syntactic processing of “short” reduced relative clause sentences. *The Quarterly Journal of Experimental Psychology*. 1999; 52A:717–737.
- Paterson KB, Liversedge SP, Filik R, Juhasz BJ, White SJ, Rayner K. Focus identification during sentence comprehension: Evidence from eye movements. *The Quarterly Journal of Experimental Psychology*. 2007; 60:1423–45. [PubMed: 17853249]
- Rochmont, MS.; Culicover, PW. English focus constructions and the theory of grammar. Cambridge: Cambridge University Press; 1990.
- Rooth M. A theory of focus interpretation. *Natural Language Semantics*. 1992; 1:75–116.
- Sag, I. Deletion and logical form. New York: Garland Publishing; 1980.
- Schwarzschild R. Givenness, AvoidF and other constraints on the placement of accent. *Natural Language Semantics*. 1999; 7:141–177.
- Sedivy JC. Invoking discourse-based contrast sets and resolving syntactic ambiguities. *Journal of Memory and Language*. 2002; 46:341–370.
- Selkirk, EO. Phonology and syntax: The relation between sound and structure. Cambridge, MA: MIT Press; 1984.
- Selkirk, EO. Sentence prosody: Intonation, stress and phrasing. In: Goldsmith, J., editor. *Handbook of Phonological Theory*. Oxford: Blackwell; 1995. p. 550-569.
- Stolterfoht B, Friederici AD, Alter K, Steube A. Processing focus structure and implicit prosody during reading: Differential ERP effects. *Cognition*. 2007; 104:565–590. [PubMed: 16989798]

Appendix A

Sentences from Experiments 1-3; slashes indicate segmentation for self-paced reading. Differing initial phrases in Experiments 2-3 shown in parentheses after each sentence.

1. On Monday/(only) the curator/embarrassed/(only) the gallery owner/in public,/not the artist,/though later everyone made up. (Experiments 2-3: Actually)
2. At the international party/(only) the Brazilian/kissed/(only) the German/on the lips,/not the Korean,/after the flaming dessert was served. (Experiments 2-3: Apparently)
3. Apparently/(only) the guitarist/respected/(only) the bassist/from the start,/not the drummer,/but eventually they all hated each other. (Experiments 2-3: Reportedly)
4. On Friday/(only) the clown/jostled/(only) the lion tamer/during the opening parade,/not the juggler,/and no one in the crowd saw it anyway. (Experiments 2-3: In fact)
5. Last weekend/(only) the rifleman/beat/(only) the foot soldier/at chess,/not the mercenary,/and the lieutenant refused to play anymore. (Experiments 2-3: Actually)
6. After Thursday/(only) the cashier/avoided/(only) the salesman/at work,/not the manager,/until a juicy new piece of gossip got around. (Experiments 2-3: On Thursday)

7. On Tuesday/(only) the psychiatrist/convinced/(only) the neurologist/of a diagnosis,/not the surgeon,/and the nurses were surprised. (Experiments 2-3: Reportedly)
8. During lunch/(only) the roofer/contacted/(only) the builder/for instructions,/not the foreman,/and the results were disastrous. (Experiments 2-3: Actually)
9. At the reception/(only) the geographer/noticed/(only) the economist/by the drinks,/not the writer,/and no one enjoyed the appetizers. (Experiments 2-3: Apparently)
10. On Sunday/(only) the butcher/greeted/(only) the baker/with warmth,/not the chef,/though they had been great pals on Saturday. (Experiments 2-3: In fact)
11. After the opening/(only) the make-up artist/praised/(only) the set designer/for originality,/not the costumer,/and everyone else said nothing. (Experiments 2-3: In the end)
12. At the games/(only) the wrestler/teased/(only) the gymnast/after competition,/not the fencer,/although the coaches weren't sure it was wise. (Experiments 2-3: Apparently)
13. After dinner/(only) the judge/joined/(only) the diplomat/for coffee,/not the senator,/although other people had been invited. (Experiments 2-3: Reportedly)
14. On Wednesday/(only) the banker/spotted/(only) the politician/near City Hall,/not the priest,/but then a moving truck got in the way. (Experiments 2-3: Apparently)
15. In September/(only) the skier/warned/(only) the snowboarder/about the weather,/not the luger,/although the athletes were all supposed to be friends. (Experiments 2-3: Actually)
16. On Friday/(only) the sculptor/informed/(only) the photographer/about the art show,/not the painter,/and no one even mentioned the etcher. (Experiments 2-3: In fact)
17. In the novel/(only) the baron/challenged/(only) the count/to a duel,/not the prince,/and then there was a flashback to their childhood. (Experiments 2-3: Actually)
18. On Monday/(only) the smuggler/followed/(only) the gangster/through the city,/not the mobster,/and the feds eavesdropped on the whole event.
19. In the confusion/(only) the guard/punched/(only) the detective/in the head,/not the robber,/as everyone could see from the videotape.
20. At the convention/(only) the minister/recognized/(only) the priest/from across the room,/not the rabbi,/but they just waved at each other. (Experiments 2-3: Actually)
21. In the epic tale/(only) the elf/rescued/(only) the dwarf/in a dramatic fashion,/not the troll,/since there were no friendly wizards around. (Experiments 2-3: Apparently)

22. On Tuesday/(only) the farmer/supported/(only) the rancher/at the council meeting,/not the forester,/though the council took no action anyway. (Experiments 2-3: Reportedly)
23. At the trial/(only) the bodyguard/supported/(only) the butler/in his testimony,/not the chauffeur,/but no one survived the cross-examination. (Experiments 2-3: In the end)
24. After the storm/(only) the hunter/heard/(only) the fisherman/in the woods,/not the camper,/so a search party was sent out later. (Experiments 2-3: Apparently)

Appendix B

Contexts from Experiments 2-3; indirect questions underlined. Target sentences are in Appendix A.

- 1a Subject: You missed a real scene at the art gallery the other night, with various people fighting with the gallery owner. There was lots of gossip about who had really embarrassed the gallery owner.
- 1b Object: You missed a real scene at the art gallery the other night, with various people fighting with the gallery owner or the artist. For a while no one was sure who the curator embarrassed.
- 2a Subject: The international students put on a very amusing skit at the end-of-summer party, with the Brazilian and Korean students as real Don Juans. The campus newspaper wanted to print a description of the plot, but for a while they weren't clear on who kissed the German student.
- 2b Object: The international students put on a very amusing skit at the end-of-summer party, with the Brazilian as a latter-day Don Juan. The campus newspaper wanted to print a description of the plot, but for a while they weren't clear on who the Brazilian student kissed.
- 3a Subject: Those Behind the Music shows can be addictive. There was one about Joe's favorite band last night, and what was particularly interesting was finding out who had respected the poor bassist.
- 3b Object: Those Behind the Music shows can be addictive. There was one about Joe's favorite band last night, and what was particularly interesting was finding out who that guitarist actually respected.
- 4a Subject: There have been recriminations ever since the day of the parade during which the elephant tripped up a bunch of people at the back. The trapeze artist was wondering who ended up jostling the lion tamer.
- 4b Object: There have been recriminations ever since the day of the parade during which the elephant tripped up a bunch of people at the back. The trapeze artist was wondering who the clown ended up jostling.

- 5a** Subject: There were only a few guys at the outpost who could play chess, but they got really obsessed about it. It was very important, for example, to establish who beat the foot soldier yesterday during the round-robin tournament.
- 5b** Object: There were only a few guys at the outpost who could play chess, but they got really obsessed about it. It was very important, for example, to establish who the rifleman beat yesterday during the round-robin tournament.
- 6a** Subject: Trudy tells that new cashier and the gullible manager the oddest things about her coworkers. I could tell which story she told by watching who avoided the salesman.
- 6b** Object: Trudy tells the new cashier the oddest things about her co-workers, including the unpopular manager. I could tell how far Trudy got in the story by seeing who the cashier interacted with.
- 7a** Subject: At the hospital, a lot of doctors seem to think they're infallible, even when other doctors disagree with them. After the accident, people wondered who managed to convince the arrogant neurologist in the Thompson case.
- 7b** Object: At the hospital, a lot of doctors seem to think they're infallible, even when other doctors disagree with them. After the accident, people wondered who the psychiatrist managed to convince in the Thompson case.
- 8a** Subject: Getting a house built can be a real mess, especially when the lines of command aren't clear and messages get lost. The collapse of the second floor made it important to find out who contacted the builder.
- 8b** Object: Getting a house built can be a real mess, especially when the lines of command aren't clear and messages get lost. The collapse of the second floor made it important to find out who the roofer contacted.
- 9a** Subject: A murder took place at the reception, and it looked like poison, so suddenly everyone's movements were under scrutiny. Police first asked who noticed the economist by the drinks.
- 9b** Object: A murder took place at the reception, and it looked like poison, so suddenly everyone's movements were under scrutiny. Police first asked who the geographer noticed by the drinks.
- 10a** Subject: In a small town like Ashland, everyone sees everyone else at church, and quarrels get discussed by the whole town. Last week the talk was all about who greeted the baker at church.
- 10b** Object: In a small town like Ashland, everyone sees everyone else at church, and quarrels get discussed by the whole town. Last week the talk was all about who the butcher greeted at church.
- 11a** Subject: Everyone had high hopes for the new play, and so it was disappointing when it was booed off the stage. The sets had been a particular problem, and I was interested to see who tried to comfort the set designer.

- 11b** Object: Everyone had high hopes for the new play, and so it was disappointing when it was booed off the stage. The sets and costumes had been particular problems, and I was interested to see who the make-up artist tried to comfort.
- 12a** Subject: At the Olympics, a lot of the athletes are nervous, though friends sometimes try to joke each other out of their moods. The reporter was interested in who would tease the nervous gymnast.
- 12b** Object: At the Olympics, a lot of the athletes are nervous, though friends sometimes try to joke each other out of their moods. The reporter was interested in who the happy-go-lucky wrestler would tease.
- 13a** Subject: A lot of Republican bigwigs were at a fancy dinner party at the embassy the other night. The newspapers were particularly interested in who stayed around for coffee with the diplomat.
- 13b** Object: A lot of Republican bigwigs were at a fancy dinner party at the embassy the other night. The newspapers were particularly interested in who the judge stayed to have coffee with afterwards.
- 14a** Subject: A strange break-in happened at City Hall the other night, and only the records from a case involving a politician were stolen. The detectives wondered if anyone saw the politician near City Hall last night.
- 14b** Object: A strange break-in happened at City Hall the other night, and only the records from a case involving a politician were stolen. The detectives wondered if the banker saw anyone near City Hall last night.
- 15a** Subject: At the practice session for the Winter Olympics last week, a fierce wind made the advanced slope really dangerous. A snowboarder went out for one last run anyway and the coach asked if anyone had told him about the weather.
- 15b** Object: At the practice session for the Winter Olympics last week, a fierce wind made the advanced slope really dangerous. A snowboarder and a luger went out for one last run anyway and the coach asked if anyone had told them about the weather.
- 16a** Subject: There was an art competition at the high school and all the senior artists hoped they would win it. When the prizes were announced, the teacher asked who would tell the photographer about it.
- 16b** Object: There was an art competition at the high school and all the senior artists hoped they would win it. When the prizes were announced, the teacher asked who would tell the others about it.
- 17a** Subject: I just read a novel that was full of swordplay and perilous quests involving a bunch of noblemen. The count fought so many duels that I forgot just who challenged the count to a duel in the first chapter.
- 17b** Object: I just read a novel that was full of swordplay and perilous quests involving a bunch of noblemen. The baron fought so many duels that I forgot just who the baron challenged to a duel in the first chapter.

- 18a** Subject: The last episode of “Law and Order” had such a variety of criminals tailing each other that even Briscoe must have lost track. The crucial thing is who followed the gangster through the city that night.
- 18b** Object: The last episode of “Law and Order” had such a variety of criminals tailing each other that even Briscoe must have lost track. The crucial thing is who the smuggler followed through the city that night.
- 19a** Subject: The security guard was testifying in a robbery case, and it went smoothly up until the description of the fight between the cops, the guard, and the criminals. The embarrassing thing was who punched the detective at the end.
- 19b** Object: The security guard was testifying in a robbery case, and it went smoothly up until the description of the fight between the cops, the guard, and the criminals. The embarrassing thing was who the guard punched at the end.
- 20a** Subject: Three religious leaders who were old boyhood friends attended the Southern Interfaith Convention, though they no longer talked each other. It wasn’t clear at first who recognized the priest.
- 20b** Object: Three religious leaders who were old boyhood friends attended the Southern Interfaith Convention, though they no longer talked each other. It wasn’t clear at first who the minister recognized.
- 21a** Subject: The band of adventurers had to split up to explore the system of caves. Members of the main group were surprised to hear who came to the dwarf’s aid after the fighting started.
- 21b** Object: The band of adventurers had to split up to explore the system of caves. Members of the main group were surprised to hear who the elf managed to rescue when the fighting started.
- 22a** Subject: The town is being split into factions over land disputes, like the one involving that cattle ranch by the forest. The last council meeting was notable mainly for who supported the rancher this time.
- 22b** Object: The town is being split into factions over land disputes, like the one involving that cattle ranch by the forest. The last council meeting was notable mainly for who the farmer supported this time.
- 23a** Subject: After old Mr. Hugginson was murdered, the servants all had conflicting stories to tell. By the time of the trial, no one was sure who would support the butler in his testimony.
- 23b** Object: After old Mr. Hugginson was murdered, the servants all had conflicting stories to tell. By the time of the trial, no one was sure who the bodyguard would support in his testimony.
- 24a** Subject: The campground was full in the summertime, so everyone could hear other parties despite the distance between campsites. After the terrible storm, the rangers came around to check up on everyone, and they asked who had heard the fisherman recently.

- 24b** Object: The campground was full in the summertime, so everyone could hear other parties despite the distance between campsites. After the terrible storm, the rangers came around to check up on everyone, and they asked who the hunter had heard recently.

Appendix C

Tables of raw reading times for Experiments 1-3: See Table file, Tables A1–A3.

Table A1

Raw reading times for segments in Experiment 1, starting with the subject phrase*

	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
Conditions	Subject	Verb	Object	PP	Contrast	Final clause
No only	731	621	859	1140	1401	1688
Subject only	1006	655	869	1153	1283	1584
Object only	772	618	1126	1087	1193	1672

* Reading times were averaged over all trials, with times under 200 ms or over 4000 ms excluded.

Table A2

Raw reading times for segments in Experiment 2, starting with the subject phrase

	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
Conditions	Subject	Verb	Object	PP	Contrast	Final clause
Subject context						
No only	567	539	683	901	1573	1475
Subject only	776	598	728	849	1502	1702
Object context						
No only	589	499	719	877	1362	1652
Object only	521	490	1002	913	1317	1640

Table A3

Raw reading times for segments in Experiment 3, starting with the subject phrase

	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
Conditions	Subject	Verb	Object	PP	Contrast	Final clause
Subject context						
Subject only	802	629	767	993	1303	1655
Object only	609	559	1047	1092	1242	1843
Object context						
Subject only	703	678	928	1076	1332	1767
Object only	611	558	1044	947	1198	1649

Figure 1.
End-of-sentence interpretation percentages, Experiments 2-3

Table 1
Residual reading times for segments in Experiment 1, starting with the subject phrase

Segment 1		Segment 2		Segment 3		Segment 4		Segment 5		Segment 6	
Conditions	Subject	Verb	Object	PP	Contrast	Final clause					
No only	-117	-138	-43	159	427	10					
Subject only	1	-97	-23	199	296	-126					
Object only	-80	-125	93	119	221	-73					

Table 2
Residual reading times for sentence segments in Experiment 2, starting with the subject phrase

	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
Conditions	Subject	Verb	Object	PP	Contrast	Final clause
Subject context						
No only	-544	-496	-457	-297	370	-287
Subject only	-445	-436	-408	-352	305	-62
Object context						
No only	-524	-535	-422	-321	159	-114
Object only	-590	-548	-248	-295	115	-116

Table 3
Residual reading times for segments in Experiment 3, starting with the subject phrase

	Segment 1	Segment 2	Segment 3	Segment 4	Segment 5	Segment 6
Conditions	Subject	Verb	Object	PP	Contrast	Final clause
Subject context						
Subject only	-50	-35	11	134	528	269
Object only	-132	-120	203	253	498	460
Object context						
Subject only	-127	-5	224	273	483	404
Object only	-141	-124	183	103	410	284