Structural economy in the processing and representation of gapping sentences

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Abstract. The processing of ellipsis sentences can provide clues to their structure, as their structure can influence their processing. We present two studies examining the processing of a previously unexplored subclass of ellipsis sentence, gapping sentences in which one of the remnants is a preposed PP (PPGs). Like some other gapping structures, PPGs are ambiguous between readings in which a DP remnant is interpreted as a subject or as an object. However, we find that PPGs exhibit a weaker and more flexible object bias than other ambiguous gapping sentences (Carlson 2001a, 2002), one comparable to clausal ellipsis constructions like comparatives and replacives. We argue that this result supports the syntactic assumption that gapping is a non-uniform phenomenon: PPGs involve clausal conjunction on either reading, much like comparative ellipsis, while regular gapping has a non-ellipsis alternative (Johnson 1996), which underlies the strong preference for an object reading.

Keywords: gapping, ellipsis, sentence processing, parallelism, prosody

1. Introduction

Work on the processing of different sentence types can provide clues to their structure, since structure can influence processing. For example, work on the processing of wh-extractions (Stowe 1986; Pickering & Traxler 1996) shows that perceivers are sensitive to strong islands in their on-line comprehension of movement dependencies. Similarly, work on scrambling (Clahsen & Featherston 1999, Ueno & Kluender 2003) suggests that scrambling is processed like other movement dependencies, as would be expected if scrambling involves movement (Webelhuth 1989, e.g.). This paper makes a similar connection between syntactic processing and syntactic structure by examining ambiguous gapping sentences with preposed PPs.

Descriptively, gapping structures are conjoined clauses in which all material has been omitted from the second conjunct except for two XP 'remnants'. The omitted material is understood to be identical to the first conjunct minus those XPs that are parallel to the remnants (if the omitted material is non-identical, sentences are processed much slower; Black, Coltheart, & Byng 1987). The examples in (1a-c) exemplify the phenomenon, and show that the remnants can range from arguments to simple adjuncts to subordinate clauses. (See Hankamer 1971 for a comprehensive survey of varieties of gapping.)

(1) a. Kim enjoys backgammon, and Lee ø chess.

b. Julian slept for 8 hours, and Olive ø for 10 hours.

c. Nolan clapped when he saw the balloon, and Alana ø when she saw the train.

There are two competing theoretical analyses of gapping. The first, which we will refer to as the 'ellipsis analysis', assigns gapping to the large family of coordinate ellipsis structures (Ross

1967, Hankamer 1971, Sag 1980, Kuno 1981, Pesetsky 1982, Schwarz 1999, 2000). On this view, (1a) is derived by first scrambling the remnant DPs out of the clause in which they are generated, and then deleting the clause, as shown in (2).[1,2]

(2) [$_{IP}$ Kim enjoys backgammon] and [$_{IP}$ Lee [$_{IP}$ chess ~~[$_{IP}$ t_{Lee} enjoys t_{chess}]~~]]

The second analysis denies that examples like those in (1) involve ellipsis, instead claiming that they involve across-the-board (ATB) movement of a verbal constituent, and that the gapped 'clause' is actually a VP or some other sub-clausal constituent (Johnson 1996, 2000; cf. Steedman 2000 for a related analysis in terms of Combinatory Categorial Grammar). On this view, which we refer to as the 'ATB analysis', the structure of (1a) is as shown in (3).

(3) [$_{IP}$ Kim [$_{vP}$ enjoys [$_{VP}$ [$_{VP}$ t_{Kim} t_{enjoys} backgammon] and [$_{VP}$ Lee t_{enjoys} chess]]]]

The different structural assumptions of the two analyses generate different predictions about the distribution and interpretation of gapping structures, most of which we do not have space to review here (see Johnson 1996 and Coppock 2002 for detailed discussion). Of interest to us is the fact that the structures posited by these analyses also lead to different predictions about the processing of gapping structures. All other things being equal, ATB structures should be easier to process than ellipsis structures, since they involve construction of smaller constituents (conjoined VPs or VP-internal constituents rather than clauses) in processing.[3] The goal of this paper is to show that the processing data supports a 'mixed' analysis of gapping, in which not all

surface strings that have the basic descriptive characteristics of gapping have the same derivations: some involve ellipsis, and some involve ATB movement.

Our empirical focus is on gapping structures in which there is more than one DP in the antecedent clause that could be construed as parallel to a DP remnant, resulting in ambiguity in the gapping clause. For example, the second conjunct in (4) is ambiguous between the interpretation in (4a), in which *Samuel* is understood as parallel to the subject of the first clause (*Robert*), and the interpretation in (4b), in which it is understood as parallel to the object of the first clause (*the guests*). We will refer to these interpretations as the *subject reading* and *object reading*, respectively.

(4) Somehow, Robert insulted the guests during dinner and Samuel during the dance.

a. Samuel insulted the guests during the dance. (subject reading)

b. Robert insulted Samuel during the dance. (object reading)

In previous studies of the processing of ambiguous gapping sentences like (4), Carlson (2001a, 2002) found clear evidence for a strong bias in favor of the object reading. Carlson argues that this bias arises precisely because an ATB analysis is possible for the object reading of (4) (as well as an ellipsis analysis), but only an ellipsis analysis is possible for the subject reading. The ATB structure, which is simpler than the ellipsis structure, is preferred for reasons of structural economy (Frazier 1979, 1987), resulting in an overall bias for the object reading.

If this hypothesis is correct – if the object bias in examples like (4) is essentially structural in nature – then we predict that ambiguous gapping structures in which both the subject and object

readings require an ellipsis analysis should fail to display the same bias. Gapping sentences with preposed temporal and locative PPs (PPGs) such as (5) provide exactly the test case we need.

(5) At Marshall Field's, Melissa saw a classmate, and at J.C. Penney's, Sabrina.

a. Sabrina also saw a classmate. (subject reading)

b. Melissa also saw Sabrina. (object reading)

Like (4), (5) has both the subject reading paraphrased in (5a) and the object reading paraphrased in (5b). However, unlike (4), the object reading of (5b) must be derived via ellipsis rather than ATB movement: assuming that preposed temporal and locative PPs are left-adjoined to IP (cf. Reinhart 1983, Dickey 2001), the fact that the second conjunct of (5) contains a preposed PP indicates that it has clausal structure.

Two studies examined the interpretation of PPGs. In both studies, PPGs showed a weaker object preference than other gapping sentences (Carlson 2001a, 2002), similar in size to the bias found for uncontroversial cases of clausal ellipsis like comparatives and replacives. This object bias was also more flexible than the object bias in typical gapping sentences: prosodic similarity between parallel DPs in the target and antecedent clauses had a stronger effect on the interpretation of PPGs than has been found for other gapping sentences. Again, the size of the effects was comparable to the size of prosodic effects found for other types of clausal ellipsis.

These results indicate that Carlson's explanation of the object preference in examples like (4) is correct: it is structural in nature, due to the possibility of an alternative non-ellipsis ATB analysis. When a non-ellipsis analysis is unavailable, as in PPGs, this effect disappears. This result is expected only if gapping is actually a non-uniform phenomenon: neither always ellipsis

nor always coordination of sub-clausal categories. Instead, 'true' gapping involves clausal ellipsis (Sag 1980, Coppock 2002), but some surface strings that appear to be gapping structures actually involve coordination of sub-clausal constituents.

Finally, the structural difference between PPGs and typical gapping sentences also means that the remaining object bias seen for PPGs must be due to non-structural factors. We suggest that this residual bias is rooted in information structure. The remnant in an ellipsis construction must be focused, as must its correlate in an antecedent clause (Hankamer 1971, Sag 1980, Rooth 1992, Merchant 2001). English sentences are usually constructed with subjects as topics and objects as new information, so objects are more commonly focused than subjects (Selkirk 1984, 1995, Gussenhoven 1994). If perceivers expect focus on the object, then this information structure regularity could explain the object bias found for a wide variety of ambiguous ellipsis sentences (Frazier & Clifton 1998, Carlson 2001ab, 2002, Carlson et al. 2003).

The rest of this paper will proceed as follows. First, previous results demonstrating the strong object bias found for ambiguous gapping sentences will be presented, along with discussion of the structural differences between PPGs and other ambiguous gapping sentences. Then, two studies examining the processing of PPGs will be presented, along with comparisons of the PPG results to results for other ambiguous gapping sentences and comparative ellipsis. Finally, the grammatical and psycholinguistic implications of the results will be presented in the Conclusion.

2. Ambiguities in Gapping

As noted above, globally ambiguous gapping sentences like (6) have a strong object bias in their interpretation, though the preferences can be affected by prosody (Carlson 2001a, 2002). An auditory questionnaire tested the prosodic contours sketched in (6), which differ in the placement

of the first L+H* accent on the subject (SA condition) or the object (OA condition) of the first clause:

(6) Somehow, Robert insulted the guests during dinner and Samuel during the dance.

SA	H* L-	L+H*		L+H* L-H%	L+H*	L+H*L-L%
OA	H* L-		L+H*	L+H* L-H%	L+H*	L+H*L-L%

This prosodic manipulation affected interpretation preferences, with the Subject Accent prosody producing 33% subject responses, and the OA prosody producing 14%.

Participants provided reliably more subject-interpretation responses for SA than for OA sentences. Nevertheless, a clear object bias remained: even the subject accent elicited fewer than 50% subject responses. This result is in line with written questionnaire results for gapping sentences. For example, Carlson (2001a, 2002) also found that lexical similarity, or parallelism, between the remnant DP and the main clause subject could facilitate subject interpretations, but even strong parallelism as in (7) did not raise subject responses above chance levels.

(7) Josh visited the office during the vacation and Sarah during the week.

Something about gapping sentences creates a strong object bias in their interpretation, one which cannot be entirely overridden by parallelism or prosodic marking.

As discussed above, Carlson (2001a, 2002) argues that the source of this strong object bias is structural, due to the fact that the connective *and* may conjoin both VPs and clausal constituents. In the case of the subject reading, this flexibility is irrelevant: the fact that the remnant *Sarah* is

interpreted as a subject indicates that it originates in an external argument position, which in turn means that the gapped constituent is clausal; for the purposes of this paper, we assume that the category of this constituent is IP.[4] The surface form is derived by scrambling the remnants to an IP-external position and eliding the evacuated IP, as shown in (8).[5]

(8) [$_{IP}$ Josh visited the office during the vacation] and [$_{IP}$ Sarah [$_{IP}$ during the week ~~[$_{IP}$ t$_{Sarah}$ visited the office t$_{during}$]]]~~

In contrast, on the object reading, the surface string in (7) is compatible with two structurally distinct parses. Under the ellipsis analysis represented in (9a), the remnants move out of a conjoined IP that has been deleted under identity with the antecedent clause; under the ATB analysis shown in (9b), (7) involves conjoined VPs out of which the verb *visit* has raised (to vP).

(9) a. [$_{IP}$ Josh visited the office during the vacation] and [$_{IP}$ Sarah [$_{IP}$ during the week ~~[$_{IP}$ Josh [$_{VP}$ visited t$_{Sarah}$ t$_{during}$]]~~]]

b. Josh [$_{vP}$ visited [$_{VP}$ [$_{VP}$ t$_{visit}$ the office during the vacation] and [$_{VP}$ t$_{visit}$ Sarah during the week]]

Crucially, in the ATB structure (9b), the remnant NP *Sarah* is in its canonical direct object position. This parse therefore involves both less structure and fewer derivational steps than either the object ellipsis parse (9a) or the subject ellipsis parse (8), which require clausal coordination and multiple applications of scrambling. Thus the structure in (9b), and the object reading

associated with it, should be preferred for reasons of structural economy, generating an overall preference for the object interpretation in processing.

This explanation captures the object bias for ambiguous gapping sentences and assimilates it to the broader class of structural-economy-driven preferences in processing (Frazier 1979, 1987). It also makes two specific predictions. First, it predicts that if the simpler, ATB analysis of an ambiguous gapping sentence is unavailable or impossible, the strong object bias should be reduced or eliminated. In other words, ambiguous gapping sentences which have only clausal ellipsis analyses available to them should elicit fewer object interpretations than the ambiguous gapping sentences previously studied. Second, ambiguous gapping sentences without ATB alternatives should exhibit more flexible biases than other gapping sentences: once the overriding influence of the structural preference is eliminated, more subtle factors (such as parallelism) may come into their own.

These predictions, which are specific to gapping, are corroborated by processing results for non-gapping clausal ellipsis sentences, such as comparative ellipsis. Consider for example the comparative ellipsis construction in (10), which has both the subject reading paraphrased in (10a) and the object reading in (10b).

(10) Tasha called Bella more often than the doctor.

a. … more often than the doctor called Bella. (subject reading)

b. … more often than Tasha called the doctor. (object reading)

A distinguishing property of comparatives is that the constituent introduced by *than* is necessarily clausal; specifically, it is a CP in which *wh*-movement has raised a degree term from

a position corresponding to the morphologically comparative element in the matrix (see Kennedy 2002 for an overview). This means that both the subject and object readings of (10) involve clausal ellipsis, as illustrated in (11):

(11) a. … more often than [$_{CP}$ *wh* [$_{IP}$ the doctor ~~[$_{IP}$ t$_{doctor}$ called Bella t$_{wh}$ often]~~]]

b. … more often than [$_{CP}$ *wh* [$_{IP}$ the doctor ~~[$_{IP}$ Tasha called t$_{doctor}$ t$_{wh}$ often]~~]]

In processing, ambiguous examples of comparative ellipsis show a mild object bias, but the preferences are more strongly affected by lexical and prosodic parallelism than the interpretations for gapping sentences are (Carlson 2001b, 2002; Carlson & Dickey 2003, 2004). Comparative ellipsis sentences with Subject Accent prosody and subject-biased lexical parallelism have received up to 80% subject responses, while with Object Accent and object-biased lexical parallelism, under 10% subject responses are given. The generalization, then, is that structural preferences take precedence over all other factors – if a more economical parse is available, then it is chosen – but in the absence of a structural bias towards one reading over another, other factors come into play. This means that our predictions for PPG sentences should be realized, and PPGs should join the class of clausal ellipsis types.

Our goal in this paper is to confirm the predictions outlined above by looking directly at gapping constructions. As discussed in the introduction, ambiguous gapping sentences can contain preposed adverbials of time and place, as in the PPG example (12):

(12) At Marshall Field's, Melissa saw a classmate, and at J.C. Penney's, Sabrina.

These adverbials, commonly called "frame adverbials" (Kuno 1975), adjoin to clausal projections rather than VPs (Reinhart 1983, Dickey 2001). For example, they appear to the left of material like wh- phrases, which are unambiguously in the highest and leftmost position in the clause:

(13) a. In the morning, who did John call?

b. *Who in the morning did John call?

Similarly, they appear to the left of clause-peripheral elements such as topicalized and left-dislocated phrases (Dickey 2001). Further, they are consistently outside the scope of quantifiers and sentence-level operators such as imperatives (Geis 1986, Cinque 1990). The fact that they appear to the left of elements which are at the very edge of a clause, and remain outside the scope of elements (such as imperative operators or quantifiers) which take clauses as their semantic arguments, indicates that they must adjoin to some clause-level category.

Furthermore, these adverbials appear to be in a clause-peripheral syntactic position at every level of syntactic representation. Unlike PPs which are arguments of a sentence's verb, these PPs do not reconstruct to any position below the subject (Reinhart 1983, Speas 1990):

(14) a. In Kissinger's$_i$ hometown, he$_i$ is a hero.

b. *In Kissinger's$_i$ office, he$_i$ put a couch.

In (14b), the PP *in Kissinger's office* is an argument of the verb *put*; as a result, it reconstructs to a position inside the verb phrase by LF. This puts the name *Kissinger* in a position where it is c-

commanded by the coreferential subject pronoun *he*, triggering a Condition C violation. In (14a), in contrast, there is no Condition C violation, despite the fact that the subject pronoun and *Kissinger* are coreferential. Since the frame adverbial in (14b) is not an argument of the verb, it does not have a reason to reconstruct to any lower position in the clause and remains in its surface position. This fact suggests that preposed frame adverbials are not associated with a projection any smaller than a clause at any point in the syntactic derivation of a sentence. (See Dickey 2001 for further arguments that frame adverbials consistently occupy a position at the left edge of a clausal constituent; see also Haegeman 2003.)[6]

Preposed frame adverbials therefore constrain the syntactic analyses available for a gapping sentence, because a preposed PP in the second conjunct requires it to have clausal structure. Specifically, a gapping sentence with preposed PPs such as (15) has the structural options shown in (15a-b).

(15) In the morning, Jason called a plumber, and in the afternoon, Brian.

a. … [$_{IP}$ in the afternoon [$_{IP}$ Brian ~~[$_{IP}$ t_{Brian} called a plumber]~~]] (subject reading)

b. … [$_{IP}$ in the afternoon [$_{IP}$ Brian ~~[$_{IP}$ Jason called t_{Brian}]~~]] (object reading)

Since the preposed PP in the second conjunct eliminates the possibility of a non-clausal ATB parse of the object reading, it neutralizes the potential structural difference between the two interpretations. PPGs therefore provide the crucial case for testing the two predictions of Carlson's account described above. If the structural explanation of the object preference in ambiguous gapping constructions is correct, PPGs should show a weaker object bias than other ambiguous gapping sentences of the sort Carlson tested (such as (7), above) and should show

greater flexibility in their interpretation in response to parallelism manipulations. These predictions were tested in two studies, presented below.

3. Experiment 1

The first experiment was designed to find out what analysis of PPG sentences was preferred in the absence of prosody. This result provided a baseline against which to compare the results of auditory conditions manipulating accent placement. This experiment also tested the first prediction above: that gapping sentences with full clauses on both analyses should show a weaker bias towards the object analysis. Results at or near chance (50% subject responses) would suggest that the strong object bias of other gapping sentences was entirely due to structural factors.

3.1 Stimuli

Because of the strong object bias in gapping sentences, the PPG sentences in this experiment were constructed with mild subject parallelism (Carlson 2001a, 2002). That is, although the major DPs in the sentences were all human and animate, the subject and the remnant DP were always similar to each other and differed from the object in several features. Subjects and remnants in each sentence were singular first names of the same gender, while objects were bare plural DPs or definite or indefinite descriptions:

(16) At Marshall Field's, Melissa saw a classmate, and at J.C. Penney's, Sabrina.

Sixteen sentences of this type were created (see the Appendix for a list of the experimental sentences).

3.2 Procedure

This experiment was a written questionnaire involving a forced-choice task. Below each experimental sentence were two answer choices, paraphrases of some portion of the sentence, each consistent with only one resolution of the sentence ambiguity. Participants read each sentence and then selected the answer that best fit how they had understood the sentence (parenthesized labels added here for clarity).

(17) At Marshall Field's, Melissa saw a classmate, and at J.C. Penney's, Sabrina.

a. Sabrina saw a classmate at J.C. Penney's. (subject reading)

b. Melissa saw Sabrina at J.C. Penney's. (object reading)

The order of the two answers was varied between versions of the questionnaire, so the items were seen equally often with the object reading first or the subject reading first. In addition to the 16 PPG sentences, the questionnaire contained a variety of other sentence types, including VP Ellipsis sentences, sentences with time-ambiguous gerundive relative clauses, and sentences with quantifier scope ambiguities, for a total of 110 items. The items appeared in one of twelve pseudo-randomized orders such that no consecutive items were of the same type or condition. Participants usually completed the questionnaire within half an hour.

3.3 Participants

There were 38 native English-speaking participants in this experiment. All were undergraduate students at Northwestern University taking introductory-level linguistics classes. They participated in this experiment in exchange for course credit.

3.4 Results and Discussion

Participants gave 36% subject responses to the PPG sentences in this written questionnaire. Clearly the subject interpretation of PPG sentences was available, but there was a bias toward the object analysis. This was confirmed by statistical analysis, since this 36% differed significantly from chance performance of 50% by participants and items ($t1(37) = 3.11$, $p < .005$; $t2(15) = 3.61$, $p < .005$). As with other gapping sentences, PPG sentences elicited different reactions from participants, some of whom never chose the subject interpretation while others clearly favored it.

Turning to the comparison between PPG sentences and other gapping sentences, the most similar gapping sentences without preposed PPs (in previously reported studies) received 20% subject responses in a written questionnaire (Carlson 2001a, 2002). The difference between these two results (36% vs. 20%) was significant in between-participants and between-items ANOVAs ($F1(1, 104) = 9.53$, $p < .005$; $F2(1, 24) = 5.22$, $p < .05$). Although this statistic compares different subject groups and different items, it suggests that PPG sentences have a less overwhelming object bias than other gapping sentences. However, note that subject responses remained under 50% for PPG sentences even with mild subject parallelism: the form of the DPs should have made the subject interpretation slightly more attractive. Thus it seems that there is still an object bias to explain for PPG sentences, even though structural factors no longer favor the object analysis.

4. Experiment 2

This experiment was designed to test our second prediction: that PPG sentences would be more affected by prosodic manipulations favoring the different interpretations than other gapping sentences. The higher level of subject responses found in Experiment 1 alone did not confirm a structural difference between PPG sentences and other gapping sentences, since they might simply have different baseline preferences for some other reason. But if responses to PPG sentences could be shown to be both less polarized and more mobile than responses to other gapping sentences, this would support the claim that PPG sentences lack a structural bias which drives their interpretation.

PPG sentences, like other ellipsis sentences, involve a contrast between the elements left behind after ellipsis (the remnants), and elements in the complete first clause. Linguistic analyses of ellipsis often use the focus structure of the first clause to derive the interpretation of the remnants (see in particular Rooth 1992, Fox 1999, Merchant 2001; see also Hankamer 1971). A remnant should be treated as a subject if the first-clause subject was focused, because the default value of the elided material in the second conjunct is a constituent that is identical to what is obtained by removing the focused material from the first conjunct. Contrastive pitch accents will be used to indicate the intended focus structure in this experiment, as they have been effective in the processing of other ellipsis sentences (Frazier & Clifton 1998, Carlson 2001ab, 2002, Stolterfoht et al. 2003). Therefore Experiment 2 varied the position of accent in PPG sentences.

4.1 Stimuli

The same 16 PPG sentences used in Experiment 1 were used in this experiment, so that the written baseline could be directly compared to the auditory results. The sentences were recorded

with two prosodic contours, one in which the first-clause subject was contrastively accented and one with the object accented. The remnant DP and the preposed PP were accented in all versions, so only the prosodic structure of the first clause was manipulated. Pitch tracks from a representative item can be seen in Figures 1 and 2.

--Insert Figures 1 and 2 about here--

The sentences were recorded by the first author, a native English speaker with training in prosody, following the above ToBI analyses. All recorded sentences were viewed in Praat (Boersma & Weenink 2003) and analyzed for consistent renditions of the desired prosody, and any anomalous sentences were re-recorded. The other sentences in the experiment were also produced by this speaker.

4.2 Procedure

This experiment was an auditory questionnaire with a forced-choice task. Participants were seated in front of a computer, wearing headphones. They pressed a button to hear each sentence, and then circled one of two answer choices for that item on a printed answer sheet. This sheet showed the same paraphrases as in the written questionnaire, and the order of answers was varied as before. Participants completed a short practice session before beginning the actual experiment in order to be familiar with the procedure. The experiment included sentences with ambiguous pronouns, VP Ellipsis sentences, and other fillers in addition to the sixteen PPG sentences, for a total of 96 items. Each subject heard only one prosodic version of a particular item, but heard equal numbers of each prosodic condition over the experiment. Items were presented in one of four pseudo-randomized orders so that consecutive items were never of the same type. The experiment lasted roughly half an hour.

4.3 Participants

There were 28 native English-speaking participants with normal hearing in this experiment. All were undergraduate students at Northwestern University taking introductory-level linguistics classes. They participated in this experiment for course credit.

4.4 Results

The results of this experiment can be seen in Figure 3. As expected, there were more subject interpretations with the Subject Accent prosody than with the Object Accent prosody. This difference was significant by participants and items ($t1(27) = 10.93$, $p < .001$; $t2(15) = 7.55$, $p < .001$). In addition, the percentages for each prosodic condition differed from that of the written baseline (Experiment 1), in between-participants and within-items t-tests (Subject Accent vs. Written, $t1(63) = 3.27$, $p < .005$, $t2(15) = 3.84$, $p < .005$; Object Accent vs. Written, $t1(63) = 3.61$, $p < .005$, $t2(15) = 4.95$, $p < .001$).

--Insert Figure 3 about here--

4.5 Discussion

In Experiment 2, interpretive preferences for PPG sentences proved to be quite mobile, since the prosodic conditions produced almost a 50% difference in interpretations. With the first-clause object and the remnant DP accented, very few subject responses (14%) were given. In this condition, the overt prosodic marking was on the object. As this argument was the preferred contrast in Experiment 1, participants were almost unanimous in choosing the object interpretation. With the first-clause subject accented, participants were torn: more subject responses (60%) were given than in the written baseline and object accent conditions, but the overt prosodic marking did not unambiguously signal the intended contrast.

When non-PPG gapping sentences like (18) were produced with similar Subject and Object Accent prosodies (Carlson 2002), they received 33% and 14% subject responses, respectively.

(18) Somehow, Robert insulted the guests during dinner and Samuel during the dance.

This result has been replicated several times with different choices of pitch accents and experimental tasks (Carlson 2001a, 2002), and in each case the difference between prosodic conditions was significant, but less than 20%. Thus it seems that gapping sentences without preposed PPs are less mobile in response to prosodic manipulations than PPGs are. This contrast is illustrated in Figure 4.

--Insert Figure 4 about here--

The processing differences between PPG sentences and other gapping sentences support the differing syntactic analyses presented earlier. Reasonable syntactic assumptions based on the behavior of *and* led us to conclude that non-PPG gapping sentences have a non-elided, VP-level structure available on the object analysis. This analysis does not require scrambling of the remnant material, in contrast to the ellipsis subject analysis, and it also involves coordination of lower-level categories. Sentences with this structure available therefore have a very strong bias for the object reading, because it involves building a smaller and less complex structure than the subject analysis (due to structural economy, a la Frazier 1979, 1987). Further reasonable syntactic assumptions based on the behavior of preposed PPs led us to decide that PPG sentences demand clausal structure on either the subject or object reading. If structural economy was part of the reason for the strong bias of other gapping sentences, then PPG sentences were predicted to have weaker and more mobile biases. Experiment 2 has confirmed this prediction.

5. Conclusions

This paper has used the convergence of syntactic analysis and processing data to argue for a distinction between two types of gapping sentences. In particular, we suggest that the constructions that superficially fall under the descriptive label 'gapping' – conjoined structures in which all material has been omitted from the second conjunct except for two XP remnants – actually represent a non-uniform set of sentence types. Sentences such as (19), which are ambiguous between subject and object readings of the NP remnant, have distinct structural analyses for the two readings: an ATB parse as in (19a) for the object reading, and an ellipsis parse as in (19b) for the subject reading.

(19) Bob insulted the guests during dinner and Sam during the dance.

a. ... and [$_{VP}$ $t_{insulted}$ Sam during the dance]

b. ... and Sam_i ~~[$_{IP}$ t_{Sam} [$_{VP}$ insulted the guests]~~ during the dance

On the object reading in (19a), where *Sam* is being insulted, this is not truly an ellipsis sentence at all (on the preferred parse). Instead, there is conjunction of VP-level constituents with ATB-movement of the verb out of a VP shell (Larson 1988, Johnson 1996, 2000). On the subject reading in (19b), though, this is a true ellipsis sentence, with a full clausal structure following the conjunction and internal material deleted or unpronounced. The syntactic differences between these two structures explain the strong processing bias toward the object analysis, we believe (following Carlson 2001a, 2002). The object analysis involves a smaller and less complicated structure, so a processing strategy such as Minimal Attachment (Frazier 1979, 1987) would predict this preference.

PPG sentences such as (20), on the other hand, involve true ellipsis structures on either analysis.

(20) At Marshall Field's, Melissa saw a classmate, and at J.C. Penney's, Sabrina.

Because the preposed PP *at J.C. Penney's* must be adjoined to a clause-level constituent, the material following the conjunction cannot be a VP even if *Sabrina* is interpreted as an object. This syntactic assumption was supported by the mobility of processing preferences for such PPG sentences. These sentences did show an object preference, but prosodic manipulations were able to effectively raise or lower the number of subject interpretations in Experiment 2. Our experimental results thus bear out the claim that a structural difference is responsible for the interpretation bias of sentences like (19), and that this strong bias is absent in PPG sentences. This difference also illustrates the dominant role structural economy plays in sentence comprehension, since factors such as lexical or prosodic parallelism have only limited effects until structurally-governed preferences are eliminated. This favors a processing architecture in which not all sources of information are equally important to parsing, and syntactic structure has a central role, such as the Garden Path theory (Frazier 1978, 1987).

The difference found between PPGs and other ambiguous gapping sentences also has implications for the grammatical representation of gapping sentences. These processing differences are naturally explained if the object reading of ambiguous gapping sentences like (19) has a different (and simpler) structure than the subject reading, as discussed above. However, the processing results become mysterious if there is not a structural difference between the two readings, as under some analyses of gapping. For example, Steedman's (1990, 2000)

analysis of gapping assimilates it to other kinds of coordination phenomena, claiming that gapping is simply an instance of unlike-constituent coordination. Under this analysis, there would be no significant structural difference between the subject and object interpretations of an ambiguous gapping sentence like (19), just as there is no structural difference between the two readings of a PPG. The processing differences found here are at face inconsistent with such an analysis.

The syntactic structures proposed in this paper explain the contrast between PPG sentences and other ambiguous gapping sentences in both the strength and the mobility of their processing preferences. However, the remaining object bias found for PPG sentences has not received an explanation yet. By assumption, the structures associated with the subject and object readings of PPG sentences do not differ in their size or complexity, so we are not proposing a structural source for this bias. But the results of both Experiments 1 and 2 show that there is a preference to interpret PPG sentences with the object reading.

The processing of PPG sentences is reminiscent of comparative ellipsis sentences, such as *Tasha called him more often than Sonya* (Carlson 2001b, 2002; Carlson & Dickey 2003, 2004), in its responsiveness to prosodic and parallelism manipulations, as noted above. Since comparative ellipses are usually analyzed as involving clausal structures under either subject or object analysis, their processing results are consistent with our syntactic analysis of PPG sentences.

In fact, PPG sentences and comparatives are not the only sentences with an object bias but no structural explanation for it. Processing studies of a range of ellipsis sentences with subject/object ambiguities (as in (21-25)) have shown object biases for all of them, abstracting away from parallelism or prosodic manipulations:

(21) Tasha called Bella more often than Sonya — comparative ellipsis

(22) A friend called Marcus for advice, (but) not a relative — replacive/(stripping)

(Carlson 2001b, 2002)

(23) Somebody claimed that the President fired someone. Guess who? — sluicing, indefinite

(Frazier & Clifton 1998)

(24) The bully teased the new kid, but I don't know who else. — sluicing, definite

(Carlson, Dickey, Frazier, & Clifton 2003)

(25) Am Freitag hat der Vater den Onkel beleidigt, und nicht der/den Neffe(n)

'On Friday, the father insulted the uncle, and not the nephew (Nom/Acc)' — German replacive

(Stolterfoht, Friederici, Alter, & Steube 2003)

Frazier and Clifton (1998) proposed that expectations about the position of focus might explain such interpretive results. In English, focus tends to appear towards the end of a sentence, in the absence of reasons to place focus elsewhere (Selkirk 1984, 1995), which means that the first-clause objects would be likely to be focused in the sentences above (and not the subjects). The position of focus is integral to the interpretation of ellipsis sentences on many theories (Sag 1980, Rooth 1992, Fox 1999, Merchant 2001), with the semantics abstracting over the position of focus in order to generate a meaning that licenses ellipsis. Frazier and Clifton relate these two facts and claim that processors expect focus to be on the first-clause object and interpret the remnant accordingly, more often than not. Intriguingly, despite the known connection of prosody

and focus, perceivers are influenced by this default focus position even when pitch accents suggest that the subject should be focused instead (i.e., in Subject Accent conditions, overt prosodic marking of the subject and deaccentuation of the object does not disambiguate the position of focus). Carlson, Dickey, Frazier, & Clifton (2003) also presented evidence that focus structure expectations affect the comprehension of sluicing sentences.

Regardless of the explanation for the residual object bias, these experiments on PPGs point to the crucial role that syntactic structure plays not only in grammatical representations but also the processing of gapping sentences specifically, and ellipsis sentences in general. The contrast between the processing results for non-PPG gapping vs. PPG sentences also demonstrates that what is sometimes labeled gapping can be a simpler structure in disguise. Potential non-PPG gapping sentences are best analyzed as involving simple VP conjunction with ATB movement on the object analysis, rather than clausal conjunction, since this economic structure is so strongly preferred. Thus although an ellipsis analysis of typical gapping sentences on the object interpretation is presumably possible, it seems to be unavailable. This work shows how processing results and syntactic analyses can be used to inform each other and advance our understanding of complex syntactic phenomena such as ellipsis.

Footnotes

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[1]We do not take a position here on what the correct licensing conditions on this deletion are, noting only that there are several theories on the market that can correctly capture the fact that what is deleted here is a constituent that is identical to the antecedent clause minus the parallel DPs. For example, we might assume syntactic identity of LFs in which the parallel DPs in the antecedent clause have also raised out of IP, or semantic redundancy under focus (Rooth 1992, Merchant 2001).

[2]Whether the scrambled remnants are left- or right-adjoined (or both) to IP is a question that is irrelevant to the main line of reasoning in this paper. For simplicity, we will represent them as left-adjoined, but this is not crucial. However, the remnants must be adjoined to a propositional-level category, one which contains positions for both subject and object arguments. That category could in principle be either vP (viz. Chomsky 2000) or IP.

[3]As an anonymous reviewer notes, the ellipsis structure for gapping sentences also involves greater derivational complexity than the ATB structure: it requires scrambling of the remnant material. These additional derivational steps may also contribute to the perceptual complexity of gapping sentences and to the bias toward the ATB structure. On the other hand, it may be the

case that ATB movement is itself costly, making any difference in derivational complexity negligible. As we do not know the answers to these questions, we focus our attention in this paper on the clear difference in structural complexity between the two representations and the corresponding predictions about processing load.

[4] In fact, there is evidence that this constituent may be smaller than IP, as an anonymous reviewer points out. The contrasting availability of bound-variable readings in (i-ii) below indicates that the subject of a gapped clause is c-commanded by the subject of the antecedent clause, while the subject of a corresponding non-elided clause is not (Johnson 1996):

(i) *No man*$_i$ joined the Army and *his*$_i$ *wife*, the Navy.

(ii) **No man*$_i$ joined the Army and *his*$_i$ *wife* joined the Navy.

These data show that the gapped clause must be conjoined to a category which is c-commanded by the quantificational subject of the first clause *no man*, indicating that the gapped 'clause' is actually a vP or some other sub-IP constituent large enough to contain the external argument (cf. McCawley 1993, Johnson 1996, Coppock 2000, Lin 2002). However, the ellipsis structure still involves coordination of constituents that are larger and more complex than those involved in the ATB structure associated with the object reading, both with respect to structure and meaning. The ATB structure involves conjunction of sub-propositional constituents (VP or some other VP-internal projection); the ellipsis structure involves conjunction of a propositional constituent, i.e., one that minimally contains the external argument. By both metrics, the ellipsis structure is more complex than the ATB structure, regardless of whether it involves conjunction of actual IPs or some lower propositional projection (such as vP), so parsing preferences should favor the latter.

[5]Johnson (1996) shows that the subject reading of (7) can actually be derived within an ATB analysis if we assume that what undergoes ATB movement is the VP *visit the office* (the constituent that corresponds to what is 'missing' in the second conjunct), as shown in (i).

(i) Josh $[_{vP}\ [_{vP}\ t_{Josh}\ [_{VP}$ visited the office] during the vacation] and $[_{vP}$ Sarah t_{VP} during the week]]

It is unclear whether this analysis supports the structural explanation of the object preference proposed by Carlson; this depends on the parsing preferences of phrasal vs. head movement. If ATB head movement is in general simpler than ATB phrasal movement, then the object reading ATB remains structurally simplest, and Carlson's explanation of the object preference still holds. If not, then the object preference remains mysterious; the fact that it exists would therefore call into question this aspect of Johnson's proposal. Note that the PPG structures that are the focus of this paper have only ellipsis analyses, as discussed below.

[6]The availability of bound variable readings for PPGs also indicates that PPGs must involve clause-level structure. Consider (i-ii) below in light of footnote 4:

(i) *This spring, *every eligible man*$_i$ enlisted and this fall, *his$_i$ wife*.

(ii) This spring, *my neighbor$_i$* enlisted and this fall, *his$_i$ wife*.

The unacceptability of (i) shows that the bound variable reading is unavailable for subjects of gapped clauses in PPGs, while (ii) shows that coreference between the gapped and antecedent clause is not generally blocked. This indicates that PPGs must involve IP-level coordination, higher than even regular gapping (which likely involves vP-level coordination). This contrast indicates that "gapping" strings may be even more syntactically heterogeneous than argued here. We are grateful to anonymous reviewers for bringing the importance of these data to our attention.

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Appendix

1. At Marshall Field's, Melissa saw a classmate, and at J.C. Penney's, Sabrina.

2. At the library, Delilah tutored third-graders, and in the cafeteria, Theresa.

3. In the morning, Jason called a plumber, and in the afternoon, Brian.

4. After lunch, Trent beat up younger kids, and after school, Jed.

5. In the pool, Natasha splashed a boy, and in the hot tub, Amanda.

6. At the fundraiser, Valerie thanked the volunteers, and at the party, Lillian.

7. At the dinner, Richard complimented a girl, and at the dance, Matthew.

8. In high school, Pete advised freshmen, and in college, Todd.

9. On Monday, Nathan upset a client, and on Thursday, Henry.

10. On Thursday, Lizanne irritated co-workers, and on Friday, Joyce.

11. Near the food court, Megan spotted a policeman, and near the exit, Tina.

12. After the disastrous meeting, Jill snubbed PTA members, and after the raffle, Kate.

13. Before the first race, Ned psyched out a competitor, and before the second, James.

14. Outside the clinic, Pamela avoided protestors, and in the parking lot, Marian.

15. At ten o'clock, Gail interviewed an applicant, and at two o'clock, Anne.

16. At baseball tryouts, Rob outplayed the seniors, and at football practice, Dave.

Figure 1: Subject Accent

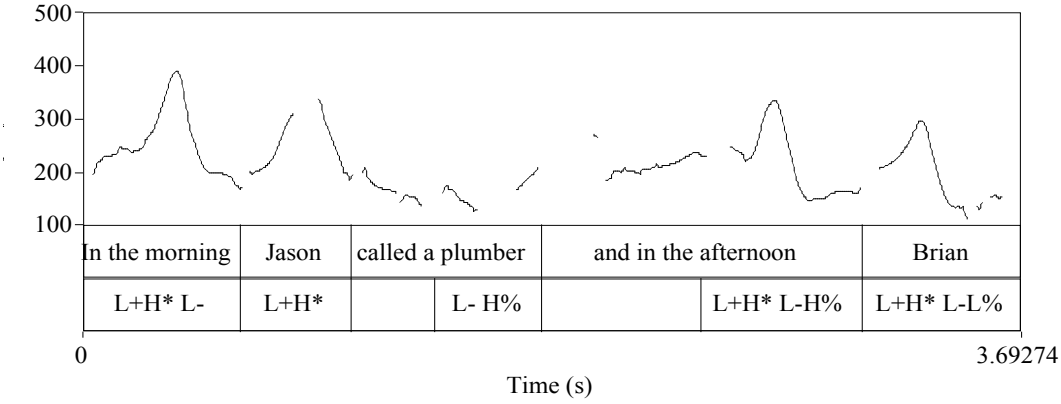

Figure 2: Object Accent

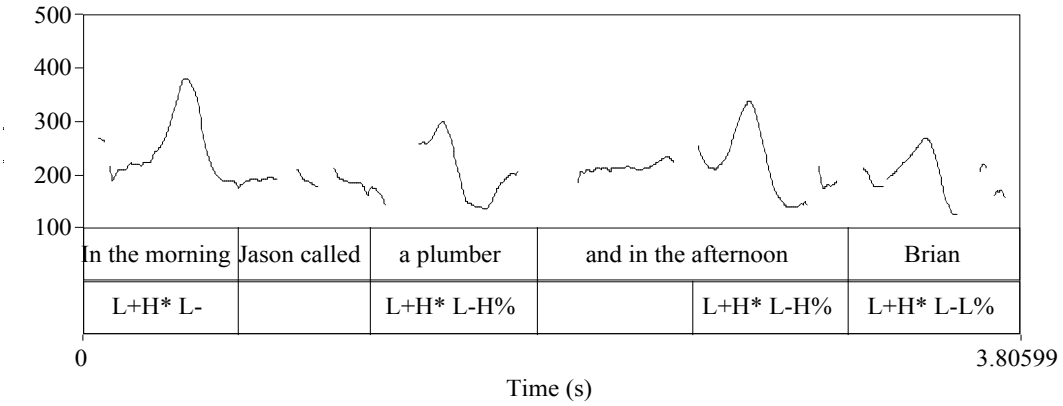

Figure 3: Experiment 2 Results

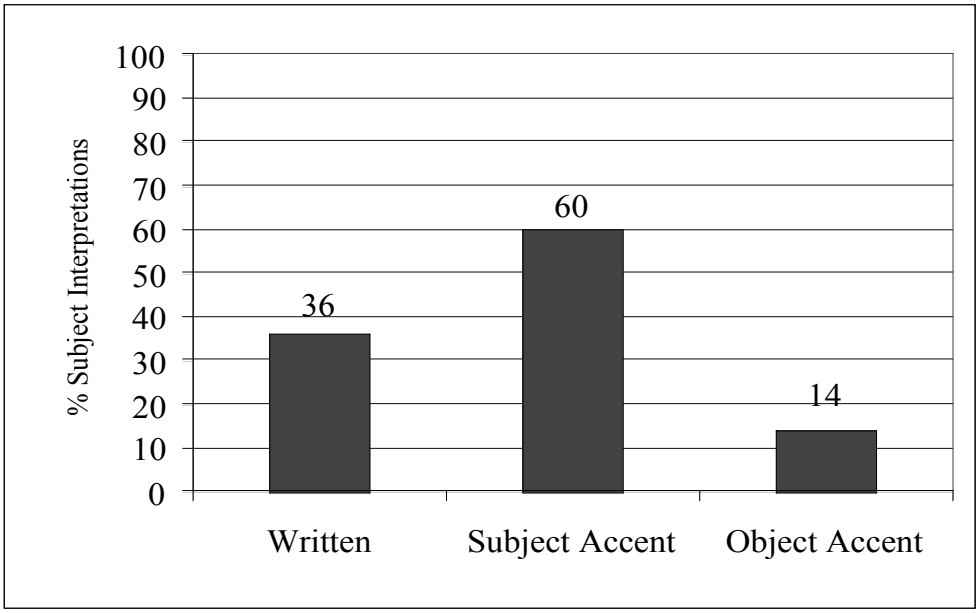

Figure 4: PPGs vs. other gapping results