Published in final edited form as:

Lang Speech. 2007 ; 50(Pt 1): 1–21.

Focus and VP Ellipsis¹

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Abstract

In spoken English, pitch accents can convey the focus associated with new or contrasted constituents. Two listening experiments were conducted to determine whether accenting a subject makes its predicate a more tempting antecedent for an elided verb phrase, presumably because the accent helps focus the subject of the antecedent clause, increasing its likelihood of contrasting with the subject of the elided clause. The results of Experiment 1 supported the predictions of this “contrasted remnant hypothesis” but in principle could also be caused by listeners avoiding antecedents containing a focused (F-marked) constituent. Experiment 2 disconfirmed the hypothesis that listeners avoid antecedents containing a focused constituent, although pitch accents within a potential antecedent VP affected ellipsis resolution.

It has been known for some time that focus directs listeners’ attention in language processing, whether it is conveyed by a pitch accent (Cutler, 1976; Cutler & Foss, 1977) or by the nature of a preceding question (Cutler & Fodor, 1979). We may think of focus as marking new information (“informational focus”) and important information which may contrast with another constituent (“contrastive focus”). In spoken English, informationally or contrastively focused constituents must not be deaccented, so deaccented material must be given and noncontrastive (Schwarzschild, 1999). Accented material may be new or given, since given material may receive a pitch accent to signal that it contrasts with other material and, at times, accents may appear on unfocused constituents for purely phonological reasons.

For the most part, we will not be concerned with informational focus in the present paper. We will assume that contrastively focused constituents are F-marked in the syntax (Selkirk, 1984) and assume that a contrastively focused constituent introduces a variable into the semantics (Rooth, 1992). Contrast, we assume, involves having an alternative value for the same variable. Thus, overtly negated material (not Mary) may introduce a contrast, but so too can similarity (and Mary too). Rooth (1992a) and van Deemter (1998) describe parallel syntactic constructions (e.g., John is married to Mary and Peter is married to Sally; van Deemter 1998), as well as constructions involving negation or contrariety, as prototypical situations for contrastive focus and intonation (i.e., on John vs. Peter, and Mary vs. Sally). In Kehler (2000)’s theory of discourse coherence, these constructions would be categorized as having a Resemblance relationship between sentences. Contrast also arises in situations in which only

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Authors’ Note: This research was supported by Grant BCS 0090674 from NSF to the University of Massachusetts, an Andrew W. Mellon Foundation Postdoctoral Fellowship at Northwestern University, and Kentucky NSF EPSCoR REG grant EPS-0132295. A preliminary version appeared in S. Kitagawa, (ed.), *University of Massachusetts Occasional Papers 30: Papers on Prosody* (pp. 31–52), GLSA, Amherst MA.

a visual display, rather than the linguistic material, identifies the alternatives. For example, Sedivy et al. (1999) found that a contrastive statement, e.g. “Pick out the TALL _____,” leads listeners to immediately look at the taller of two candles if the domain (array of relevant objects) contains only two objects of the same type varying in the relevant adjectival property (e.g., two candles, a pitcher, and a key).

Pierrehumbert & Hirschberg (1990) claim that a particular pitch accent, L+H*, characterized by a low pitch target and a steep rise to a high F0 target on the stressed syllable, marks contrastive focus in English. There remains some controversy, however, about whether this L+H* accent is grammatically distinct from the H* accent commonly used to convey informational focus (see, for example, Bartels & Kingston, 1994; Schafer, Carter, Clifton, & Frazier, 1996; Ladd & Morton, 1997; Krahmer & Swerts, 2001; Dainora, 2001; Selkirk, 2002; Ladd & Schepman, 2003, among others). Whether or not there are two phonetic accent categories which are used for distinct types of focus, though, it is generally agreed that higher, steeper pitch peaks convey a more emphatic (perhaps contrastive) meaning than lower and less prominent peaks. We will follow the ToBI transcription conventions and assume that L+H* accents are a distinct category in what follows, but even in a gradient system, the relevant accents in our stimuli would be noticeably prominent. And although it may be a slight idealization, we will assume that typically L+H* accents, or particularly prominent H* accents, mark contrastive focus while H* accents mark informational focus.²

In many structures, contrastive focus appears to play a helpful role in disambiguating the analysis of an English sentence (e.g., Schafer et al., 1996). The effect of focus is particularly clear in cases of ellipsis. Carlson (2001a,b,2002) has shown that the interpretation of ambiguous ellipsis sentences such as gapping (1), bare argument ellipsis (2), comparatives (3) and replatives (4) is influenced in all cases by the placement of L+H* pitch accents.

1. Josh visited Marjorie during vacation and Sarah during the week.
  - a. ...and Sarah [~~visited Marjorie~~ during the week]_{VP}. (subject reading)
  - b. Josh visited [Marjorie during vacation]_{VP} and [Sarah during the week]_{VP}. (object reading)
2. Stanley insulted the students during class and Jeff too.
  - a. ...and Jeff [~~insulted the students during class too~~]_{VP}. (subject reading)
  - b. Stanley insulted [the students during class]_{VP} and [Jeff too]_{VP}. (object reading)
3. Tasha called Bella more often than Sonya.
  - a. ...more often than [Sonya ~~called Bella~~]_{IP}. (subject reading)
  - b. ...more often than [~~Tasha called~~ Sonya]_{IP}. (object reading)
4. Dr. Waters saved Maria from drowning, not Dr. Green.
  - a. ...not [Dr. Green ~~saved Maria from drowning~~]_{IP}. (subject reading)
  - b. ...not [~~Dr. Waters saved~~ Dr. Green ~~from drowning~~]_{IP}. (object reading)

For example, in (4) placing L+H* pitch accents on the subject and the unelided material in the second clause (Dr. Waters and the “remnant,” Dr. Green) increases how often listeners report

²Although speakers may differ from each other and from occasion to occasion in how they employ accents, we suspect that a speaker using a less prominent H* for informational focus will employ either a L+H* or a more prominent H* for contrastive focus, thereby tending to maintain the distinction between the marking of informational focus and the marking of contrastive focus.

the subject reading relative to the same sentence spoken with an object accent pattern (accenting Maria and Dr. Green; see also Frazier & Clifton (1998) for discussion of similar effects of focus in processing sluicing structures). One way to view this effect is that an accented remnant (and all remnants bore L+H* accents in the research discussed above) is lined up with the contrastively focused material in the antecedent clause and then the same property is predicated of them both. Let's dub this the "contrasted remnant hypothesis."

We suggest that the effect of accent location in Carlson's studies reflects a comparison or contrast between the remnant and its correlate (the argument in the antecedent clause in a corresponding syntactic position to the remnant). In other words, the remnant and its correlate are alternative values for the same variable: in (2), Stanley and Jeff may be alternative values for X in X insulted the students during the class. Carlson (2001a,b,2002) has also shown that similarity between the remnant and a potential correlate NP in their internal features (features such as definiteness, gender, animacy, and form) favors that correlate. For instance, a version of (4) with greater similarity between the object and the remnant, as in Maria saved Dr. Waters from drowning, not Dr. Green, favors the object reading. We suggest that this effect occurs because internal similarity between phrases makes them seem more likely to have similar syntactic roles. In general, contrasting two constituents presupposes that they appear in syntactically parallel or corresponding positions, and it suggests that the two constituents are sufficiently similar to be plausible alternatives for the same variable.

In studies of ellipsis structures like (1) – (4), Carlson found that the location of L+H* pitch accents influenced which interpretation of the sentence listeners reported.³ Interestingly, the structures split into two groups. One showed an increase of 15% to 20% in the frequency with which the interpretation favored by prosody was chosen. The other (represented by replatives and sluices with who else) showed a much larger increase, approximately 40% (Carlson 2002, Carlson et al., in progress). The importance of contrastive focus to this distinction between ellipsis types is suggested by the work of Carlson et al. (in progress) on sluicing structures.

(5) The bully teased the new kid, but I don't know who else [ ].

(6) Some bully teased some new kid, but I don't know who [ ].

This research showed a relatively large effect of pitch accent placement (on bully or kid) in sentences like (5), where contrast between the wh-remnant and its antecedent is conveyed, but a smaller effect in the same ellipsis structure when the wh-remnant does not contrast with its antecedent but is anaphoric to it (6).

The present paper is concerned with the effect of pitch accents in VP ellipsis, as in (7).

(7) Mary said Jenny went to Europe and Fred did __ too.

a. ...Fred ~~went to Europe~~ too. (embedded VP antecedent)

b. ...Fred ~~said Jenny went to Europe~~ too. (matrix VP antecedent)

In VP ellipsis, the remnant is the subject of the elided clause (Fred) and the correlate is the subject of the antecedent VP (Mary or Jenny), much like the subject reading of a comparative sentence (Tasha called Bella more often than Sonya called Bella). The comparison or contrast

³Only L+H* accents were tested in these structures, so the possible biasing effects of H* accents are not known. All sentences were spoken with L-H% Intonational Phrase (IPh) boundaries at the end of the first clause, except for the comparatives in (3). Sentences contained H* accents on some content words, along with whatever other accents were necessary for felicitous productions (so in (1), for example, the contrasting PP-internal nouns vacation and week received L+H* accents). These did not vary between conditions.

between these subjects seems to invite L+H* accents on the two constituents involved, although it is certainly acceptable to only place a L+H* on the later member of a contrast (Rooth 1992a noted that this was true for contrasts in general). But VP ellipsis may differ from, for example, replacive structures like (4) in the strength of the implied contrast, since it is difficult to imagine using the explicitly negative replacive structure without intending a contrast between the remnant and its correlate. Thus we might expect smaller effects of accent placement in VP ellipsis sentences than the 40% effects seen for replacives. Experiment 1 tests whether accent placement in VP ellipsis sentences does indeed influence the preferred analysis of the sentence, and whether the effect is smaller than the effect seen for more contrastive sentences.

There is already an interesting literature on the processing of VP ellipsis, but for the most part it has concentrated on what type of antecedent is required for an elided VP or for an anaphoric element contained inside the elided VP (e.g., Tanenhaus & Carlson, 1990; Ward, McKoon & Sproat, 1991; Shapiro & Hestvik, 1995; Shapiro, Hestvik, Lesan, & Garcia, 2003). It has not addressed the role of accent in processing VP ellipsis nor the role of other intonational properties, such as prosodic boundaries. In previous work (Frazier & Clifton, 2005), we have found that with ambiguous VP ellipsis materials like (7), readers can interpret the elided VP either as the higher/larger VP said Jenny..., or as the lower/smaller VP went to Europe. When the antecedent and the ellipsis were within a single sentence, the lower VP was favored 60% of the time (for our particular items). But across sentence boundaries, i.e. if a period replaces the conjunction and, the preference shifted toward 15% more matrix VP antecedent interpretations, so that the lower VP was chosen only 45% of the time. This difference in preferences is traced to the different priorities found in discourse processing (relating new material to the speaker's main assertion) vs. sentence processing (relating new material to highly accessible recent constituents).

This earlier work leaves open several questions about the role of intonation in the processing of auditory VP ellipsis. As noted above, we are interested in whether accenting Mary versus Jenny influences the probability of assigning a particular interpretation in VP ellipsis examples like (7). Experiment 1 will also test whether the nature of the prosodic boundary at the end of the first conjunct matters. Often one finds a low boundary tone (L%) at the end of a sentence or discourse, suggesting closure, instead of a H% (Pierrehumbert & Hirschberg, 1990; Bartels, 1999). We can imagine that a L% in a VP ellipsis context like (7) might function as a period did in Frazier and Clifton's (2005) written experiments, indicating the end of a sentence-level constituent. If so, then listeners should assign more matrix VP antecedents when the final clause is preceded by a L% than when it is preceded by a H%. The result would be of interest because it might help us to understand how intonation guides the updating and use of discourse representations. If accent location (on the matrix vs. embedded subject) and boundary type (L% vs. H%) both influence the probability of choosing a particular interpretation of (7), then examining how the two interact will be of interest. Though the topic of how boundaries and pitch accents interact has long been of interest to prosody researchers (as least as early as Pierrehumbert & Hirschberg (1990), and continuing through, for example, Selkirk (2002), Dainora (2001), Dainora (2002) and others), it has not received much attention in the processing literature.⁴

⁴Two notable exceptions to this generalization are Schafer's (1997) work showing that a focus introduced by a pitch accent does not project beyond a prosodic phrase boundary, and Schafer and Jun's (2005) recent work showing that a boundary following a contrastively focused constituent syntactically disambiguates a closure ambiguity less effectively than a boundary following a constituent that is not contrastively focused.

EXPERIMENT 1

Experiment 1 investigated whether accenting the matrix vs. embedded subject, as well as the remnant in the final clause, would influence the interpretation listeners assign to the elided VP in VP ellipsis sentences like (7). If the highest subject of the antecedent sentence is realized with a L+H* accent, making it similar to the subject of the elided VP, we would expect more matrix VP antecedents of the elided VP than if the embedded subject and the remnant receive L+H* accents. Experiment 1 also explored whether the nature of an intonational phrase break before and would affect the interpretation of the ellipsis. In particular, it asked whether a simple fall (L-L%) would result in more matrix VP interpretations than a continuation rise (L-H%).

Method

Materials—Sixteen ambiguous VP ellipsis sentences were constructed. Each was pronounced in one of four ways, as illustrated in (8). (Capital letters indicate the L+H* accents whose position was varied to affect the interpretation of the sentences, although other, less prominent accents were also present; for example, too was accented in all conditions. See the pitch tracks in Figure 1.)⁵

(8)

- a. JULIE said Maria went to the rally L-H% and GREG did too.
- b. JULIE said Maria went to the rally L-L% and GREG did too.
- c. Julie said MARIA went to the rally L-H% and GREG did too.
- d. Julie said MARIA went to the rally L-L% and GREG did too.

Two forms (8a,b) had a L+H* pitch accent on the matrix subject; two (8c,d) had a L+H* pitch accent on the embedded subject. All forms had a prominent L+H* pitch accent on the subject of the final clause, as ellipsis remnants demand (Sag 1980, Johnson 1996, Rooth 1992a). The word too was also accented to increase the naturalness of the materials, receiving a L+H* in a downstepped range. The boundary tone at the end of the first conjunct was also manipulated to determine whether listeners would compute more matrix VP interpretations with an L%, as in written conditions where the final clause appeared as a separate sentence (Frazier & Clifton, 2005). All experimental sentences appear in Appendix 1.

The sentences were recorded by the third author, a native speaker of American English with ToBI training, who pronounced the sentences with L+H* accents on the uppercase words in (8) and the intonational phrase boundaries indicated. Each utterance was digitized for examination in PRAAT (Boersma & Weenink, 2003) to ensure that the intended accents and boundaries had been produced, and any anomalous sentences were re-recorded. Representative pitch tracks for this item are shown in Figure 1.

Durational and acoustic measurements confirmed that the conditions had the intended prosodic properties, showing that arguments were longer and higher when they were spoken with a L+H* accent vs. without one. The duration of the matrix subject (e.g., Julie) in conditions (8a) and (8b) averaged 363 and 345 ms respectively, vs. 263 and 268 ms for conditions (8c) and (8d). The peak F0 on this NP averaged 367 and 363 Hz in conditions (a–b) vs. 235 and 239 Hz in conditions (c–d). The patterns for the embedded subject (Maria) were exactly reversed. Its duration averaged 288 and 292 ms in conditions (a–b), vs. 367 and 370 ms in conditions (c–d). Peak F0 was 210 and 205 Hz in conditions (a–b) vs. 330 and 321 Hz in conditions (c–d).

⁵Sound files for this and all later figures with Fo traces are available at <http://people.umass.edu/cec/labpage.html>

The subject of the ellipsis clause (Greg) was always accented, with an average duration of 338 ms and an average F0 peak of 303 Hz.⁶ The word too was also always accented in a downstepped range, with an average F0 peak of 239 Hz (and a standard deviation of less than 10 Hz). At the boundary position following the first clause, conditions (a,c) reached a L-averaging 161 Hz followed by a H% of 228 Hz, while the pause durations averaged 161 and 145 ms. In conditions (b,d), a low F0 target averaging 151 Hz was reached, with no following rise in pitch, and the following pauses averaged 252 and 261 ms. The sentences were too long to be produced naturally with no prosodic boundaries, and our previous unpublished work had suggested that an ip boundary would at best slightly increase the already preferred embedded VP interpretations.

The experimental sentences were supplemented by a total of 74 other sentences. Forty-eight of them were from other unrelated experiments and were ambiguous in some way. The remaining 26 sentences were fillers of a variety of forms, and were unambiguous. One two-choice question was made up for each sentence. For the experimental sentences, the two choices provided as answers corresponded to the two possible interpretations of the sentence (e.g., for (8), the question was What did Greg do? and the two possible answers were Greg said that Maria went to the rally and Greg went to the rally). A six-item practice list, with half ambiguous sentences, was also prepared.

Participants and Procedures—Seventy-two University of Massachusetts undergraduates (all native speakers of American English with normal hearing) participated in individual half-hour auditory questionnaire sessions. A session began with the practice list and continued with one individually-randomized presentation of the experimental list. Participants were tested in an IAC sound-attenuated chamber, and a computer presented digitized versions of the sentences. Four counterbalancing conditions were used to ensure that each sentence was tested equally often in each of the four versions. A Latin square procedure was used to determine which version of each sentence was tested in each counterbalancing condition. Eighteen participants were tested in each condition.

On each trial, a ready signal came up, the participant pulled a trigger to begin the trial, a sentence was played over loudspeakers at a comfortable listening level, and the participant pulled a trigger to indicate that s/he had heard and understood the sentence and was ready to see a question about the sentence. The question and its two possible answers then appeared on the screen. The participant pulled the trigger under the answer s/he considered correct. Participants were instructed that some of the sentences in the experiment would be ambiguous and that they were simply to respond according to how they intuitively understood the sentence. The choice made in answering the question after each sentence, and the time taken to pull the trigger indicating the choice, were recorded.

Results

Table 1 presents the mean proportions of matrix interpretations (answers like Greg said that Maria went to the rally) and the time taken to choose an answer. Analyses of variance of the response times (with the factors location of the prominent pitch accent and the type of boundary tone) indicated that no differences among the means were significant. However, an analysis of

⁶Although this peak might seem to show pitch resetting that could favor the matrix interpretation, two unpublished studies of materials like (8) have found no effect of pitch resetting. In these studies, both first-clause subjects received L+H* accents, the second downstepped, and the remnant subject received either a H* accent or a L+H* accent, the latter peaking some 115 Hz higher than the former (means of 235 and 350 Hz); the boundary type (IPh vs. ip) was also manipulated. All conditions received around 30% matrix VP responses, with no significant differences. Nevertheless, since the matrix VP reading is the dispreferred one, we chose to use a relatively high peak in this study.

the answer proportions indicated significantly more matrix answers when the matrix subject had a L+H* pitch accent (8a,b) than when the embedded subject did (8c,d) (.559 vs. .422; $F(1,71) = 22.43$, $MSe = 0.06$, $p < .001$; $F(1,15) = 16.14$, $MSe = 0.02$, $p < .01$). There was no effect of the type of boundary tone (.486 vs .494 for H% vs. L% tones; $F < 1$) nor was there any interaction ($F < 1$).

Discussion

The placement of L+H* pitch accents influenced how often listeners reported a matrix VP antecedent interpretation. A L+H* accent on the matrix subject resulted in more matrix interpretations of the ellipsis than when accent was placed on the embedded subject. This result extends the work of Carlson (2001a,b,2002), which has already found that gapping structures, bare argument ellipsis, comparatives, and replacives show effects of the location of L+H* accents. But replacives in particular seem to more clearly draw attention to the contrast between the remnant and its associate in the antecedent clause, since they show a shift of some 40% in interpretation when the position of the L+H* accent changes. In VP ellipsis, the effect of accent placement shrinks to about 15%, on a par with comparatives and gapping.

Surprisingly, there was no effect of which boundary tone appeared. This shows that although L% is associated with utterance-finality, it does not unambiguously signal the end of a sentence in the way that a written period does. Perhaps the presence of and virtually required listeners to analyze the experimental sentences as single sentences, at least given the intonation used here. Further work is needed to investigate other possibilities, such as whether the L% is a default tone consistent with additional material or with finality and therefore not biasing in Experiment 1, or whether there was some other feature of our materials which required them to be interpreted as single sentences even though the first conjunct ended with a L%. We return to this issue in the General Discussion.

Experiment 1 suggests that the presence of a prominent accent on a constituent in the first conjunct helps listeners to construct a contrast between that constituent and the subject of the elided VP. This biases toward an interpretation of the sentence where the same VP is predicated of the two contrasted subjects, as predicted by the contrasted remnant hypothesis. It seems quite plausible that L+H* pitch accents do help listeners to set up contrasts between constituents. It also seems plausible that given such a contrast listeners would tend to predicate the same property of the two contrasted constituents by choosing the predicate of the first member of the contrast as the antecedent for the elided VP. Put differently, constituents contrast if they are alternative values for the same variable (in a presupposition/focus structure).

There is an alternative explanation, however. Although focus directs the listener's attention to a constituent, deaccenting or eliding the constituent does just the opposite. Only material that is already given, hence predictable, may be elided, since the perceiver must have some way of filling in what is not pronounced in the sentence. Indeed, we may think of a continuum along the lines of (9), where ellipsis is just the extreme end of phonological degradation (though additional constraints may determine when an item can be unpronounced instead of only deaccented; cf. Rooth 1992b,1996).

(9) prominently accented (“contrastively focused”) constituent > less prominently accented (“informationally focused”) constituent > deaccented (background) constituent > unpronounced (elided) constituent

Merchant (2001) argues for this sort of theory of ellipsis, where the syntactic structure of elided material is left intact and only the phonological matrix is affected (deleted or not pronounced).

In this, or any theory, the question arises of how closely the structure in the ellipsis must correspond with the structure of its antecedent. For example, if a constituent in the antecedent is focused (F-marked), must it also be focused in the material to be elided? The continuum in (9) would suggest that material could not easily be focused and at the same time go unpronounced, i.e., be elided. Experiment 2 was designed to explore this question by testing a hypothesis suggested by the continuum in (9), namely, that listeners would disprefer an analysis where the antecedent for elided material contains F-marking, because listeners expect F-marked material to be pronounced.

A relevant situation arises when focus is not being introduced but instead maintained after its initial introduction, so-called “second occurrence focus.” Beaver, Clark, Flemming, & Wolters (2003) and Beaver, Clark, Flemming, & Jaeger (2004) have presented evidence that some acoustic prominence is found on the second occurrence of the phrase with focus when the phrase is overt. In our Experiment 2, the second occurrence of a goal NP (which in one condition was initially accented and thus presumably focused) was not overt, so maintaining an acoustically marked prominence on the F-marked goal could not be accomplished (at least not straightforwardly by making the goal itself prominent). The question we asked in Experiment 2 was whether this would lead to an avoidance of an antecedent verb phrase that contained an F-marked constituent (perhaps because the constituent could not be realized with acoustic prominence if it was not overt).

We assume that listeners copy the syntactic structure of an antecedent into the ellipsis site (Frazier & Clifton, 2001) and therefore could copy F-marking too if the antecedent contained it, assuming that focus is represented in syntax (following Selkirk 1995, Rooth 1992a, etc.). Given these assumptions, we cast the hypothesis that listeners disprefer an antecedent containing an embedded F-marking as “avoid elided focus.” The hypothesis that focus is avoided in an ellipsis makes the same prediction as the contrasted remnant hypothesis does for the materials used in Experiment 1. The presence of F-marking on the subject of the embedded clause (Maria, in (8)) would discourage taking the matrix subject as the antecedent of the ellipsis, because that interpretation would force the elided material (the matrix VP) to contain F-marking. The materials used in Experiment 2 permit the contrasted remnant hypothesis and the avoid elided focus hypothesis to be distinguished.

EXPERIMENT 2A

Consider a sentence like (10), where a goal intervenes between the matrix subject and the embedded subject. According to the avoid elided focus hypothesis, a prominent L+H* pitch accent on either Mother or Rose should bias against a matrix VP antecedent because then the antecedent and presumably the ellipsis would contain an F-marked constituent. (Capital letters indicate the L+H* accents whose position was varied to affect the interpretation of the sentences; condition (d) used only H* accents within the first clause.)

(10)

- a. JULIA informed Mother that Rose went to the rally and GREG did too.
- b. Julia informed MOTHER that Rose went to the rally and GREG did too.
- c. Julia informed Mother that ROSE went to the rally and GREG did too.
- d. Julia informed Mother that Rose went to the rally and GREG did too.

In order to avoid elided focus, listeners should tend to compute the embedded VP interpretation for both (10b) and (10c), relative to both (10a) and (10d), where (10d) is a condition without a L+H* on any antecedent constituent. By contrast, if L+H* pitch accents establish a contrast

which then favors corresponding predicates for the contrasted arguments, as the contrasted remnant hypothesis predicts, then condition (10a) should favor matrix VP antecedents and (10c) should favor embedded VP antecedents, relative to two intermediate conditions (10b,d).

Method

Materials—Sixteen sets of sentences like those in (10) were constructed. Each was recorded with four different pronunciations: with a L+H* pitch accent on the matrix subject (10a), on the matrix indirect object (10b), or on the embedded subject (10c), or a H* pitch accent on each of these three NPs plus the embedded verb (10d). The same speaker used in Experiment 1 recorded the sentences, and the recordings were evaluated as described in Experiment 1. Pitch tracks for a representative item are shown in Figure 2.

Durational and acoustic measurements confirmed the presence of the intended prosodic properties of the items. The matrix subject (Julia) averaged 440 ms in condition (a) vs. 331, 319, and 323 ms in the other conditions, respectively; its peak F0 averaged 347 Hz in condition (a) but 220, 210, and 211 Hz elsewhere. The indirect object (Mother) was longest in condition (b), averaging 570 ms, vs. 459, 454, and 449 in the other conditions; its mean peak F0 was 329 Hz in condition (b) vs. 206, 199, and 199 Hz. The embedded subject (Rose) averaged 369 ms in condition (c) but 295, 288, and 305 elsewhere; its mean peak F0 was 310 Hz in condition (c) vs. 197, 194, and 195 in the other conditions. These measurements support the claim that condition (d) did not contain any L+H* accents. The boundary at the end of the first clause was a L-H% in all conditions. The remnant NP in the ellipsis clause (Greg) was always given a L+H* accent, with average F0 peaks of 322 Hz in condition (a), 313 Hz in condition (b), 304 Hz in (c), and 305 Hz in (d). The average F0 peak height on too ranged between 245 and 251 Hz.

These 16 items were combined with 120 other sentences, designed to investigate other experimental questions. All sentences were ambiguous, although approximately one third of the fillers had an 80 to 90% bias in favor of one interpretation. A two-choice question was constructed for each sentence, as in Experiment 1. For instance, the question for (10) was What did Greg do? and the answers were Informed Mother about Rose (the matrix subject answer) and Went to the rally. The same practice list used in Experiment 1 was used in Experiment 2.

Participants and procedures—Eighty-eight University of Massachusetts undergraduates, none of whom had participated in Experiment 1, were tested individually using the same procedures as in Experiment 1. After receiving instructions to answer each question according to his or her intuitive understanding of the sentence and being told that some of the sentences were ambiguous, each participant received one of four counterbalanced lists of items in an individually randomized order. Each sentence was tested in one pronunciation in a given list, and was tested in all four pronunciations equally often across the four lists. As in Experiment 1, the question answers and the times to pull the trigger under the chosen answer were recorded.

Results

Table 2 presents the mean proportions of matrix interpretations of the ellipsis clause together with the mean times taken to indicate the choice of answer. One-way analyses of variance were conducted on these measures. No differences were significant in the analysis of response times. However, the main effect of conditions on proportions of matrix interpretations was highly significant ($F(3,261) = 16.48, p < .001$; $F(3,45) = 15.52, p < .001$).

This main effect was followed up using t-tests using a Bonferroni correction, comparing each proportion to each other proportion. The matrix accent conditions (10a, b) received significantly more matrix interpretations ($p < .05$ after Bonferroni correction) than the

embedded subject accent condition (10c) and than the across-the-board H* accent condition (10d). The difference between the latter two (10c–d) was significant only without the Bonferroni correction ($t(187) = 2.08, p < .05$; $t(15) = 2.14, p = .05$).

EXPERIMENT 2B

Before discussing the results of Experiment 2A, we report a modified replication, Experiment 2B. The questions used in Experiment 2A offered listeners a choice between a two-argument matrix interpretation (e.g., Informed Mother about Rose) and a one-argument embedded interpretation (e.g., Went to the rally) as responses to a question like What did Greg do?. These responses were constructed as being good matches to the possible completions of the ellipsis, Greg informed Mother that Rose went to the rally and Greg went to the rally. We will argue that the most informative result from Experiment 2A was the high frequency of choices of the matrix antecedent when the L+H* pitch accent fell on the matrix indirect object (10b). In this condition, the matrix antecedent interpretation implies that an accented and presumably F-marked constituent, Mother in the example, is elided. However, it is possible that our participants chose the matrix antecedent interpretation in this case not because it matched their interpretation of the ellipsis, but simply because it contained a word that received a pitch accent in the utterance (and thus mentioned Mother, a prominent participant in the event). Experiment 2B was designed to control for this possibility.

Method

The materials used in Experiment 2A were modified only by changing the matrix interpretation response alternative so that it did not contain the literal indirect object, the accented constituent in (10b). For instance, when the matrix verb required an indirect object, an indefinite term like someone was substituted; thus, the alternatives to the question What did Greg do? were Informed someone about Rose and Went to the rally. When the matrix verb was felicitous without an indirect object, it was omitted (e.g., following the sentence Michael wrote to relatives that Sam got married and Emily did too, the question was What did Emily do? and the alternatives were Wrote about Sam and Got married).

All procedures were the same as in Experiment 2A, except that the 16 experimental items were combined with 82 filler items of a variety of constructions, and 48 new University of Massachusetts undergraduates were tested.

Results

The results appear in Table 2. Again, no differences among the response times approached significance. However, again the difference among the four conditions was significant ($F(3,141) = 9.89, p < .001$; $F(3,42) = 9.80, p < .001$). T-tests with a Bonferroni correction again indicated that the matrix subject and indirect object L+H* accent conditions (10a) and (10b) received more matrix antecedent interpretations than did the embedded subject accent condition (10c). The across-the-board accent condition (10d) again fell in between, this time receiving significantly more matrix interpretations than condition (10c) but not significantly fewer than conditions (10a) and (10b). The essential elements of the results are the same as in Experiment 2A, indicating that the concern about artifactual choices of a response that included an accented item was not justified.

Discussion

The results of Experiments 2A and 2B are generally consistent with the predictions of the contrasted remnant hypothesis but do not provide any support for the avoid elided focus hypothesis. An L+H* accent on the goal did not lead listeners to choose embedded VP

antecedents more often than in the baseline (10d), which they should have done if their interpretation of the elliptical phrase required deleting an F-marked constituent. In many ways, this is surprising. One might have imagined that if the speaker intended to focus a constituent, then that constituent should not be deleted or unpronounced. But instead we find no tendency for listeners to avoid an analysis of a sentence which includes an overtly L+H* accented constituent in the antecedent for the elided VP. This indicates either that copied F-marking without acoustic prominence is not problematic OR that when the antecedent is copied the F-marking need not be copied. In any case, the results of Experiment 2 suggest that F-marking in ellipsis does not pattern with second occurrence focus in demanding realization and acoustic prominence (Beaver et al. 2003,2004).

Prior research reveals a complex web of interactions between levels of prosodic prominence and the contrastive focus status of constituents (e.g., Bartels & Kingston 1994, Frazier & Clifton 1998, Carlson 2001a,2002, Carlson et al. in progress). This is consistent with the conclusion that the presence of a contrast between a remnant and a correlate does not preclude the existence of an independent focus in the antecedent clause, e.g. Mother in (8) (Rooth 1992a). But no prior research directly explains the processing question we raised: why do listeners choose antecedents independent of whether the potential antecedent contains a focused constituent or not? Perhaps the answer is that the comparison/contrast between the remnant and its correlate is a contrast along only one specific dimension. In VP ellipsis, that dimension would be the one provided by the predicate that serves as antecedent. On this view, the remnant (the subject of the elided VP) could only contrast with another subject (the subject of the antecedent VP, whichever it is). Consequently, ANY focus on a non-subject would be taken to indicate a contrast that is independent of the remnant, and irrelevant to the choice of its correlate (and thus to the choice of an antecedent VP).

The question then is why the accented goal condition patterns with the accented matrix subject condition and not with the accented embedded subject condition. One possibility is that making any material in the matrix clause stand out perceptually increases the probability of the listener looking for an antecedent in that clause. If it's not clear why the speaker is drawing attention to a (part of a) clause, the listener might assume it's because the clause is important for what the speaker wishes to convey. This fits with the rational speaker hypothesis we have developed and supported elsewhere (Carlson, Clifton & Frazier, 2001; Clifton, Carlson & Frazier, 2002; Clifton, Frazier & Carlson, submitted; see also Schafer & Jun, 2005) because it suggests that the speaker's choice among the grammatically available options is not arbitrary but must be both self-consistent and consistent with the speaker's intent.

GENERAL DISCUSSION

Despite the fact that VP ellipsis does not contain a lexically contrastive constituent (e.g. who else or negation), the results of Experiment 1 support the contrasted remnant hypothesis, which predicted that placement of a L+H* accent on the matrix subject would increase the probability of listeners choosing the matrix predicate as the antecedent for an elided VP. In fact, matrix VP interpretations increased significantly when the matrix subject bore a L+H* accent, but only by approximately 15%. The current results reinforce the conclusion that a prominent pitch accent, even a L+H*, does not by itself dictate the focus structure of the sentence: a listener can choose to interpret a constituent as being the correlate that contrasts with the remnant in the ellipsis, even when that constituent does not carry the most prominent pitch accent.

In Experiment 1, the size of the accent placement effect was on a par with what Carlson has found for gapping, bare argument ellipsis, comparatives, and ordinary ('noncontrastive') sluicing structures, not the larger effect found for replacives and for sluicing with who else

(see Carlson, 2001a,b,2002;Carlson et al., in progress;Frazier & Clifton, 1998). Perhaps structures containing negation (e.g., replacives) or lexically contrastive material reinforce the existence of a contrast, thereby increasing the probability that listeners interpret a prominent accent as marking the constituent that contrasts with the remnant.

Concerning the very similar results in Experiment 1 for sentences containing a L% versus H% at the end of the first conjunct, it is not clear at the moment why the type of boundary tone did not matter. One possibility that we are currently investigating is that the particular acoustic renditions of these boundary tones had other important properties. The boundary tones in Experiment 1 were produced with a long following pause, which might support an “afterthought” analysis of the final conjunct. If an afterthought can occur after either a final fall or a continuation rise, depending on exactly when during the planning process the speaker decided to include it, then the afterthought interpretation might vitiate the distinction between the L% and H%.

Another possibility is that the tonal scaling in the test materials essentially disambiguated the materials. Since the pitch peak of the accent on the ellipsis clause subject was relatively high, this may have provided information about the syntactic/discourse status of the final clause in one of two directions. The height of the L+H* accent on the ellipsis clause subject might have been taken as evidence of no downstepping and/or as pitch resetting, thereby favoring a two sentence analysis both with a L% and with a H% tone. Alternatively, the comparability of the pitch maxima of the L+H* accents on the remnant and its correlate might have been interpreted as evidence that the speaker planned the accents as part of a single unit, favoring a one sentence analysis both with a L% and a H% tone. Without varying the tonal scaling of the ellipsis clause in concert with accent placement, these possibilities are difficult to assess (though see note 6, which suggests that pitch range manipulations were ineffective when accents were placed on both potential correlates).

Turning to the Experiment 2 results, they show very clearly that listeners do not avoid elided focus, or at least do not avoid copying material that is focused in the antecedent clause. It is possible that once a speaker has F-marked a constituent in an antecedent, listeners can carry over this F-marking to the elided constituent, or that listeners are able to copy the syntactic material without retaining the F-marking. Our results failed to support the hypothesis that the preferred antecedent for an elided constituent does not contain an F-marked constituent. They would thus fit with the idea that a phonetically more robust form (e.g., + pronounced) is not required in order to preserve a focus once it has been established. The results do not encourage the view that ellipsis (being unpronounced) is at the opposite end of a hierarchy from focus.

If the focus occurs on a non-subject in a VP ellipsis sentence, then it does not pick out a potential correlate for the remnant. But, as indicated by the results of Experiment 2, the focus may still influence the choice of an antecedent for the elided VP by some more general mechanism such as perceptually highlighting a particular clause and thereby increasing the likelihood of its predicate being selected as an antecedent.

The mysteries of focus are numerous. Given a grammatical account of focus like that offered by Rooth (1992a), the grammar only requires that focus introduce a free variable, which “from the point of view of competence theory, is non-deterministic” (Rooth, 1992a, p.108). This means that understanding the role of focus in language comprehension will depend heavily not only on understanding the grammar of focus but also the processing principles that listeners use to recover the alternatives for a focused constituent. This in turn may depend heavily on the particular syntax and discourse environment of the focused constituent. Prominent (L+H*) accents do play a role in determining the position of focus, as in Experiments 1–2, but even in

sentences containing a single most prominent L+H*, this L+H* is by no means the only determinant of focus, as shown in VP ellipsis and in other ellipsis structures we have tested. Experiment 2 shows clearly that avoiding elided accents plays no role at all in ellipsis resolution. The effect of prominent accents (e.g., in Experiment 1) must therefore be one of making the analysis with a clearly contrasted remnant and correlate more tempting, and not due to avoidance of an antecedent that contains a focused (F-marked) constituent.

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APPENDIX 1

Materials in Experiment 1. All prosodic versions and question shown for Item 1.

1. JOHN said Fred went to Europe L-H% and Mary did too.
     JOHN said Fred went to Europe L-L% and Mary did too.
     John said FRED went to Europe L-H% and Mary did too.
     John said FRED went to Europe L-L% and Mary did too.
     What did Mary do? said something; went to Europe
2. Jason claimed Tom left school and Tina did too.
3. Michael wrote that Sam got married and Emily did too.
4. Fred thought Max opened a business and Gloria did too.
5. Kate announced that Anita passed the bar exam and Roger did too.
6. Lucy mentioned that Kathy got sick and Joe did too.
7. Melissa assumed Karen got a raise and Ernie did too.
8. Julie said Maria went to the rally and Greg did too.
9. Henry claimed that Ian studied all yesterday evening and Margo did too.
10. Roger thought Steve missed class and Barbara did too.
11. Shawn remarked that Rob seemed preoccupied and Tanya did too.
12. Luke noticed that Pete left work early and Sue did too.
13. Jessica assumed Sharon got an award and William did too.
14. Jenny said Anne bought a Siberian husky and Tom did too.
15. Sonia observed that Mara took a second job and Timothy did too.
16. Lynne indicated Marcie signed up for a shop class and Peter did too.

APPENDIX 2

Materials in Experiment 2A and 2B. All prosodic versions and question shown for Item 1.

1. JOHN told the investigator Fred went to Europe and Mary did too.
     John told the INVESTIGATOR Fred went to Europe and Mary did too.
     John told the investigator FRED went to Europe and Mary did too.
     John told the investigator Fred went to Europe and Mary did too.
     What did Mary do? Told the investigator about Fred; Went to Europe (2A)
     What did Mary do? Tell someone about Fred; Went to Europe (2B)
2. Jason informed the teacher that Tom left school and Tina did too.
3. Michael wrote to relatives that Sam got married and Emily did too.
4. Fred said to the reporter that Max opened a business and Gloria did too.
5. Kate assured many classmates that Jill passed the bar exam and Roger did too.

6. Lucy mentioned to the nurse that Kathy got sick and Joe did too.
7. Melissa assured the new employee that Karen got a raise and Ernie did too.
8. Julia informed Mother that Rose went to the rally and Greg did too.
9. Henry reported to the TA that Tim studied all last night and Margo did too.
10. Frank mentioned to Father that Steve missed class and Barbara did too.
11. Shawn remarked to the therapist that Rob seemed preoccupied and Tanya did too.
12. Luke told the supervisor that Pete left work early and Sue did too.
13. Jessica announced to the audience that Sharon got an award and William did too.
14. Jenny told the neighbors that Anne bought a Siberian husky and Brandon did too.
15. Sonia wrote to Grandma that Mara took a second job and Ian did too.
16. Marcie indicated to registrar that Lynne signed up for a shop class and Peter did too.

Figure 1. Pitch tracks for a representative item in Experiment 1. Panel A: Matrix subject accent, L-H% boundary. Panel B: Matrix subject accent, L-L% boundary. Panel C: Embedded subject accent, L-H% boundary. Panel D: Embedded subject accent, L-L% boundary

Figure 2. Pitch tracks for a representative item in Experiment 2. Panel A: Matrix subject accent. Panel B: Matrix goal accent. Panel C: Embedded subject accent. Panel D: Neutral accent.

TABLE 1

Proportions of Matrix Interpretations and Mean Question-answering Times (ms), Experiment 1

Boundary Tone	Matrix subject	L+H* Pitch Accent Location Embedded subject
		Proportion Matrix Interpretations
L-H%	.545	.427
L-L%	.572	.416
		Mean Question-answering Times
L-H%	2602	2730
L-L%	2761	2777

TABLE 2
Proportions of Matrix Interpretations and Mean Question-answering Times (ms), Experiment 2A and 2B

Pitch Accent Condition	Proportion Matrix Interpretation	Time to Answer Question
Experiment 2A		
Matrix Subject	.319	2332
Matrix Indirect Object	.298	2492
Embedded Subject	.148	2315
Across-the-board	.199	2353
Experiment 2B		
Matrix Subject	.432	2376
Matrix Indirect Object	.382	2423
Embedded Subject	.154	2257
Across-the-board	.322	2386