**Effects of Varying Focus and Accenting of Adjuncts
on the Comprehension of Utterances**

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Abstract

Six experiments investigated the combined influence of syntactic argument structure and pitch accent patterns on the acceptability and comprehension of spoken utterances. Linguistic analyses of intonational structure have indicated that some syntactic constituents, when accented, can "project" focus to an entire phrase, but other constituents, including adjuncts, cannot project focus. Listeners made judgments of prosodic appropriateness (Experiments 1, 3, and 5) and comprehensibility (Experiments 2, 4, and 6) regarding spoken dialogues in which focus requirements and accent patterns on adjuncts were manipulated. All six experiments supported the claim that adjuncts cannot project focus. Regarding the relation between focus and accenting, results from Experiments 1-4 generally indicated that new (focused) adjuncts must be accented, and given adjuncts must be deaccented. However, results from Experiments 5 and 6 indicated that the accent-focus relationship that held for other types of adjuncts does not seem to apply to prenominal adjectives. We suggest that contemporary semantic analyses can explain this observation by claiming that a prenominal adjective is not an adjunct of the noun it modifies, but rather, is a function that takes the noun as its argument.

Keywords: Arguments, adjuncts, accent, dialog, focus, functional application

**Effects of Varying Focus and Accenting of Adjuncts
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Intonation, the timing and pattern of voice pitch rises and falls, is a crucial component of spoken utterances, affecting not only stylistic issues - how pleasing utterances are - but also how utterances are interpreted. Intonation has grammatically and pragmatically correct and incorrect options. In this paper, we examine some of the factors that govern appropriateness of intonational structure for dialogues with varying accent patterns on syntactic adjuncts.

Understanding a spoken sentence requires identifying the sentence focus, which is guided in part by the intonation structure of the utterance. Informally speaking, the focus of a sentence is its most important and emphasized constituent. Focus typically constitutes new, as opposed to given information, i.e., is the part of a sentence singled out as the update of the discourse (Gussenhoven, 1983; Halliday, 1967; Rochemont & Culicover, 1990). According to Selkirk (1995), the focus of a sentence introduces a set of alternatives into the discourse, which are put to use in various ways in the semantics. For instance, the answer to the wh-question, book, in (1a) is focused: it asserts that the speaker bought a book, not something else.

(1)   (a)   What did you buy? I bought a book.

        (b)   I bought a BOOK.

        (c)   I BOUGHT a book.

In English, pitch accents (characterized by shifts in the pitch of the voice in addition to other changes which increase perceptual prominence, e.g., increased loudness or duration) typically signal sentence focus. Accents can be seen as morphemes that convey the focus distribution of the sentence (Gussenhoven, 1983; Selkirk, 1995). For instance, the answer in (1a) would typically be spoken as (1b), where capitalization denotes the presence of a pitch accent. That is, the noun phrase (NP), book, is in focus, and is the locus of the pitch accent. Generally speaking, listeners expect new (or contrastive) information to be focused and thus accented, and given (and noncontrastive) information not to be, and they better comprehend utterances in such

cases (Birch & Clifton, 1995; Bock & Mazzella, 1983; Cutler, 1990; Nooteboom & Kruyt, 1987; Terken & Nooteboom, 1987).

However, the characterization of the pitch accent-focus relationship is less straightforward than "whatever is accented is focused." For instance, (1b) would be an appropriate answer to the question, <u>What did you do?</u> In this case, the entire verb phrase (VP), <u>bought a book,</u> is focused. Nevertheless, a single pitch accent on <u>book</u> can project or carry focus for the entire focused VP. However, focus cannot be carried by just any constituent. For instance, (1c) would not be an appropriate answer to the question in (1a). Gussenhoven (1983; 1992) and Selkirk (1984; 1995) have each proposed a set of focus projection principles characterizing the focus-accent relationship.

Selkirk's (1995) proposal involves the following set of rules. First, any accented word is "F-marked." (F-marking is a component of meaning and also allows projection of focus.). Focus projection can occur according to two basic rules: F-marking of the head of a phrase (e.g., the N in an NP) licenses F-marking of the entire phrase; F-marking of an internal argument of a head licenses F-marking of the head. The two rules thus jointly permit an F-marked argument to project focus to an entire constituent. (A third rule permits F-marking of the trace of a syntactically-moved constituent.) However, licensing focus projection does not force focus to be projected; it simply permits it. A pitch accent on an argument or a head can be interpreted as narrowly focusing on that phrase, without projection.

Regarding interpretation within Selkirk's theory, the Focus of a sentence (FOC) is the highest constituent that is F-marked, following the constraints described in the focus projection rules. The FOC can be interpreted as new information, or (if contrastive) as given. Constituents that are F-marked, with the exception of the sentence FOC, are interpreted as new information, and all other (non-f-marked) constituents are interpreted as given.

As an example of Selkirk's focus projection principles, consider the following (modified from Selkirk, 1995 and Birch & Clifton, 1995):

(2) What did Mary do?

Mary bought a book about deaf BATS.

The wh-question focuses the VP in the answer sentence. In the answer sentence, <u>BATS</u> is accented and is therefore F-marked. F-marking of <u>BATS</u> (argument of <u>about</u>) licenses f-marking of the head of the prepositional phrase (<u>about</u>). If <u>BATS</u> is f-marked, it licenses f-marking of the entire PP. F-marking of the PP allows f-marking of <u>book</u>, assuming that the PP is an argument of <u>book</u>. F-marking of <u>book</u> licenses f-marking of the NP, which is an argument of the verb <u>bought</u>. Thus, F-marking of the NP licenses f-marking of <u>bought</u>, which licenses F-marking of the entire VP. In this way the single accent on <u>BATS</u> ultimately can project focus to the entire VP, which in that case is the focus of the sentence (but note, focus can remain narrow and not be projected; there is no unambiguous broad-focus prosody).

In Selkirk's theory, argument structure is a crucial component of focus projection. Syntactic constituents other than arguments and heads, i.e., adjuncts, cannot license F-marking. Arguments correspond to "inherent" roles that are specified by a constituent, e.g., a direct object for a verb; adjuncts are constituents that are not lexically specified, such as modifiers - adjectives, adverbs , relative clauses, and some prepositional phrases. (See Schütze & Gibson, 1999, for a summary of tests of syntactic argumenthood; see Abney, 1989; Boland & Boehm-Jernigan, 1998; Clifton, Speer, & Abney, 1991, for discussion of some processing implications of the argument/adjunct distinction; see Frazier & Clifton, 1996, for discussion of the closely-related distinction between primary and non-primary phrases.) In (2), the distinction between arguments and adjuncts is the basis of the observation that an accent on <u>deaf</u> rather than <u>bats</u> would not allow focus projection to other constituents, because <u>deaf</u> is an adjunct.

Gussenhoven's (1983; 1992; 1999) account of focus projection differs from Selkirk's in that it depends primarily on surface positions rather than syntactic roles of constituents. His sentence accent assignment rules (SAAR) state that sentence constituents - predicates, arguments and adjuncts - that are focused must be accented, except for predicates that are adjacent to their arguments (or that are separated from their arguments only by a non-focused constituent). More recent accounts (e.g., 1999) additionally suggest that constituents that are outside focus constituents, and predicates that are adjacent to an accented argument (or separated only by a non-focused constituent), must be de-accented. Thus, Gussenhoven, like Selkirk (1995), specifies that new adjuncts should be accented, whereas given adjuncts should not be accented. Further, both Gussenhoven and Selkirk predict that adjuncts cannot project focus.

Existing experimental evidence (Birch & Clifton, 1995; Gussenhoven, 1983) demonstrates that accented syntactic arguments can project focus to other constituents. Birch and Clifton used the techniques to be used in the present paper to demonstrate that arguments can project focus. They played listeners dialogs like those in (3) (beginning with a question that required broad VP focus in its answer by treating both <u>move</u> and its argument <u>to Iowa</u> as new) and asked them to rate the appropriateness of the second sentence in the dialog (Experiment 1) or to make speeded semantic appropriateness judgments (Experiment 2)

(3) Why is Gretchen so sad?

    a. She's MOVING to IOWA.

    b. She's MOVING to Iowa.

    c. She's moving to IOWA.

Listeners rated sentences such as those in (3c) nearly as highly as those in (3a), and comprehended them as quickly. They apparently understood a sentence with broad VP focus equally well when the argument prepositional phrase (PP) (<u>to IOWA</u>) was alone accented (and therefore projected focus) as when the V was also accented. Sentences like (3b), in which the

argument PP was not accented, were judged to be less prosodically acceptable and harder to comprehend than (3a) and (3c), presumably because the unaccented PP was new and therefore should have been focused.

The present experiments test the claim (Gussenhoven, 1999; Selkirk, 1995) that adjuncts, in contrast to arguments, fail to project focus. The experiments were guided by three hypotheses derived from Gussenhoven (1992; 1994; 1999) and Selkirk (1995) regarding the role of adjuncts in focus projection:

Hypothesis 1: An adjunct that is focused, i.e., new to a discourse must be accented...

Hypothesis 2: ...but cannot project focus to other constituents.

Hypothesis 3: A non-focused, i.e., given adjunct must not be accented.

These hypotheses are identical to those tested by Birch and Clifton (1995) with the exceptions that (a) all three make claims about the focus and focus-projection properties of adjuncts rather than of arguments, and (b) Hypothesis 2 claims that an accented adjunct, in contrast to an accented argument, cannot project focus to other constituents. We note that Hypotheses 1 and 3, while consistent with Selkirk's (1995) analysis, are not consistent with her 1984 analysis. Selkirk (1984) claimed that "the presence or absence of focus on an adjunct will not contribute to the old/new information content of the utterance" (p 231). Her evidence for this point came largely from the observation that utterances like JOHN bought a red TIE were acceptable uttered out of the blue, where red had to be considered new but still did not require an accent. We examine constructions like this in Experiments 5 and 6, but until then assume with Gussenhoven (1999) and Selkirk (1995) that new adjuncts require focus.

In Experiments 1 and 2 we tested Hypotheses 1 and 2 with respect to the role of post-verbal adjuncts in focus projection. In Experiments 3 - 6 we investigated all three hypotheses with respect to the role of post-nominal relative clauses and prenominal adjectives. We investigated these questions by manipulating focus (given-new status) and accenting of

constituents in recorded dialogues, and then measuring listeners' linguistic judgments of prosodic appropriateness (Experiments 1, 3 and 5) and their comprehension (Experiments 2, 4 and 6).

Experiments 1 and 2

In Experiments 1 and 2 we manipulated focus and accenting of post-verbal VP adjuncts, including PP's and adverbs. The dialogues consisted of recorded sentence pairs in which the first sentence, a question, established broad VP focus for the second sentence, such that the V and the post-verbal adjunct in the second sentence would be new. In the second sentence, accent was manipulated, i.e., was placed on both the V and the adjunct as in 4a, on the V only (4b), or on the adjunct only (4c):

(4)   Why is Jessica quitting her job?

        a. She is MOVING in MARCH.

        b. She is MOVING in March.

        c. She is moving in MARCH.

For each experiment participants listened to sentence pairs (i.e., the combination of the question in (4) with one of the three answers), and made linguistic appropriateness or comprehension judgments. By hypothesis 1, the combination of focus structure and accent pattern in conditions (4a) and (4c) (with accent on a new post-verbal adjunct), but not in condition (4b) (with no accent on the adjunct), is appropriate. By hypothesis 2, since the adjunct cannot project focus to the VP, the V must do so, hence, the focus-accent relationship in conditions (4a) and (4b) but not (4c) is appropriate. Together these hypotheses lead to the prediction that appropriateness judgments should be higher and comprehension better for condition (4a) vs. condition (4b) or (4c), both of which are prosodically inappropriate to possibly differing degrees.

Experiment 1

In this experiment we asked listeners to make linguistic judgments of the recorded dialogues. Their task was to judge the appropriateness of the intonation patterns of target sentences with respect to the context sentences. The goal was to test whether listeners' linguistic intuitions matched the predictions from focus projection theory.

Method

Materials and Design The materials consisted of 18 experimental and 36 filler dialogues. The experimental dialogues established VP focus by the question sentence and varied accenting on the V and post-verbal adjunct in the second sentence. See (4) above and (5) below (and see Appendix 1 for all experimental materials).

(5) How did Ted get to Minnesota?

a. He DROVE SPEEDILY. (Condition 1)

b. He DROVE speedily. (Condition 2)

c. He drove SPEEDILY. (Condition 3)

Combining the question with the three versions of the answer sentences resulted in three experimental conditions, in which accent was placed on both V and adjunct in Condition 1; on the V in Condition 2; and on the adjunct in Condition 3. The fillers consisted of question-answer pairs in which focus structure was established by the question, and accent was placed on the V, the object NP, or both.

Prosodic analyses. Each version of each answer sentence was analyzed prosodically using ToBI guidelines (Silverman, Beckman, Pitrelli, Ostendorf, Wightman, Price, Pierrehumber, & Hirschberg, 1992; Beckman & Ayers, 1994). The ToBI system, derived primarily from Pierrehumbert (1980), is a notation system for representing the intonation and rhythmic break structure of utterances. Pitch accents are denoted as high (H*) or low (L*) tone (the two tones may be combined, as in $L + H*$). Phrase and boundary tones are noted at the ends

of intermediate and intonation phrases (e.g., L- would denote a low phrase tone and L% a low

boundary tone).

The first author analyzed each answer sentence. ToBI descriptions of the pitch accent and

boundary tone patterns for the three answer sentences are shown in (6).

(6)   L+H* L-   L+H* L- L%

   a. He DROVE SPEEDILY.

       L+H*   L- L%

   b. He DROVE speedily.

        L+H*   L- L%

   c. He drove SPEEDILY.

Fundamental frequency contours for a typical example of these utterances are illustrated in

Figure 1. The mean durations of utterances like (6a), (6b) and (6c) were 1.96, 1.88, and 1.86 s,

respectively. Accenting two phrases rather than one lengthened the utterances.

The three versions of the experimental utterances all followed the intonation pattern

shown in (6) and Figure 1. No other pitch accents were present in the body of the answer

sentences (although pitch accents were sometimes present on introductory clauses, such as in the

answer sentence, <u>He's got a good chance; he writes beautifully.</u>) Our speaker used an L+H* pitch

accent to focus a word, which appears to be the normal way to impart focus in her dialect.

According to Pierrehumbert and Hirschberg (1990), while a L+H* accent is often used to mark a

contrast, it doesn't necessarily do so. Rather, it indicates "a strong sense of commitment to [the]

accented item" (p. 297). Note that version 1 of the answer sentences (e.g., 5a) contained an

internal phrase boundary at the point of the first L- tone. While Selkirk's (1995) and

Gussenhoven's (1983, 1992) accounts permit broad focus to be conveyed either by accenting

both the verb and its adjunct or only accenting its adjunct, there may be a pragmatic difference

between (5a) and (5c). For instance, Beckman and Pierrehumbert (1986) observe that a focused word that is accented seems even more prominent when it is "set off" as a phrase by itself.

*** FIGURE 1 ABOUT HERE ***

Procedure. All of the dialogues were tape recorded in a sound-attenuated chamber then digitized at a 10 kHz rate. A male spoke the question, and a female answered. The dialogues were played over two speakers from the digitized versions using 10 kHz digital-audio conversion. The digitized files were played in the experiment by a computer.

As in all experiments reported here, participants were tested individually in a sound-attenuated chamber, listening to loudspeakers that were adjusted to a comfortable listening level. They were told that they would be listening to a subset of the dialogues from a task they had just completed (as Experiment 2b) and would rate each answer sentence on how appropriate its stress pattern was. An example of appropriate and inappropriate accenting was given. Participants were to give responses on a scale of 1 to 5, where 1 was "totally inappropriate," accenting, and 5 was "totally appropriate" accenting. Each participant contributed appropriateness judgments to one of the three versions of each of the 18 items. As in all experiments reported here, a fully counterbalanced design was used, so that across the full experiment, each item was tested equally often in each prosodic condition, and each participant received equal numbers of each prosodic condition. The order of presentation of the items was individually randomized for each participant. Note that no mention of prosody or prosodic appropriateness had been made in the listeners' previous task, reported here as Experiment 2.

Participants. There were 59 participants who participated immediately following the task reported as Experiment 2b.

Results and Discussion

Mean ratings by subjects and by items were obtained for each condition and were submitted to ANOVA's and planned comparisons. The mean appropriateness ratings are shown by condition in Table 1 (SE = .087; all standard errors reported in this paper are derived from the high-order error term of the appropriate by-subjects analysis of variance).

TABLE 1 ABOUT HERE

The pattern of results supports Hypotheses 1 and 2, which together predicted higher appropriateness ratings in Condition 1 than in 2 and 3, $F1(1,58) = 51.58$, $p < .01$; $F2(1,17) = 36.77$, $p < .01$ for planned comparison of Condition 1 vs. 2 and 3 together. There was no difference in the ratings of Conditions 2 and 3 ($F1$ and $F2 < 1$). Thus, participants' linguistic judgments matched up well with the predictions from Gussenhoven and Selkirk's accounts of focus projection.

Experiments 2a and 2b

Experiments 2a and 2b were intended to test the focus projection principles with a comprehension task. Participants listened to the dialogues from Experiment 1 and made YES-NO responses as to whether the two sentences fit together, i.e., whether or not the second sentence of the pair made sense with respect to the first. We recorded response times and proportion of YES (makes sense) responses. The only difference between the two experiments was the presence of a response deadline in 2b.

Method

Materials and Design. The experimental and filler dialogues from Experiment 1 were used here, in addition to another 48 filler dialogues and 6 practice dialogues. All 54 of the dialogues used in Experiment 1 were sensible, i.e., the two sentences fit together coherently. Of the 48 new fillers, 18 were sensible, and 36 were nonsensible dialogues (i.e., were intended to receive NO responses; see example (7):

(7)   What color is Lonnie's cat?

The CAT jumped out the window.

There were more sensible (YES) than nonsensible (NO) dialogues in the experiment, but we assumed that some of the experimental dialogues would receive responses of NO when they were inappropriately accented, providing a rough balance of YES and NO responses.

Procedure. All sentences were recorded and digitized as described in Experiment 1. The duration of each sentence was measured by use of a graphic waveform editor that included auditory feedback. The dialogues were played over two speakers from the digitized versions using 10 kHz digital-audio conversion. During playback, a timer was activated at the start of each answer sentence and was terminated upon a participant's response. The timer was activated at the beginning rather than at the end of the answer sentence to allow for cases where a response came before the sentence had ended. However, the recorded reaction times were referenced to the end of the sentence.

Participants were instructed to decide for each dialogue whether or not the second sentence made sense given the question sentence, i.e., whether it was a meaningful response. They were not told to consider the prosody of the response, just its content. They were to pull the YES key for responses that did make sense given the question, and to pull the NO key otherwise. In Experiment 2a listeners were not given a response deadline. In Experiment 2b listeners were told to make their responses as quickly as possible without compromising accuracy. To further stress the importance of speed, a response deadline was imposed, such that responses that came after a 1.5-second deadline that began with the end of the sentence were followed by a "TOO SLOW!" message.

Participants. There were 48 University of Massachusetts students in Experiment 2a and 60 in 2b who participated for course credit. All were native American English speakers. The

participants from Experiment 2b were the same as in Experiment 1, plus one whose data were

lost for Experiment 1.

Results and Discussion

      The durations of the answer sentences were subtracted from the total recorded response

time (RT) for each item so that RT's would reflect time from the end of the last word of the

sentence. RT means included only responses where participants responded YES to the target

sentence; responses of NO and, for Experiment 2b, time-outs (responses that were not made

before the 1.5 sec deadline) were excluded. The mean RT's and %YES's for each condition are

shown in Table 2.

<div align="center">***TABLE 2 ABOUT HERE***</div>

      For the %YES analyses (SE = .017), there were main effects of experiment (88% Yes

rate in 2a and 84% in 2b; $F1(1,106) = 4.13$, $p < .05$; $F2(1,17) = 9.28$, $p < .01$), and accenting

($F1(1,106) = 3.6$, $p < .05$; $F2(1,17) = 3.1$, $p < .06$). Experiment did not interact with accenting,

indicating that the deadline procedure did not substantially affect the pattern of results (even

though making participants respond faster did lower their overall accuracy). Thus, planned

comparisons were carried out on the combined data. As predicted by Hypotheses 1 and 2, the

YES rate for Condition 1 was higher than for Conditions 2 and 3 together, $F1(1,106) = 6.64$, $p <$

$.01$; $F2(1,17) = 5.63$, $p < .05$. There was no difference between Conditions 2 and 3 (F1 and F2 <

1).

      For the RT analyses (SE = 49), there was a main effect of experiment: responses in

Experiment 2a (without a deadline) were 653 ms. slower than in 2b, $F1(1, 106) = 105.79MS$, $p <$

$.01$; $F2(1,17) = 121$, $p < .01$. However, there were no other main effects or interactions. In

particular, there were no significant differences among Conditions 1-3, $F1 (2,212) = 1.2$, $F2 < 1$.

      The comprehension task provided partial support for the hypothesis that listeners prefer

sentences in which a new post-verbal adjunct is accented but in conjunction with an accented V

to project focus to the VP. They gave a higher proportion of "makes sense" judgments to sentences in which both the V and the adjunct were accented, compared to sentences with only the adjunct or only the V accented. The high overall proportion of "makes sense" judgments reflects the fact that participants were instructed to reject sentences whose content was inappropriate (no mention of prosody was made in the instructions). Still, the differences in proportion of "accept" responses, while small, were significant. However, in contrast with Birch and Clifton (1995), the speed with which these judgments were carried out did not significantly change as a function of accent.

That our participants performed the timed comprehension task prior to making the prosodic acceptability judgments should be borne in mind in interpreting our results from Experiments 1 and 2. One might argue that there could be a carryover effect from the first task (Experiment 2) to the second. While this is a possibility, we believe that it does not undermine our conclusions. First, our listeners' attention was not called to prosody in the initial (comprehension) task. We believe that this procedure has a potential advantage in that it prompted listeners to treat the dialogs as meaningful speech before they made prosodic judgments about them. Secondly, the same procedure was used in Birch and Clifton (1995), and the main point of the current experiment is how its results differ from Birch and Clifton's results: unlike arguments, adjuncts do nor project focus. The contrast between the present results and the earlier ones cannot be attributed to the common procedure they used.

Taken together the results of Experiments 1 and 2 indicate a preference by listeners for new predicate adjuncts to be accented, but listeners seem to view these adjuncts as incapable of projecting focus beyond the adjunct's own phrase. The lack of focus projection with predicate adjuncts contrasts with the results Birch and Clifton (1995) reported for arguments: judgments were nearly as favorable when just an argument was accented as when both the head verb and an argument were accented, and RTs and percentage acceptances were fully as high. The contrast

between the results of Birch and Clifton's (1995) Experiments 1 and 2 and the current

Experiments 1 and 2 is more compelling in light of the similarity between the two types of

dialogues; e.g., note the small difference between the sentences in (3) and (4-5) above.

According to the linguistic accounts of focus projection outlined previously, listeners

comprehend (3c) as easily as (3a), but comprehend (4c) less easily than (4a) just because to Iowa

is an argument and therefore allows focus projection, whereas in March is an adjunct, which

cannot project focus.

The contrasting effects of accenting arguments and adjuncts support linguistic analyses

of the prosody-focus relationship like those of Gussenhoven (1999) and Selkirk (1995). By

requiring the argument/adjunct distinction, they specifically disconfirm earlier theories of the

prosody-focus relationship which claimed that prosodic prominence is assigned by the Nuclear

Stress Rule (in English, the rule that prominence will fall on the main-stressed syllable of the

rightmost word of a focused phrase; Chomsky & Halle, 1968; Chomsky, 1971). The effects of

arguments vs. adjuncts also support claims that the two types of constituents can play distinct

roles in language processing (Abney, 1989; Frazier & Clifton, 1995).

Experiments 3 and 4

In Experiments 3 and 4 we further investigated the influence of syntactic argument

structure on the relationship between accent and focus. Here we tested whether post-nominal

modifiers (for the most part, relative clauses containing predicate adjectives), like other

constituents, must be accented when new to a discourse and deaccented when given, and whether

they license focus projection to higher constituents. Post-nominal modifiers, like the adverbs

and prepositional phrases tested in Experiments 1 and 2, are adjuncts. Rather than modifying a

verb, however, they modify a noun. We tested all three of the preceding hypotheses, namely, that

relative clauses new to a discourse must be accented (H1) but cannot project focus (H2) (such

that another constituent must be accented to "carry" focus), and that an adjective that is given from prior discourse must not be accented (H3) when it appears in a relative clause.

To test these questions we measured listeners' linguistic preferences (Experiment 3) and comprehension (Experiment 4) for sentences in which a noun phrase (NP) was the focus; given-new status of a post-nominal modifier was manipulated, along with accenting on the adjective and the head noun of the NP. An example is given in (8):

(8)   A. Did they find anything pertaining to the trial?

        B. Did they find anything that was stolen?

                1. They found the FILES that were STOLEN.

                2. They found the FILES that were stolen.

                3.   They found the files that were STOLEN.

As shown in the example, both versions of the question sentences set up object NP focus in the answer sentences (the subject NP and V were contextually given). One version (A) established the adjective as new, the other (B), as given. In the answer sentences, accenting was placed on both the head noun and the adjective (1), on the head noun only (2), or on the adjective only (3). Combining both questions with the three answer sentences resulted in six conditions, referred to as A1-3 and B1-3.

By Hypothesis 1, a new modifier must be accented, i.e., conditions A1 and A3 but not A2 are appropriate renderings. However, according to H2, that a new modifier cannot project focus more broadly (to the NP), the head noun must be accented to license focus projection to the NP, hence, A3 is inappropriately accented. Accordingly, H1 and H2 together lead to the prediction that appropriateness judgments should be higher and comprehension better for condition A1 vs. condition A2 or A3. Hypothesis 3, a given modifier should not be accented, predicts that condition B2 should be preferred over B1 and B3.

<center>Experiment 3</center>

In Experiment 3 listeners made linguistic judgments regarding the intonational appropriateness of the dialogues, as in Experiment 1.

Method

Materials and Design. There were 36 experimental dialogues of the type shown in (8) (see Appendix 2). The experimental dialogues established object NP focus by the question sentence and varied accenting on the object NP and post-nominal adjective in the second sentence. There were 24 filler dialogues, in which there was either NP or VP focus, and accenting occurred on the V, the object NP or a prenominal adjective (or on some combination of these constituents). All dialogues were recorded and digitized using the procedures of Experiment 1. In Experiment 2, half the questions and half the answer sentences were spoken by a female, and the remaining half of the question and answer sentences were spoken by a male. ToBI analyses were carried out on the answer sentences as in Experiment 1 and appear in (9):

(9)   L+H* L-   L+H* L- L%

     a. They found the FILES that were STOLEN.

                      L+H*   L- L%

     b. They found the FILES that were stolen.

                          L+H* L- L%

     c. They found the files that were STOLEN.

The intonation patterns were the same for all items. As in Experiment 1, the speaker used a L+H* accent to focus a phrase. Also, there were no other pitch accents in the body of any answer sentence, although there were pitch accents in introductory clauses. The mean durations of utterances like (9a), (9b), and (9c) were 1.74, 1.60, and 1.54 s, respectively.

Procedure and Participants. The procedure was the same as in Experiment 1. The participants were 42 University of Massachusetts students. All were native American English

speakers who participated for course credit immediately following participation in Experiment 4.

Results and Discussion

The mean appropriateness ratings are shown by condition in Table 3 ($SE = .10$). The mean ratings were higher for responses to new (A1-3) versus given (B1-3) post-nominal adjectives ($F1(1, 41) = 17.15$, $p < .001$; $F2(1,35) = 21.05$, $p < .001$). There was also a significant main effect for accent pattern (1 vs. 2 vs. 3: $F1(2, 82) = 69.86$, $p < .001$; $F2(2,70) = 87.38$, $p < .001$). The interaction was also significant ($F1(2, 82) = 44.57$, $p < .001$; $F2(2, 70) = 40.89$, $p < .001$).

TABLE 3 ABOUT HERE

The expectation that conditions A1 and B2 would be the most preferred received strong support. Planned comparisons indicated that, as predicted by Hypothesis 1, condition A1, in which the adjective was accented, received a higher appropriateness rating than A2, in which the adjective was not accented ($F1(1,41) = 26.19$, $p < .01$; $F2(1,35) = 36.92$, $p < .01$). Also, as predicted by Hypothesis 2 (adjectives cannot project focus), A3, where the head noun was not accented, was rated lower than A1 ($F1(1,41) = 81.29$, $p < .01$; $F2(1,35) = 91.2$, $p < .01$). Moreover, B1, in which a given adjective was inappropriately accented, was given a lower appropriateness rating than B2, supporting Hypothesis 3 ($F1(1,41) = 47.93$, $p < .01$; $F2(1,35) = 47.36$, $p < .01$).

In summary, listeners expected new post-nominal modifiers to be accented and given modifiers to be deaccented. Listeners also did not allow post-nominal modifiers to project focus. These results are consistent with Hypotheses 1, 2, and 3.

Experiment 4

We used the comprehension task of Experiment 2b to investigate the accent-focus relationship for post-nominal adjectives. Participants listened to the dialogues from Experiment

3 and judged whether they were meaningful. Response times and proportion of YES judgments were analyzed to test the three hypotheses.

Method

Materials and Design. The experimental and filler dialogues from Experiment 3 were used here, in addition to another 48 filler dialogues, and 6 practice dialogues. The experimental and filler dialogues used from Experiment 3 were all sensible, i.e., the two sentences fit together coherently. The 48 additional fillers were those from Experiments 2a and 2b.

Procedure and Participants. The procedure was the same as in Experiment 2b. Listeners judged whether the dialogues were coherent, and were to respond within a 1.5-s deadline. The participants from Experiment 3 had participated in this experiment prior to participating in Experiment 3.

Results and Discussion

RTs (measured from the end of the utterances) and %YES rates were obtained as in Experiment 2b. The means are shown by condition in Table 4 (SE = 30.99 for RT and .033 for %YES).

TABLE 4 ABOUT HERE

For %YES, the main effect for responses to new (A1-3) versus given (B1-3) post-nominal adjectives was significant, 88.6 vs. 76.5% ($F1(1, 41) = 9.21$, $p < .005$; $F2(1, 35) = 22.26$, $p < .001$), as was the main effect for accent pattern (1 vs. 2 vs. 3: $F1(2, 82) = 13.69$, $p < .001$; $F2(2,70) = 13.24$, $p < .001$). The interaction was also significant ($F1(2, 82) = 10.52$, $p < .001$; $F2(2, 70) = 18.36$, $p < .001$). For the RT results, the main effect of new versus given adjectives was not significant (F1 and F2 < 1). There was a main effect of accent pattern ($F1(2,82) = 16.71$, $p < .001$; $F2(2, 70) = 8.78$, $p < .001$) and an interaction between new/given and accenting ($F1(2,82) = 7.43$, $p = .001$; $F2(2, 70) = 3.89$, $p < .03$).

The numerical pattern of the data was consistent with Hypothesis 1, but statistical support was lacking. Planned comparisons indicated that condition A1 received a marginally higher YES rate than A2, according to the by-subjects analysis only ($F1(1,41) = 3.6$, $p = .064$; $F2(1,35) = 2.23$, $p = .14$). However, A1 was not significantly faster than A2 ($F1(1,41) = 1.20$, $p = .28$; $F2(1,35) = 1.46$, $p = .24$).

Hypothesis 2 was supported since A1 had a higher YES rate and faster RT than A3 ($F1(1,41) = 7.05$, $p < .05$; $F2(1,35) = 4.93$, $p < .05$ for %YES; $F1(1,41) = 12.25$, $p < .01$; $F2(1,35) = 9.21$, $p < .01$ for RT). In support of Hypothesis 3, B2 had a higher YES rate and faster RT than B1 ($F1(1,41) = 10.42$, $p < .01$; $F2(1,35) = 15.12$, $p < .01$ for %YES; $F(1,41) = 14.05$, $p < .01$; $F2(1,35) = 13.09$, $p < .01$ for RT).

The results of this experiment show that listeners may accept sentences slightly more often, but not significantly faster, when new post-nominal modifiers are accented than when they are not. This result provides weak support for Hypothesis 1. Listeners do comprehend sentences more quickly and easily when given post-nominal modifiers are deaccented, consistent with Hypothesis 3 and with the results of Experiment 3. In addition, post-nominal modifiers apparently do not project focus, consistent with Hypothesis 2.

Experiments 3 and 4 together indicate that listeners generally preferred accented new modifiers (although they were not significantly faster to comprehend them), and they strongly preferred de-accented given modifiers and comprehended them better. These results are consistent with the results from Experiments 1 and 2, in which listeners preferred that new predicate adjuncts be accented along with the V. The results are also consistent with claims from Gussenhoven (1983; 1994) and Selkirk (1995), that adjuncts are subject to the basic rule, "whatever is accented is focused." Moreover, the finding that listeners did not allow for post-nominal modifiers, even when accented, to project focus, is consistent with Experiments 1 and 2, as well as with Gussenhoven and Selkirk's theories.

Experiments 5 and 6

Experiments 5 and 6 were designed to explore the prenominal adjective construction described earlier that led Selkirk (1984) to suggest that accent on adjuncts does not contribute to an utterance's old/new information content. These experiments used modified versions of the dialogues from Experiments 3 and 4 in which the modifiers were prenominal adjectives rather than post-nominal relative clauses. For instance the sentences from Example (8) were modified as in (10):

(10)　　A.　Did they find anything pertaining to the trial?

　　　　B.　Did they find anything that was stolen?

　　　　　　　1.　They found the STOLEN FILES.

　　　　　　　2.　They found the stolen FILES.

　　　　　　　3.　They found the STOLEN files.

Thus, we tested Hypotheses 1-3 for the case of prenominal adjectives. Specifically we tested whether prenominal adjectives new to a discourse must be accented (Hypothesis 1) but cannot project focus (Hypothesis 2) (such that another constituent must be accented to "carry" focus), and that a prenominal adjective given from prior discourse must not be accented (Hypothesis 3). We again measured listeners' linguistic preferences (Experiment 5) and comprehension (Experiment 6) for sentences in which a noun phrase (NP) was the focus. Given-new status of a prenominal adjective was manipulated, along with accenting on the adjective and the head noun of the NP.

The results expected on the basis of Gussenhoven (1999) and Selkirk (1995) were the same as those expected for Experiments 3 and 4. According to hypotheses 1 and 3, Conditions A1 and B2 were expected to receive the highest appropriateness ratings where all and only the new constituents in the answer sentence were accented. The remaining conditions were expected to receive lower ratings: A2 because the new adjective was not accented; A3 because the head

noun was not accented, and an adjective cannot project focus; B1 and B3 because a given

adjective is accented (Moreover, in B3 the head noun is new and not accented, which also

renders the answer sentence inappropriate).

<div align="center">Experiment 5</div>

Method

      Materials and Design. Thirty-two experimental dialogues of the type shown in (10) were

derived from the dialogs used in Experiments 3 and 4 (all appear in Appendix 3). The

experimental dialogues established object NP focus by the question sentence and varied

accenting on the prenominal adjective and the Object NP in the second sentence. The 24 filler

dialogues were from Experiment 3. All dialogues were recorded and digitized as in Experiment

1. ToBI analyses were carried out on the answer sentences as in Experiment 1 and appear in

(11):

(11)   L+H* L- L+H* L- L%

        a. They found the STOLEN FILES.

                          L+H* L- L%

        b. They found the stolen FILES.

                          L+H*   L- L%

        c. They found the STOLEN files.

The intonation patterns were the same for all items with one exception. In version 1 of the

answer sentence of one item, We're having a FRESH COBBLER, there was no L- following the

adjective. The utterances of the remaining answer sentences had the intonation pattern as given

in (11). As in Experiment 1, no other pitch accents were present in the body of any answer

sentence, although there were pitch accents in introductory expletives. The mean durations of

utterances like (11a), (11b), and (11c) were 1.7, 1.58, and 1.61 s, respectively.

Procedure and Participants. The procedure was the same as in Experiments 1 and 3, except that the speakers (male questioner, female answerer) used in Experiment 1 were again used. The participants were 58 University of Massachusetts students (data from two of the original 60 participants were lost). All were native American English speakers who participated for course credit immediately following participation in Experiment 6.

Results and Discussion

The mean appropriateness ratings are shown by condition in Table 5 (SE = .11). The expectation that conditions A1 and B2 would be the most preferred received little or no support. Basically, listeners liked any sentence with an accented head noun in the focused constituent, regardless of the given/new status of the adjective. By Hypothesis 1, condition A1 should have received a higher appropriateness rating than A2, in which the new adjective is not accented. The pattern is consistent with the prediction, but the difference was not reliable ($F1(1,57) = 2.19$, $p < .15$; $F2(1,31) = 2.83$, $p < .1$). This result indicates only a slight, non-significant preference for accenting a new adjective.

TABLE 5 ABOUT HERE

By Hypothesis 2, accenting of the adjective should not suffice to project focus to the focused NP, i.e., condition A3, in which the head noun is not accented, should be rated as less appropriate than A1. This was the obtained result ($F1(1,57) = 35.89$, $p < .01$; $F2(1,31) = 49.1$, $p < .01$).

Hypothesis 3, that a given adjective should not be accented, is tested by the comparison between conditions B1 and B2. The very slight difference in appropriateness ratings between these two conditions actually was in the opposite direction as that prediction ($F1$ and $F2 < 1$). Hence, listeners do not require given prenominal adjectives to be deaccented.

Taken together the results of this experiment show that listeners neither prefer nor dis-prefer accenting on new prenominal adjectives or deaccenting on given adjectives for sentences

with NP focus. They do judge such sentences with a deaccented head noun as less appropriate, consistent with the hypothesis that adjectives (even when accented) cannot project focus for sentences with NP focus.

Experiment 6

We used the comprehension task of Experiment 2b to investigate the accent-focus relationship for prenominal adjectives. Participants listened to the dialogues from Experiment 5 and judged whether they were meaningful. Response times and proportion of YES judgments were submitted to analyses to test the three hypotheses.

Method

Materials and Design. The experimental and filler dialogues from Experiment 5 were used here, in addition to another 48 filler dialogues, and 6 practice dialogues. The experimental and filler dialogues used from Experiment 5 were sensible, i.e., the two sentences fit together coherently. The 48 additional fillers were the same as those from Experiment 4.

Procedure and Participants. The procedure was the same as in Experiment 2b, i.e., participants judged whether the dialogues were meaningfully coherent, and were to respond within the 1.5-s deadline. The participants from Experiment 5, plus one other, participated in this experiment prior to participating in Experiment 5. One other participant's data were lost.

Results

RTs and %YES rates were obtained as in Experiment 2b. The means are shown by condition in Table 6 (SE = 22 for RT and .02 for %YES). Just as Experiment 5 gave no support for Hypothesis 1, neither did Experiment 6. There was very little difference in the likelihood or speed of comprehension in conditions A1 and A2 (all Fs < 1).

TABLE 6 ABOUT HERE

Experiment 5 supported Hypothesis 2, that accenting on a new adjective is not sufficient to carry focus for the entire focused NP. Instead, the head noun must be accented. Experiment 6

provides some support for H2 as well, but only in the RT results, not in %YES. RT was faster in A1 than in A3 ($F1(1,58) = 3.56$, $p < .06$; $F2(1,31) = 6.59$, $p < .01$. However, there was no difference in %YES for these two conditions ($F1$ and $F2 < 1$).

Finally, whereas Experiment 5 gave no support for Hypothesis 3, the results here were somewhat conflicting. According to H3, a given adjective should not be accented, so that B1 should be slower and/or receive a lower %YES rate than B2, with a deaccented adjective. In fact, contrary to H3, the RT was significantly faster for condition B1 than B2 ($F1 = 9.96$, $p < .01$; $F2 = 6.53$, $p < .05$). However, correspondent with H3, %YES was significantly lower in B1 than in B2 ($F1 = 7.5$, $p < .01$; $F2 = 4.3$, $p < .05$). This pattern of results for the RTs and %YES suggests a speed-accuracy tradeoff. The most likely conclusion to draw, therefore, is that listeners did not really distinguish these two conditions in terms of their meaningfulness. If the tradeoff interpretation is correct, Hypothesis 3 is not supported, as in Experiment 5, in that it does not seem to matter whether or not a given adjective is accented.

The results here, then, are similar to those from the linguistic judgment task in Experiment 5. Whether making linguistic appropriateness or meaningfulness judgments, listeners do not care whether an adjective, new or given, is accented. These results are unlike those from Experiments 3 and 4, in which listeners generally preferred sentences in which all and only the new post-nominal modifiers were accented. They are also unlike the results from Experiments 1 and 2, wherein listeners preferred that new predicate adjuncts be accented along with the V. However, in Experiments 5 and 6 (consistent with results from Experiments 1-4) they did not view a prenominal adjective as capable of projecting focus.

The finding that listeners had no preferences for accented new prenominal adjectives and for de-accented given prenominal adjectives is inconsistent with claims from Gussenhoven (1983; 1994) and Selkirk (1995), that adjuncts are subject to the basic rule, 'whatever is accented is focused.' The results from Experiments 5 and 6 are, on the other hand, consistent with

proposals from Selkirk (1984), who argued that the given-new status of adjuncts does not align with accentedness at all. As discussed earlier, Selkirk (1984) considered the following sentences (12):

(12) (a) JOHN bought a red TIE.

(b) JOHN bought a RED tie.

She argued that in sentence (12a) red, which is not accented, can nevertheless be interpreted as new information. In (12b), red is contrastive (and does not project focus to tie). Thus, Selkirk's (1984) proposals are clearly consistent with our results from Experiments 5 and 6. However, they are not consistent with our results from Experiments 1-4, in which listeners dispreferred sentences in which a new adjunct was not accented and those in which a given adjunct was accented. We will consider one possible basis of this contrast in the following section.

General Discussion

Table 7 presents a capsule synopsis of the main results of the current experiments (plus Birch & Clifton, 1995, Experiment 1). While this synopsis abstracts away from inconsistencies between our different measures (e.g., the occasional failure of reaction time differences to reach significance or a tradeoff between time and accuracy), we believe that it presents the main phenomena to be explained. Sentence forms marked as + were found to be relatively acceptable in the indicated contexts; sentence forms marked as - were relatively unacceptable; and sentence forms marked as - - were very unacceptable.

*** TABLE 7 ABOUT HERE ***

Consider the extent to which this pattern of results supports the three hypotheses advanced earlier. The results from Experiments 1-4 generally supported Hypothesis 1, that new adjuncts must be accented. In the linguistic judgment tasks, listeners strongly preferred that new post-verbal (Experiment 1) and post-nominal (Experiment 3) modifiers be accented. In the comprehension tasks they were faster and more accurate when new modifiers were accented in

Experiment 2, and they were marginally more accurate, but not significantly faster, in the corresponding conditions in Experiment 4. Results from Experiments 5 and 6, however, were clearly inconsistent with Hypothesis 1. Listeners seemed to have no preferences for the accent-focus relationship for prenominal adjectives. It made no difference to them whether or not new adjectives were accented.

All six experiments supported Hypothesis 2, that adjuncts, including post-verbal, post-nominal, and prenominal modifiers, cannot project focus to higher constituents. Listeners dispreferred sentences in which the heads of focused constituents (VPs in Experiments 1 and 2, NPs in Experiments 3 -6) were not accented even if an adjunct was accented, suggesting that the accented adjunct could not project focus. This result contrasts with the results obtained for arguments of heads. With broad VP focus, listeners do not seem to require accenting of V if the argument NP is accented (Birch & Clifton, 1995), indicating that arguments, unlike adjuncts, can project focus.

Results from Experiments 3 and 4 clearly supported Hypothesis 3, that given adjuncts must be deaccented (Hypothesis 3 was not tested in Experiments 1 and 2). However, Experiments 5 and 6 failed to support Hypothesis 3, just as they had failed to support Hypothesis 1. The presence or absence of accent on a given adjective failed to affect the evaluation of a sentence.

Selkirk's earlier (1984) proposal is compatible with the results of Experiments 5 and 6. In that analysis, Selkirk claimed the information status of adjuncts could not be derived from the presence or absence of accenting. However, this account cannot explain why listeners in Experiments 1-4 dispreferred sentences in which a new post-verbal or post-nominal adjunct was not accented and those in which a given post-nominal adjunct was accented.

We would like to advance a possible explanation for the discrepancy between Experiments 3 and 4, and Experiments 5 and 6.[i] From the standpoint of Selkirk (1995) and

Gussenhoven (1983, 1994), there are two facts to explain. The first fact is that a prenominal adjective can be accented, even if it is given. This fact has actually been noted previously. In English, lexical items that precede the final ("nuclear") accent of a sentence, can quite freely take accent, even if they are given. One account of this fact is Gussenhoven's 1999 prefocal pitch accent principle: "Assign pitch accents to the constituents before the nuclear pitch accent (optional)". This principle extends beyond adjectives. Consider the exchange in (13):

(13)   What did John buy? John BOUGHT a CAR.

Car carries narrow focus and accent. Bought is given information. Nevertheless, it can receive accent. But bought cannot be accented in (14), where it follows the final focused word, car.

(14)   #What was it John bought? It was a CAR John BOUGHT.

The second fact to be explained is that a prenominal adjective can be unaccented, even when it is new. This fact can be explained by appealing to one approach to formal semantics (presented in Heim & Kratzer, 1998, especially Chapter 4; see also Partee, 1995). This explanation requires a rethinking of the prevailing view of the argument-adjunct distinction. Psycholinguists typically think of this distinction as reflecting what information is included in lexical representations (see, e.g., Schütze & Gibson, 1999, for a careful discussion of this perspective). The fact that kill requires an argument in direct object position, and die does not, has to be specified in the lexical entries for kill and for die. Adjuncts, such as the temporal adverbial in (4), can appear with any verb, and do not have to be specified in a verb's lexical entry. The distinction between arguments and adjuncts is reflected in syntactic structure: An argument is the syntactic sister of the head of the phrase that contains it (i.e., is immediately dominated by the same node); an adjunct is attached higher in the phrase structure tree.

The alternative view of arguments comes from formal semantics (Heim & Kratzer, 1998). Roughly speaking, the goal of this approach to formal semantics is to compose the meaning of a sentence from the meanings of its constituents. The principle tool used is

"functional application." The interpretation of a larger constituent is composed out of smaller ones by treating one of the smaller constituents as a function that takes the other small constituents as its arguments. A sentence that consists of a subject NP and an intransitive verb, for example, is interpreted by treating the interpretation of the intransitive verb as a function that can be applied to the denotation of the subject (a proper noun or a definite NP) to yield the value "true" or "false." The interpretation of a VP containing a transitive verb plus a direct object is created by treating the transitive verb as a function that takes one argument (corresponding to the direct object) to yield a function with the same form as an intransitive verb. Some intuitively surprising linguistic forms turn out to be functions in this view. For instance, a common noun like cat is viewed not as denoting an entity, but instead as denoting a function from entities to truth values (yielding the value "true" when applied to an argument that denotes a cat).

Heim & Kratzer (1998) and Partee (1995) present reasons to believe that a prenominal adjective is a function that can be applied to a common noun, yielding as output a function of the same form as a common noun, i.e., a function from entities to truth values. One simple reason is that a phrase like old friend does not typically refer to an individual who has lived for many years and who is a friend (the so-called "intersective" meaning of an adjective plus a noun). It refers to a particular type of friend, namely, one whose friendship is of long standing. One can capture this latter ("subsective") meaning by viewing an adjective as a function that maps the semantic value of the noun it modifies onto the semantic value of the adjective+noun phrase (see Partee, 1995, p. 325). The important implication of this analysis is that a noun is an argument of an adjective that modifies it. Our initial view, that a prenominal adjective is an adjunct of the noun that follows it, may therefore have been mistaken.

In short, a noun can be an argument of a prenominal adjective. In this case, the focus projection rules described by Selkirk (1995) and Gussenhoven (1983, 1994) apply to explain the previously-unexplained aspect of our results, namely that a new prenominal adjective does not

have to be accented. A new prenominal adjective can receive focus by projection from its argument, the following noun, if that noun is accented and thus focused. As far as we have been able to determine, this new view of arguments does not conflict with our earlier syntactically-based analysis of arguments (e.g., a direct object of a verb is the sister of the verb as well as a semantic argument to which the verb function is applied). Further, it has some advantages, e.g., it permits argumenthood to be implied by the semantic or conceptual analysis of items rather than to be something that must be separately specified in individual lexical entries (cf. Jackendoff, 1990).

What about post-nominal modifiers, as examined in Experiments 3 and 4? Heim & Kratzer (1998) and Partee (1995) do not suggest that a noun can be an argument of a relative clause or other post-nominal modifier. Instead, they propose that the interpretation of a common noun followed by a relative clause is (roughly speaking) the intersection of the entities to which the noun can be applied and the entities to which the relative clause can be applied. The phrase friend who is old must refer to an individual who has lived a long time. No functional application is involved in this intersective interpretation (which comes from a composition principle that Heim & Kratzer call "predicate modification"). It is perfectly legitimate to treat the post-nominal modifier as an adjunct of the noun, as assumed in our earlier discussion. Heim & Kratzer, 1998, do go on to note that some but not all adjectives can have the sort of intersective interpretation that a relative clause can have. Old friend can mean a friend who is old. Interpreting prenominal adjectives as functions that can take a noun argument is not the only possible semantic analysis of prenominal adjectives, but it is a possible analysis that distinguishes their meaning from that of postnominal modifiers.

The present experiments support the claim common to all of Gussenhoven and Selkirk's linguistic analyses: in contrast to arguments (Birch & Clifton, 1995), no adjunct can project focus higher than its immediate phrase. The head of a focused phrase must be accented for a

discourse containing it to be acceptable, regardless of the presence of an accented adjunct. Further, all phrases that are new must be focused, either by accenting or by focus projection, and given phrases are not focused (although they can receive accent quite freely if they appear before the final focus). However, our analysis of the experimental data suggests that it will be necessary to revise our views of what arguments are, perhaps incorporating more analyses from formal semantics and de-emphasizing the lexical and syntactic perspectives on argumenthood that have dominated previous psycholinguistic analyses.

Appendices

Appendix 1: Experiments 1 and 2

There were three versions of each answer sentence, accented as illustrated in Example (4) in the body of the article.

1. What does Trisha do? She STUDIES in HOLLAND.

2. How did Heather spend her weekend? She SHOPPED in BOSTON.

3. Why did you say Jim is emotional? He CRIED during the MOVIE.

4. Why is Jessica quitting her job? She is MOVING in MARCH.

5. What does Donnie do for his part-time job? He COOKS for CHI-CHI's.

6. How does Beth manage to stay so healthy? She JOGS at NIGHT.

7. How are the sales reps attempting to cut down on costs for the company? They TRAVEL at NIGHT.

8. What's new with your dad? He's RETIRING in MAY.

9. How's Lisa's job going? She's QUITTING in TWO WEEKS.

10. How is Jeff's last year of med school going? He's CRAMMING for the BOARDS.

11. Did Cheryl have fun at the party? I guess so, she LAUGHED all NIGHT.

12. Do you think Bryan will succeed? He's got a good chance; he WRITES BEAUTIFULLY.

13. What is Anna's claim to fame? She DANCES on BROADWAY.

14. What does Laura do since her divorce? She TEACHES in DENVER.

15. Why did Luke move to Austin? He PROGRAMS for TANDEM.

16. What is Joe going to do during Spring Break? He is SAILING in the GULF.

17. What did Rick do during his Christmas vacation? He GOLFED in FLORIDA.

18. How did Ted get to Minnesota? He DROVE SPEEDILY.

Appendix 2: Experiments 3 and 4

Each item had two lead-in questions, the second of which made the final word of the post-nominal modifier GIVEN rather than NEW. There were three versions of each answer sentence that differed in accent placement, as shown in Example (8) in the body of the article.

1.   Did Karen like Lisa's remodeled kitchen?

        Did Karen like the maple wood in Lisa's remodeled kitchen?

She liked the TABLE of MAPLE.

2.   What did you want to show me?

        What new thing did you want to show me?

I wanted to show you my CAR that's NEW.

3.   What did you wear with your ski pants?

        Did you wear something of down when you went skiing?

I wore a VEST made of DOWN.

4.   What did you fix today?

        You fixed something electric today?

I fixed the CLOCK that's ELECTRIC.

5.   What are the maids cleaning today?

        Are the maids cleaning the varnished things today?

They're cleaning the WOODWORK that's VARNISHED.

6.   Are you wearing anything special for the football game?

        Are you wearing anything red to the football game?

I'm wearing my PARKA that's RED.

7.   Did they find anything pertaining to the trial?

        Did they find anything that was stolen?

They found the FILES that were STOLEN.

8.   How did Ken find his things after the move?

        Did Ken find anything broken after the move?

He just discovered a PITCHER that was BROKEN.

9.   The Smith kids are coming to visit. Should we hide anything?

        The Smith kids are coming to visit. Should we hide anything fragile?

We should hide the CANDYDISH that's FRAGILE.

10.   The fire is getting pretty hot. Should we move anything away from it?

        The fire is getting pretty hot. Should we move anything wooden away from it?

We should move the COASTER that's WOODEN.

11.   Is Tami wearing anything special to the symphony?

        Is Tami wearing anything new to the symphony?

She's wearing her NECKLACE that's NEW.

12.   Did Jenny bring anyone to the party with her?

        Did Jenny bring any of the people visiting her to the party?

She brought her COUSIN who's VISITING.

13.   What is Larry using to finish his paper tonight?

        Is Larry using anything rented this semester?

He's using a COMPUTER that's RENTED.

14.   Did Miki wear any jewelry with her costume?

        Did Miki wear any silver jewelry with her costume?

She wore her EARRINGS made of SILVER.

15.   Did Kevin wear anything appropriate for the funeral?

        Did Kevin wear anything black for the funeral?

He wore a TIE that was BLACK.

16.   What homework did Claudia bring home for spring break?

          What history homework did Claudia bring home for spring break?

She brought home her SPEECH from HISTORY.

17.   Did Christy lose anything valuable in the fire?

          Did Christy lose any gold jewelry in the fire?

She lost her BRACELET that was GOLD.

18.   What did Cowboy Dave wear to the wedding?

          Did Cowboy Dave wear anything dressy to the wedding?

He wore his BOOTS that were DRESSY.

19.   Do you know anyone in Newark?

          Do you know anyone young in Newark?

I know a LAWYER who's YOUNG.

20.   What did Gabriel buy for the winter?

          What warm thing did Gabriel buy for the winter?

He bought a COAT that was WARM.

21.   What did Liz and Phil make on Sunday?

          Did Liz and Phil make anything chocolate?

They made a DESSERT that was CHOCOLATE.

22.   What are you giving your brother for Christmas?

          Are you giving your brother something red for Christmas?

I'm giving him a SCARF that's RED.

23.   Did you buy anything today?

          Did you buy wool things today?

Yes, I bought SOCKS made of WOOL.

24.   Are we having anything for dessert?

Are we having anything fresh for dessert?

We're having a COBBLER that's FRESH.

25.   What did Jacob serve for dinner last night?

Did Jacob serve anything spicy for dinner last night?

He served a ROAST that was SPICY.

26.   What did they find in the empty lot?

Did they find anything stolen in the empty lot?

They found a TRACTOR that was STOLEN.

27.   Did Lisa buy anything for Paul in Florence?

Did Lisa buy anything leather for Paul in Florence?

She bought him some GLOVES made of LEATHER.

28.   What are you serving tonight?

Are you serving a vegetarian dish tonight?

We're serving LASAGNA that's VEGETARIAN.

29.   Did Rick buy his wife an expensive birthday gift?

Did Rick buy his wife some fur for her birthday?

He bought her a JACKET made of FUR.

30.   Do you have anything to help break this seal?

Do you have anything sharp to help break this seal?

I have a KNIFE that's SHARP.

31.   Why is your back sore? Did you move something yesterday?

Why is your back sore? Did you move something heavy yesterday?

I moved a CRATE that was HEAVY.

32.   What did you buy Glen for his birthday?

What expensive gift did you buy Glen for his birthday?

I bought him a WATCH that was EXPENSIVE.

33.　　What did you see at the zoo?

　　　　Did you see anything big at the zoo?

I saw a TIGER that was BIG.

34.　　Do you have anything going on Friday?

　　　　Do you have anything going on early Friday?

I have a CLASS that's EARLY.

35.　　Do you know anyone in the performing arts?

　　　　Do you know anyone talented in the performing arts?

I know a PIANIST who is TALENTED.

36.　　Did your sister hire anyone to help out at home?

　　　　Did your sister hire anyone creative to help out at home?

She hired a COOK who is CREATIVE.

Appendix 3: Materials for Experiments 5 and 6

Each item had two lead-in questions, the second of which made the adjective GIVEN rather than

NEW. There were three versions of each answer sentence that differed in accent placement, as

shown in Example (11) in the body of the article.

1.　　What did your mom think of the White's remodeled kitchen?

　　　　Did your mom like the maple wood in the White's remodeled kitchen?

She liked the MAPLE TABLE.

2.　　What did you want to show me?

　　　　What new thing did you want to show me?

I wanted to show you my NEW CAR.

3.　　What did you wear with your skipants?

Did you wear something made of down when you went skiing?

I wore my DOWN VEST.

4.   What project did you work on today?

You worked on something electric today?

I fixed our ELECTRIC CLOCK.

5.   Are you cleaning today?

Are you cleaning anything that's varnished today?

I'm cleaning the VARNISHED WOODWORK.

6.   Are you wearing anything special for the game?

Are you wearing anything red to the game?

I'm wearing my RED PARKA.

7.   Did they find anything pertaining to the trial?

 Did they find anything that was stolen?

They found the STOLEN FILES.

8.   How did Ken's move from Illinois go?

Did Ken find anything broken after the move?

He just discovered his BROKEN PITCHER.

9.   The Smith kids are coming to visit. Should we put anything away?

The Smith kids are coming to visit. Should we put anything fragile away?

We should hide my FRAGILE CANDYDISH.

10.   The fire in the fireplace is getting pretty hot. Should we move anything away from it?

The fire in the fireplace is getting pretty hot. Should we move anything wooden away

from it?

I'll move my WOODEN COASTER.

11.   Is Tami wearing anything special to the concert?

Is Tami wearing anything new to the concert?

She's wearing her NEW NECKLACE.

12.   Did Jenny bring anyone to the party with her?

Did Jenny bring any of the people visiting her to the party?

She brought her VISITING COUSIN.

13.   How's Larry going to finish his paper tonight?

Does Larry have anything rented this semester?

He has his RENTED COMPUTER.

14.   Did Miki wear any jewelry with her costume?

Did Miki wear any silver jewelry with her costume?

Yes, she wore her SILVER EARRINGS.

15.   Did Kevin dress appropriately at the funeral.

Did Kevin wear anything black at the funeral?

He wore his BLACK TIE.

16.   What did you say Claudia brought to her parents' house?

What little thing did you say Claudia brought to her parents' house?

She brought her LITTLE CAT.

17.   Did Christy lose anything valuable in the fire?

Did Christy lose any gold jewelry in the fire?

She lost her GOLD BRACELET.

18.   What did Cowboy Dave wear to the wedding?

Did Cowboy Dave wear anything dressy to the wedding?

He wore his DRESSY BOOTS.

19.   Do you know anyone in Newark?

Do you know anyone young in Newark?

I know a YOUNG LAWYER there.

20. How did Gabriel survive his first winter in the north?

    Does Gabriel have any warm clothes for the winter?

He bought a WARM COAT.

21. What did Liz and Phil do Sunday?

    How did they satisfy their chocolate craving?

They made a CHOCOLATE DESSERT.

22. What are you giving your brother for Christmas?

    Are you getting your brother something red for Christmas?

I'm giving him a RED SCARF.

23. Did you buy anything today?

    Did you buy any wool things today?

Yes, I bought WOOL SOCKS.

24 A re we having anything for dessert?

    Are we having anything fresh for dessert?

We're having a FRESH COBBLER.

25. What did Jacob serve for dinner last night?

    Did Jacob serve anything spicy for dinner last night?

He served a SPICY ROAST.

26. What did they find in the parking lot?

    Did they find anything stolen in the parking lot?

They found a STOLEN TRACTOR.

27. Did Lisa get anything for Paul while she was in Florence?

    Did Lisa get anything leather for Paul while she was in Florence?

She got some LEATHER GLOVES.

28.   What is the chef's special being served tonight?

        Is there a vegetarian dish being served tonight?

We're serving VEGETARIAN LASAGNA.

29.   Did Rick buy his fiancee an expensive birthday gift?

        Did Rick buy his fiancee some fur for her birthday?

He bought her a FUR JACKET.

30.   Do you have anything to help break this seal?

        Do you have anything sharp to help break this seal?

I have a SHARP KNIFE.

31.   Why is your back sore? Did you move anything yesterday?

        Why is your back sore? Did you move anything heavy yesterday?

I moved a HEAVY CRATE.

32.   What did you buy Glen for his birthday?

        What expensive gift did you buy for Glen's birthday?

I bought him an EXPENSIVE WATCH.

33.   What did you see at the zoo?

        Did you see anything big at the zoo?

I saw a BIG TIGER.

34.   Do you have anything going on on Friday?

        Do you have anything going on early Friday?

I have an EARLY CLASS.

35.   Do know anyone in the performing arts?

        Do you know any talented people in the performing arts?

I know a TALENTED PIANIST.

36.   Did your sister hire anyone to help out at home?

Did your sister hire anyone creative to help out at home?

She hired a CREATIVE COOK.

References

Abney, S. (1989). A computational model of human parsing. Journal of Psycholinguistic

Research, 18, 129-144.

Beckman, M.E., & Pierrehumbert, J.B. (1986). Intonational structure in Japanese and English.

Phonology Yearbook, 3, 255-309.

Beckman, M.E., & Ayers, G.M. (1994). Guidelines for ToBI labelling: ver 2.0. Manuscript. Ohio

State University.

Birch, S.L., & Clifton, C., Jr. (1995). Focus, accent, and argument structure: Effects on language

comprehension. Language and Speech, 38, 365-391.

Bock, J.K., & Mazzella, J.R. (1983). Intonational marking of given and new information: Some

consequences for comprehension. Memory & Cognition, 11, 64-76.

Boland, J. E., & Boehm-Jernigan, H. (1998). Lexical constraints and prepositional phrase

attachment. Journal of Memory and Language, 39, 684-719.

Bolinger, D.L. (1972). Accent is predictable (if you're a mind-reader). Language, 48, 633-644.

Bolinger, D.L. (1986). Intonation and its parts. Stanford, CA: Stanford University Press.

Chomsky, N. (1971). Deep structure, surface structure and semantic interpretation. In D.

Steinberg & L. Jakobovits (Eds.), Semantics: An interdisciplinary reader in philosophy,

linguistics and psychology (pp. 183-216). Cambridge: Cambridge University Press.

Chomsky, N., & Halle, M. (1968). The sound pattern of English. New York: Harper & Row.

Clifton, C., Jr., Speer, S., & Abney, S. (1991). Parsing arguments: Phrase structure and argument

structure as determinants of initial parsing decisions. Journal of Memory and Language,

30, 251-271.

Cutler, A. (1990). Exploiting prosodic probabilities in speech segmentation. In G.Altmann (Ed.),

Cognitive models of speech processing: Psycholinguistics and computational perspectives

(pp. 105-121). Cambridge, MA: MIT Press.

Frazier, L., & Clifton, C., Jr. (1996). Construal. Cambridge, MA: MIT Press.

Gussenhoven, C.G. (1983). Testing the reality of focus domains. Language and Speech, 26, 61-80.

Gussenhoven, C.G. (1992). Sentence accents and argument structure. In I.M. Roca (Ed.), Thematic structure. Its role in grammar (pp. 79-106). Berlin-New York: Foris.

Gussenhoven, C.G. (1994). Focus and sentence accents in English. In P. Bosch & R. van der Sandt (Eds.), Focus and natural language processing, Vol. 3 (pp. 83-92). Heidelberg: IBM Deutschland.

Gussenhoven, C. G. (1999). On the Limits of Focus Projection in English. In P. Bosch & R. van der Sandt (editors), Focus: Linguistic, cognitive, and computational perspectives (pages 43-55). Cambridge, England;: Cambridge University Press.

Halliday, M.A.K. (1967). Notes on transitivity and theme in English, part 2. Journal of Linguistics, 3, 199-244.

Heim, I., & Kratzer, A. (1998). Semantics in generative grammar. Malden, MA: Blackwell Publishers.

Jackendoff, R. (1990). Semantic Structures: Cambridge, MA: MIT Press.

Nooteboom, S.G., & Kruyt, J.G. (1987). Accents, focus distribution, and the perceived distribution of given and new information: An experiment. Journal of the Acoustical Society of America, 82, 1512-1524.

Partee, B. H. (1995). Lexical semantics and compositionality. In L. R. Gleitman & M. Liberman (Eds.), An invitation to cognitive science, second edition: Language, volume 1 (pp. 311-360). Cambridge, MA: MIT Press.

Pierrehumbert, J. (1980). The phonology and phonetics of English intonation. PhD dissertation, MIT.

Pierrehumbert, J., & Hirschberg, J. (1990). The meaning of intonational contours in the

    interpretation of discourse. In P.R. Cohen, J. Morgan, & M.E. Pollock (Eds.), <u>Intentions in</u>

    <u>communication</u> (pp. 271-311). Cambridge, MA: MIT Press.

Rochemont, M.S. & Culicover, P.W. (1990). English focus constructions and the theory of

    grammar. New York: Cambridge University Press.

Schutze, C. T., & Gibson, E. (1999). Argumenthood and English prepositional phrase

    attachment. <u>Journal of Memory and Language, 40</u>, 409-431.

Selkirk, E.O. (1984). <u>Phonology and syntax: The relation between sound and structure</u>.

    Cambridge: MIT press.

Selkirk, E.O. (1995). Sentence prosody: Intonation, stress and phrasing. In J.Goldsmith (Ed.),

    <u>Handbook of phonological theory</u>. London: Blackwell, pp. 550-569.

Terken, J., & Nooteboom, S.G. (1987). Opposite effects of accentuation and deaccentuation on

    verification latencies for Given and New information. <u>Language and Cognitive Processes,</u>

    <u>2</u>, 145-163.

Table1: Mean appropriateness ratings: Scale of 1 (inappropriate accent) to 5 (appropriate accent), Experiment 1

Accenting	Mean Rating
1. V & adjunct	4.24
2. V only	3.46
3. adjunct only	3.49

Table 2: Mean RT (in ms) and %YES responses by condition, Experiments 2a and 2b

Accenting	Without Deadline		With Deadline	
	Yes RT	%Yes	Yes RT	%Yes
1. V & adjunct	830	91	200	87
2. V only	848	86	199	83
3. adjunct only	908	86	229	80

Table 3: Mean appropriateness ratings (scale of 1-5) by condition, Experiment 3

Accenting	A: Modifier New	B: Modifier Given
1. modifier & head noun	4.12	3.38
2. head noun only	3.54	4.00
3. modifier only	3.16	2.50

Table 4: Mean RTs (in ms) and %YES by condition, Experiment 4

Accenting	A: Modifier New		B: Modifier Given	
	Yes RT	%Yes	Yes RT	%Yes
1. modifier & head noun	467	92.5	553	76
2. head noun only	499	87.9	427	87.9
3. modifier only	551	85.5	608	65.6

Table 5: Mean appropriateness ratings (scale of 1-5) by condition, Experiment 5

Accenting	A: adjective New	B: adjective Given
1. adjective & head noun	3.78	3.90
2. head noun only	3.64	3.83
3. adjective only	3.19	3.34

Table 6: Mean RTs (in ms) and %YES by condition, Experiment 6

Accenting	A: adjective New		B: adjective Given	
	Yes RT	%Yes	Yes RT	%Yes
1. adjective & head noun	234	90	148	89
2. head noun only	230	89	212	95
3. adjective only	273	90	227	88

Table 7: Summary of main points of results (including results from Birch & Clifton, 1995). Accenting indicated by UPPERCASE. Critical word is the argument, adjunct, or modifier. + signifies high acceptability rating and fast and/or frequent comprehension; - signifies low acceptability and comprehension; - - signifies very low acceptability and comprehension.

	Critical word NEW	Critical word GIVEN
Birch and Clifton, 1995		
VERB + ARGUMENT	+	-
VERB + argument	-	+
verb + ARGUMENT	+	-
Experiments 1, 2		
VERB + ADJUNCT	+	
VERB + adjunct	-	
verb + ADJUNCT	-	
Experiments 3, 4		
NOUN + MODIFIER	+	-
NOUN + modifier	-	+
noun + MODIFIER	- -	- -
Experiments 5, 6		
MODIFER + NOUN	+	+
modifier + NOUN	+	+
MODIFIER + noun	-	-

Figure Caption

Figure 1: Pitch (fundamental frequency) values for a typical answer sentence like that in (4). The sentence, <u>She studies in Holland</u> (item 1 from Appendix 1), is shown in the three variations in which both the verb and the adjunct are accented (panel A), just the verb (panel B), or just the adjunct (panel C).

Footnotes

[i] We thank Lisa Selkirk for suggesting this explanation.