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## Investigating the focus-accent-argument structure relationship

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### 1. Introduction

Comprehension requires identifying Given and New information, connecting the Given information to preceding (antecedent) information, and incorporating the New information into an evolving mental representation of the discourse (Clark & Haviland, 1977). In this study we investigate how prosody, the patterns of accent or emphasis during speech, affects identification and integration of Given and New information during discourse comprehension. In particular, we seek to provide a description of how syntactic argument structure influences the relationship between intonation and information structure.

There are a number of ways to mark information structure, but in English, intonation seems to be the primary way (Cruttenden, 1986; MacWhinney & Bates, 1978). The basic relationship between intonation and information structure is that New information is generally accented, while Given information is not (e.g., Bolinger, 1961; Chomsky, 1971; Halliday, 1967). A number of linguists have argued, and a number of experiments have shown that, generally speaking, listeners expect New information to be accented and Given information not to be (Bock & Mazzella, 1983; Nooteboom & Kruyt, 1987; Terken & Nooteboom, 1987).

Most of the empirical work on the accent-focus relationship has involved "narrow focus," where the focus is a single word within a sentence. Yet it is quite common for multiple words, or even entire phrases to be the focus of a sentence, which is the case of "broad focus." For instance, in the dialogue (1) below, a single word, "Manny" is the focus of the second sentence when it follows question (a). However, when the second sentence is a response to question (b), the focus is broad, i.e., the focus is the verb phrase (VP), "broke the vase."

- (1) a. Who broke the vase?  
b. What did Manny do?

Manny broke the vase.

Linguistic work, including that of Selkirk (1984; 1994) and Gussenhoven (1983; 1992), has shown that the relationship between focus structure and accent may not be as simple for cases of broad focus as in cases of narrow focus. For

broad focus, the relationship between accent and focus is not necessarily a one-to-one match in which whatever is the focus is accented. Selkirk and Gussenhoven have argued that whether or not a word within a broadly focused phrase is accented depends on its syntactic position in the sentence. These approaches allow for single words to project or carry focus for an entire focused phrase. For instance, even when what is focused (New) is an entire VP, a single word, e.g., the Object noun phrase (NP), can alone be accented and still convey that the VP is the focus.

For instance, Selkirk (1984; 1994) describes a set of "Focus Projection" principles that govern the relationship between focus and accent. In her account, an accented word is "F-marked," where F-marking is a semantic feature to be used in interpretation. F-marking of higher constituents is projected according to a set of rules:

- (2) F-marking of the head of a phrase licenses F-marking of the entire phrase;
- (3) F-marking of an internal argument of a head licenses the F-marking of the head.

(A third principle is also Given but is not relevant for our purposes). The Focus of a sentence (FOC) is the highest F-marked constituent (i.e., is not dominated by any other F-marked constituent), as licensed by the Focus-Projection principles. In terms of interpretation, then, all F-marked constituents that are not the FOC are interpreted as New in the discourse. All non-F-marked constituents are interpreted as Given. (The FOC can be interpreted as either Given or New). For instance, in (4), from Selkirk (1994), a single accented word can project focus to the entire VP.

- (4) What did Mary do?  
Mary bought a book about BATS.

In the answer sentence, "bats" is F-marked since it is accented. F-marking of "bats" licenses F-marking of the head of the prepositional phrase ("about") according to (3), which in turn licenses F-marking of the entire prepositional phrase according to (2). Assuming that "about bats" is an argument of "books," F-marking of the prepositional phrase allows F-marking of "books," which licenses F-marking of the Object NP. Since the Object NP is an argument of "bought," F-marking of "books" allows F-marking of "bought," which allows F-marking of the entire VP. Thus, a single accent on "bats," through focus projection, can indicate that the entire VP is the focus of the sentence.

Gussenhoven's (1983; 1992) accent-focus rules (SAAR, for sentence accent alignment rules) differ from Selkirk's in that they are based on *surface* syntactic structure. According to SAAR, all nonfocused constituents are unaccented; all focused constituents, including predicates, arguments, and modifiers, must be accented. The main exception to this rule is that focused predicates that are adjacent (in surface structure) to an argument, or that are merely separated from an argument by a nonfocused constituent, need not be accented. An example (from Gussenhoven, 1992) is in (5).

- (5) Where's the canary?  
a. The CAT'S killed it.  
b. The CAT'S GRACEFULLY KILLED it.

When the question in (5) is followed by sentence (a), "killed," is New, but it need not be accented because it is adjacent to the Subject argument, "cat's." However, when the question is followed by sentence (b), "killed" needs to be accented because it is separated from the Subject argument by an accented constituent ("gracefully"). Once again, syntactic structure governs the relationship between focus structure and the pattern of accents.

We have carried out a set of experiments designed to investigate the sentence processing consequences of manipulating the focus-accent-argument structure relationship, by testing some predictions derived from the linguistic accounts of focus projection outlined above. We tested four specific hypotheses, given in (6), concerning a spoken sentence in which the VP is the focus of the sentence:

- (6)
1. A New/focused Object NP must be accented and
  2. ...can project focus to the VP (so that the verb itself need not be accented).
  3. A Given Obj NP must not be accented, and
  4. ... cannot carry focus for the VP, so that the verb itself must be accented.

We investigated these questions by manipulating focus (Given-New status) and accenting of verbs and Object NP's in recorded dialogues, and then measuring listeners' comprehension (Experiments 1 and 2) and linguistic judgments of prosodic appropriateness (Experiment 3). The dialogues consisted of recorded sentence pairs in which the first sentence, a question, always established VP focus for the second sentence and also determined whether the Object NP in the second sentence would be New (as in A below), or Given (as in B). In the second sentence accent was manipulated, i.e., was placed on both the V and the Obj NP (1), on the Obj NP only (2), or on the V only (3):

- (7)
- A. Was Dr. Chow involved in the relief effort?
  - B. Did Dr. Chow have enough medicine for the relief effort?
1. Yes, she DONATED the MEDICINE.
  2. Yes, she donated the MEDICINE.
  3. Yes, she DONATED the medicine.

For each experiment subjects listened to sentence pairs such as these and made comprehension or linguistic judgment responses which were then analyzed to test the hypotheses.

## 2. Experiment 1

The first experiment was intended to test the consequences of our manipulation of focus, accent and argument structure on listeners' comprehension. Subjects listened to the sentence pairs and made YES-NO responses as to whether the two sentences fit together as a dialogue, 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 responses.

The hypotheses outlined above lead to the following predictions. According to the first hypothesis, that a New/focused Object NP should be accented, conditions A1 and A2, in which a New Object NP is accented, should receive a higher %YES and faster response times as compared to condition A3, in which a New Object NP is not accented. According to the second hypothesis, that whether or not a V is accented does not matter as long as the Object NP is accented, conditions A1 and A2 should be equivalent to one another. According to the third hypothesis, that Given Object NP's should not be accented, condition B3 should be faster than conditions B1 and B2. According to the last hypothesis, that a V must be accented when an Object NP is Given, conditions B1 and B3, where the V is accented, should be faster than condition B2.

## 2.1 Method

### 2.1.1 Materials and Design

The materials consisted of 36 experimental, 66 filler, and 6 practice dialogues, each consisting of a question and an answer sentence.

For the experimental dialogues, there were two versions of each question sentence and three versions of each answer sentence. Both versions of the question sentences set up a VP focus in the answer sentence by asking a broad question about someone or something's action or state. One version of a question also established the answer's Object NP as New, as in A, and the other version rendered it Given, as in B, according to whether the Object was not (A) or was (B) mentioned in the question.

Each answer sentence consisted of a Subject NP that consisted of a pronoun referring to the person or thing mentioned in the question; a verb; and an Object NP. Versions 1-3 of the answer sentences varied according to which word or words received accenting: the V and the Object NP, as in 1, the Object NP only, as in 2, or the V only, as in 3. The Subject pronoun never received an accent. See example (7) above and (8) below.

- (8) A. Isn't Kerry pretty smart?  
 B. Isn't Kerry good at math?
1. Yes, she TEACHES MATH.
  2. Yes, she teaches MATH.
  3. Yes, she TEACHES math.

Combining both versions of questions with all three versions of the answer sentences resulted in six experimental conditions, hereafter referred to as A1-3 and B1-3. All six experimental conditions were intended to be sensible dialogues, i.e., to receive YES responses during the experiment, given the "makes sense" task described below (see Procedure).

In two of the six conditions (A1 and B3), the words that were New in the answer sentence were accented and the words that were Given were not accented; these two conditions were hypothesized as appropriately accented (see hypothesis #1 above). Condition A2, in which the Object NP was New and was the only word accented in the answer sentence, was also hypothesized to be appropriately accented (see hypothesis #2). Conditions A3, B1, and B2 were hypothesized to be

inappropriately accented, since in each case either a New Obj NP was not accented or a Given Obj NP was accented (see hypotheses #1, #3, and #4).

The 66 filler dialogues were constructed to provide variety in the types of dialogues in the experiment. There were 18 fillers in which the question set up VP focus, but the answer sentence contained a prepositional phrase or an adverbial adjunct (e.g., "speedily") rather than an Object NP following the verb. For all of these 18 sentences, the dialogues were sensible (YES responses were "correct"). However only 6 had appropriate accenting, in which whatever was New was accented; in the other 12, either the verb or the adjunct was not accented.

Another 15 fillers had non-VP-focus questions (e.g., "When did Nancy leave?" or "Where does Randy's class meet?"). The answer sentences for these dialogues were all sensible (YES) responses; 11 of the 15 had appropriate accenting, and 4 had inappropriate accenting. The remaining 33 fillers had non-VP-focus questions, and answers that were inappropriate responses to their questions (NO responses; see examples 9 and 10 below). Although there were more sensible (YES) than nonsensible (NO) dialogues in the experiment, we assumed that some of the inappropriately accented dialogues would receive responses of NO, providing more of a balance of YES and NO responses.

- (9) What color is Lonnie's cat?  
The CAT jumped out the window.
- (10) Do you use any stimulants when you study?  
My cousin drinks STRONG coffee.

There were six lists of 102 dialogues (the lists contained the names of the dialogues to be played; see Procedure), each containing all of the filler dialogues and one of the six versions of each of the 36 experimental dialogues. The versions of the experimental dialogues were counterbalanced across lists; each subject received one list, and there were equal numbers of subjects who received each list.

### 2.1.2 Procedure

All of the dialogues were tape recorded then digitized at a 10 kHz rate. The duration of each sentence was measured by use of a graphic waveform editor that included auditory feedback. The digitized waveform was inspected to locate the onset and offset of each sentence; these were determined as the beginning or ending of voicing, of frication, or of a plosive release, depending on what phoneme was located at the beginning or end of the sentence. The same "acoustic landmark" (Cooper, Eady, and Mueller, 1985) for locating onsets and offsets of sentences was used across all versions of the answer sentences.

The dialogues were played over two speakers from the digitized versions using 10 kHz digital-audio conversion. During playback, a timer with 1 msec accuracy was activated at the start of each answer sentence and was terminated upon a subject'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.

Which dialogues were played was determined according to which experimental list a Given subject was to receive, where the experimental list

contained the names of the digitized dialogues. The order in which the dialogues were played was randomized for each subject.

Subjects were seated in a sound-deadened chamber between two speakers and in front of a video monitor. A response box in front of the monitor contained 3 keys: one to obtain the next trial, one for YES responses, and one for NO responses. Subjects were told that they would be listening to brief dialogues and making responses to each one. They 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 and direct response. They were to pull the YES key for responses that did make sense given the question, and to pull the NO key otherwise. They were to push the "next trial" key to begin each dialogue.

In order to prevent them from accepting a majority of the dialogues as sensible, subjects were given further instructions with respect to the task. They were told that while some of the response sentences were obviously a good answer and some were obviously a bad answer, others would not be as easy to determine. Thus, they were to "listen to each response very carefully and make sure that it is a direct answer to its question" before pulling the YES lever. No reference to intonation or stress was made. They were further informed that there were approximately equal numbers of sensible and nonsensible response sentences. Finally, subjects were instructed to keep their hands on the NO and YES keys at all times, "so that you can respond quickly while remaining accurate." They were not specifically pressed to answer as quickly as possible.

There were six practice trials, after which the experimenter made any necessary adjustments to the volume level or answered any questions. The 102 dialogues followed, and response time and response type (YES or NO) were recorded for each trial. The entire experiment lasted about 20 minutes.

### 2.1.3 Subjects

Subjects were 48 University of Massachusetts students who participated in the experiment for course credit. All were native American English speakers.

## 2.2 Results

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 sentence. The mean percentage of YES responses and the mean RT's for YES responses were obtained for each subject and for each item for each of the six conditions. For the RT's, responses greater than 2.5 standard deviations (SD) above an individual subject's mean RT were replaced with the value equal to 2.5 SD. Any responses greater than 10 s after the end, or 2 seconds before the end of the sentence were eliminated. The mean RT's and %YES's for each condition are shown in Table 1.

TABLE 1: RT's (in msec) and % YES responses by condition, Experiment 1.

	Obj NP NEW (A)		Obj NP Given (B)	
	RT	% YES	RT	% YES
V & Obj NP accented	820	87	1005	76
Obj NP accented	884	91	1328	64
V accented	942	80	1012	84

The mean % YES responses and RT's were submitted to analyses of variance (ANOVA's) with subjects and items as random effects. For the % YES analyses, the main effect for question sentence indicated that listeners were more likely to make a YES response following question A, which marked the Obj NP as new, than following question B ( $F(1,147) = 32.7$ ,  $MSe = .028$ ,  $p < .01$ ;  $F(2,135) = 7.4$ ,  $MSe = .094$ ,  $p < .01$ ). There were no significant differences among the answer sentences ( $F(1,2,94) = 1.7$ ,  $MSe = .03$ ,  $p > .1$ ;  $F(2,70) = 1.97$ ,  $MSe = .02$ ,  $p > .1$ ). The interaction between question and answer sentences was significant ( $F(1,2,94) = 27.62$ ,  $MSe = .02$ ,  $p < .01$ ;  $F(2,70) = 21.32$ ,  $MSe = .02$ ,  $p < .01$ ).

For the RT analyses, there was also a main effect of question sentence, such that subjects were faster to respond to sentences following question A (882 ms) than question B (1115 ms). The effect was significant by subjects ( $F(1,147) = 12.8$ ,  $MSe = 304697$ ,  $p < .01$ ), and marginally significant by items ( $F(2,135) = 3.09$ ,  $MSe = 418968$ ,  $p < .09$ ). The main effect for answer sentence was significant by subjects, but not by items ( $F(1,2,94) = 3.75$ ,  $MSe = 249226$ ,  $p < .05$ ;  $F(2 < 1)$ ). The interaction between question and answer sentence was significant by subjects, but not by items ( $F(1,2,94) = 3.9$ ,  $MSe = 226752$ ,  $p < .05$ ;  $F(2 < 1)$ ).

Planned comparisons among the conditions were carried out to test the specific predictions. None of these comparisons yielded a significant difference for the RT analyses. For the % YES comparisons, there were a number of significant effects. Hypothesis 1, that New Object NP's must be accented, was supported since conditions A1 and A2 together (89%), where the New Obj NP was accented, had a higher YES rate than condition 3 (80%), where the New Obj NP was not accented ( $F(1,147) = 9.97$ ,  $MSe = .04$ ,  $p < .01$ ;  $F(1,35) = 9.62$ ,  $MSe = .03$ ,  $p < .01$ ).

Hypothesis 2, that a New Obj NP that is accented can carry focus for a focused VP, so that the verb itself need not be accented, was also supported since conditions A1 and A2 did not differ ( $F(1,147) = 1.99$ ,  $MSe = .08$ ,  $p > .1$ ;  $F(1,35) = 1.63$ ,  $MSe = .04$ ,  $p > .1$ ).

The third hypothesis, that a Given Obj NP must not be accented, was supported by the % YES analysis, since condition B3, where the Obj NP was not accented, had a higher YES rate (84%) than conditions B1 and B2 together (70%), ( $F(1,147) = 23.36$ ,  $MSe = .04$ ,  $p < .01$ ;  $F(2,135) = 23.38$ ,  $MSe = .03$ ,  $p < .01$ ).



Finally, the hypothesis that a Given Obj NP cannot carry focus was supported since condition B2, where there was no accented V to carry focus, had a lower YES rate (64%) than when an accented verb carried the focus (conditions B1 and B3 together, 80%;  $F(1,147) = 23.37$ ,  $MSe = .05$ ,  $p < .01$ ;  $F(2,135) = 25.32$ ,  $MSe = .04$ ,  $p < .01$ ). Note that while conditions B1 and B2 both had an inappropriately accented Given Obj NP, B1, where the accented verb could carry focus, had a higher "makes sense" rate, 76%, than B2, 64% ( $F(1,147) = 9.93$ ,  $MSe = .07$ ,  $p < .01$ ;  $F(2,135) = 11.03$ ,  $MSe = .05$ ,  $p < .01$ ). However, condition B3, also with an accented verb, but with no accented Given Obj NP, had a higher YES rate (84%) than B1 (76%;  $F(1,148) = 5.53$ ,  $MSe = .05$ ,  $p < .05$ ;  $F(2,135) = 5.7$ ,  $MSe = .04$ ,  $p < .05$ ). The pattern of results from the %YES analyses thus supports the hypotheses given in (6) above.

### 2.3 Discussion

The results from Experiment 1 provide limited support for the hypotheses derived from the linguistic accounts of focus projection. Listeners were more likely to accept dialogues as sensible when accent patterns corresponded to the linguistic theories outlined above. Listeners were more likely to indicate that a second sentence of a dialogue made sense when what was New was accented and what was Given was not accented, except that a verb did not need to be accented when a New Obj NP was accented. Also, accenting a Given Obj NP was not as disruptive for listeners if the verb was accented. These results held only for the rate of "makes sense" responses, not for the response time analyses.

The tests for response times did not yield significant effects, despite, in some instances, rather sizeable differences between conditions. It is possible that large variability in response times obscured what may have been real differences among the conditions. Perhaps subjects interpreted the task differently from one another, with some listeners emphasizing speed much more than others. To investigate this possibility we carried out Experiment 2, which was intended to reduce the opportunity for such highly variable response times.

## 3. Experiment 2

This experiment was a replication of Experiment 1 but with new instructions for the listening task. To reduce the variability in response times and to obtain subjects' first impressions as their responses to the dialogues, listeners were told to make their responses as quickly as possible while still remaining accurate. To further stress the importance of speed, a response deadline was introduced such that responses that came after the deadline were followed by a "TOO SLOW!" message.

### 3.1 Method

#### 3.1.1 Materials and Design

The materials and design were the same as in Experiment 1.

3.1.2 Procedure

Subjects were informed that we were interested in their first impression of the answer sentence's sensibility. Whereas in Experiment 1 subjects were told to make careful judgments, subjects in this experiment were told to respond as quickly as possible while remaining accurate. If a response was not made within about 1.5 seconds following the answer sentence, they received a message telling them that they were too slow. Subjects were also told that this task would be followed by a second, related task (to be described in Experiment 3). All other aspects of the procedure were the same in Experiment 2 as in Experiment 1.

3.1.3 Subjects

There were 60 University of Massachusetts students, native American English speakers, who participated in the experiment for course credit.

3.2 Results

RT and %YES responses were collected and trimmed for analyses by subjects and by items as in Experiment 1. RT means included only responses where subjects responded YES to the target sentence; responses of NO and timeouts (responses that were not made before the 1.5 sec deadline) were excluded. The RT and %YES responses were submitted to ANOVA's; there were too few timeouts to analyze. Table 2 displays the mean RT, %YES and %Timeouts for each condition.

TABLE 2: RT, %YES and %Timeouts for responses to target sentences, Experiment 2

	Obj NP NEW (A)			Obj NP Given (B)		
	RT	%YES	%T-O	RT	%YES	%T-O
V & Obj NP accented	209	79	2.8	301	71	1.0
Obj NP accented	226	84	2.5	392	54	6.0
V accented	255	78	2.5	225	80	1.3

For the %YES analyses, subjects were more likely to make a YES response to sentences following question A than following question B, 80 % vs. 68% ( $F(1,59) = 42.51$ ,  $MSe = .03$ ,  $p < .01$ ;  $F(2,135) = 7.75$ ,  $MSe = .11$ ,  $p < .01$ ). The main effect of answer sentence was also significant ( $F(2,118) = 7.26$ ,  $MSe = .04$ ,  $p < .01$ ;  $F(2,70) = 11.48$ ,  $MSe = .02$ ,  $p < .01$ ). Importantly, there was an interaction between question and answer sentence ( $F(2,118) = 27.46$ ,  $MSe = .03$ ,  $p < .01$ ;  $F(2,70) = 28.44$ ,  $MSe = .02$ ,  $p < .01$ ). For the RT analyses, responses to sentences following question A, 230 ms, were faster than following question B, 306 ms ( $F(1,59) = 23.35$ ,  $MSe = 22278$ ,  $p < .01$ ;  $F(2,135) = 4.98$ ,  $MSe = 30717$ ,  $p < .05$ ). There was also a main effect of answer sentence, but this was only marginally significant by items ( $F(2, 118) = 5.62$ ,  $MSe = 28377$ ,  $p < .01$ ;  $F(2,70) = 2.85$ ,  $MSe = 20674$ ,  $p < .07$ ). The interaction between question and answer sentence was also significant ( $F(2, 118) = 11.32$ ,  $MSe = 25948$ ,  $p < .01$ ;  $F(2,70) = 7.12$ ,  $MSe = 20268$ ,  $p < .01$ ).

Planned comparisons were carried out to test the specific hypotheses. The test for the first hypothesis, that a New Obj NP must be accented, involved the comparison between conditions A1 and A2 together, with a mean of 82% and 218 msec, versus condition A3, with 78% and 255 msec. The 4% difference for YES rate was not significant ( $F(1,59) = 2.22$ ,  $MSe = .04$ ,  $p < .15$ ;  $F(1,35) = 2.34$ ,  $MSe = .02$ ,  $p < .14$ ). However the 37-msec effect for RT's was significant ( $F(1,59) = 4.22$ ,  $MSe = 19983$ ,  $p < .05$ ;  $F(1,35) = 4.67$ ,  $MSe = 15878$ ,  $p < .05$ ) and indicates that listeners were quicker to understand a sentence when a New Obj NP was accented than when it was not accented.

The test of the second hypothesis was the comparison between conditions A1 and A2. The 5% difference in YES rate was not significant ( $F(1,59) = 2.06$ ,  $MSe = .07$ ,  $p < .16$ ;  $F(1,35) = 2.68$ ,  $MSe = .07$ ,  $p < .11$ ), nor was the 17-msec RT difference ( $F(1,59) < 1$ ,  $F(1,35) < 1$ ). Listeners seem to have understood a sentence with VP focus similarly when both the V and the Obj NP were accented and when only the NP was accented. Note that the RT for condition A1 was faster than for A2, but the %YES was lower for A1 than for A2, indicating a possible speed-accuracy trade-off (a similar pattern occurred in Experiment 1). This result further supports the interpretation that there is no real difference between the two conditions.

The hypothesis that a Given Object NP must not be accented was supported by both the %YES and the RT comparisons. When a Given Obj NP received an accent, as in conditions B1 and B2, "YES" judgments were less likely (63%) and slower (347 msec) than when a Given Obj NP was not accented, as in condition B3 with 80% YES responses and 225 msec ( $F(1,59) = 29.45$ ,  $MSe = .07$ ,  $p < .01$ ;  $F(1,35) = 31.99$ ,  $MSe = .04$ ,  $p < .01$  for the %YES analysis;  $F(1,59) = 22.75$ ,  $MSe = 38863$ ,  $p < .01$ ;  $F(1,35) = 8.49$ ,  $MSe = 47045$ ,  $p < .01$  for the RT analysis). Thus, accenting Given Obj NP's caused disruption during comprehension.

The hypothesis that a Given Obj NP cannot carry focus for a focused VP, was also supported. Condition B2, where there was no accented V to carry focus, had a lower YES rate (54%) and longer RT (392 msec) than conditions B1 and B3 together, with 76% YES and 263 msec. The 22% difference for the YES rate was significant ( $F(1,59) = 42.42$ ,  $MSe = .07$ ,  $p < .01$ ;  $F(1,35) = 50.58$ ,  $MSe = .03$ ,  $p < .01$ ). The 129 msec difference for RT's was also ( $F(1,59) = 14.81$ ,  $MSe = 67861$ ,  $p < .01$ ;  $F(1,35) = 9.49$ ,  $MSe = 39986$ ,  $p < .01$ ).

It is interesting to note that accenting a Given Obj NP was not as disruptive if the V was accented, as in B1 vs. B2. The 17% difference in YES rate was significant ( $F(1,59) = 21.82$ ,  $MSe = .08$ ,  $p < .01$ ;  $F(1,35) = 27.56$ ,  $MSe = .04$ ,  $p < .01$ ). The 91-msec difference in RT's was significant by subjects and marginally significant by items ( $F(1,59) = 4.93$ ,  $MSe = 102355$ ,  $p < .05$ ;  $F(1,35) = 2.94$ ,  $MSe = 54454$ ,  $p < .10$ ). Nooteboom & Kruyt (1987) report a similar result. However, it is also the case that when the V was accented, accenting the Given Obj NP was worse than not accenting it, B1 vs B3. This 9% difference was significant for the YES rate ( $F(1,59) = 7.33$ ,  $MSe = .08$ ,  $p < .01$ ;  $F(1,35) = 8.84$ ,  $MSe = .04$ ,  $p < .01$ ). The 76-msec difference in RT was significant by subjects and marginally significant by items ( $F(1,59) = 5.38$ ,  $MSe = 63691$ ,  $p < .05$ ;  $F(1,35) = 2.92$ ,  $MSe = 63866$ ,  $p < .10$ ).

### 3.3 Discussion

In Experiment 1, where subjects were asked to make careful responses and were not specifically pressed to make fast ones, the pattern of YES rates, but not the pattern of response times, supported the focus projection hypotheses. In Experiment 2, where subjects were pressed to make speeded responses, the pattern of YES rates was generally consistent with the hypotheses, and the pattern of response times was completely consistent with the hypotheses. The results of Experiments 1 and 2 together provide broad empirical support for focus projection theory. These results will be further considered following Experiment 3.

## 4. Experiment 3

Whereas in the first two experiments listeners made comprehension responses, in this experiment we asked listeners to make linguistic judgments of the recorded dialogues. Unlike in Experiments 1 and 2, subjects were specifically asked to pay attention to intonation; their task was to judge the appropriateness of the intonation patterns of target sentences with respect to the context sentences. The goal of this experiment was to see whether listeners' linguistic intuitions matched the predictions from focus projection theory, and whether they also matched up with the comprehension results.

### 4.1 Method

#### 4.1.1 Materials and Design

The materials consisted of the 36 experimental dialogues from Experiments 1 and 2, i.e., the only difference in materials was that the fillers were excluded. The design was the same as in the first two experiments.

#### 4.1.2 Procedure

The subjects from Experiment 2 participated in Experiment 3 directly after they finished the first task. They were told that they would be listening to a subset of the dialogues from the earlier task, and they received the following information:

Each of the responses in these dialogues is an appropriate and direct response to their question with respect to meaning. However, the response sentences may or may not be appropriate with respect to the WAY they are said. In particular, some of the response sentences contain words that are stressed or emphasized inappropriately, while others are stressed appropriately.

An example of appropriate and inappropriate accenting was given and was followed by the task instructions. The task was to listen to each dialogue and rate each sentence on how appropriate its stress pattern was. Subjects were to give responses on a scale of 1 to 5, where 1 was "totally inappropriate," accenting, and 5 was "totally appropriate" accenting. They were to say the number to the experimenter, who entered it on a computer. Each subject thus contributed appropriateness judgments to one version of each of the 36 items in the experiment. There were no speed requirements for this task.

## 4.1.3 Subjects

The subjects were 59 of the 60 subjects who participated in Experiment 2; one subject's data were lost due to computer failure.

## 4.2 Results

Mean ratings by subjects and by items were obtained for each condition, and these were submitted to ANOVA's and planned comparisons. The mean appropriateness ratings are shown by condition in Table 3.

TABLE 3: Mean ratings on a scale of 1 (inappropriate stress) to 5 (appropriate stress), Experiment 3

	Obj NP NEW (A)	Obj NP Given (B)
V & Obj NP accented	4.02	2.96
Obj NP accented	3.74	2.12
V accented	2.83	3.93

The global ANOVA for these data yielded, first, a main effect for question sentence such that ratings were higher following question A, 3.53, than following question B, 3.0 ( $F(1,58) = 83.76$ ,  $MSe = 2.95$ ,  $p < .01$ ;  $F(1,35) = 74.82$ ,  $MSe = 2.04$ ,  $p < .01$ ). There was also an effect of answer sentence ( $F(2,116) = 40.31$ ,  $MSe = 2.59$ ,  $p < .01$ ;  $F(2,70) = 30.39$ ,  $MSe = 2.12$ ,  $p < .01$ ). The critical interaction between question and answer sentence was highly significant ( $F(2,116) = 151.79$ ,  $MSe = 4.03$ ,  $p < .01$ ;  $F(2,70) = 215.9$ ,  $MSe = 1.71$ ,  $p < .01$ ).

The same follow-up comparisons as in the previous experiments were carried out here to test specific hypotheses. Listeners judged sentences in which a New Obj NP was accented, A1 and A2 together (3.88), to be more appropriate than those in which a New Obj NP was not accented, as in A3 (2.83). The 1.05-point difference was highly significant ( $F(1,58) = 74.25$ ,  $MSe = 8.89$ ,  $p < .01$ ;  $F(2,135) = 141.2$ ,  $MSe = 2.79$ ,  $p < .01$ ).

However, the hypothesis that whether or not the V is accented should not matter was not supported. The difference between A1 and A2 (.28) was much smaller than that in the preceding comparison, but the difference here was also significant ( $F(1,58) = 11.14$ ,  $MSe = 4.31$ ,  $p < .01$ ;  $F(1,35) = 7.9$ ,  $MSe = 3.7$ ,  $p < .01$ ). It seems that listeners preferred for the verbs to be accented along with their objects when VP was the focus, at least when they were making linguistic judgments.

The hypothesis that a Given Obj NP must not be accented was strongly supported, since B1 and B2 together (2.54) were judged as much less appropriate than B3 (3.93), a difference of 1.39 ( $F(1,58) = 209.23$ ,  $MSe = 5.4$ ,  $p < .01$ ;  $F(2,135) = 160.97$ ,  $MSe = 3.7$ ,  $p < .01$ ).

The hypothesis that a V must be accented when there is no Obj NP to carry focus for a focused VP, was supported by the difference between the mean of B1 and B3 (with accented V, 3.45) and B2 (with no accent on the V, 2.12). The 1.33-point difference was again highly significant ( $F(1,58) = 295.1$ ,  $MSe = 3.5$ ,  $p < .01$ ;  $F(1,35) = 308.1$ ,  $MSe = 2.06$ ,  $p < .01$ ).

Note that, as with the comprehension tasks in Experiments 1 and 2, an accented Given Obj NP was not disliked as much if the V was accented. The .84-point difference between B1 and B2 was significant ( $F(1,58) = 136.85$ ,  $MSe = 3.05$ ,  $p < .01$ ;  $F(1,35) = 119.12$ ,  $MSe = 2.15$ ,  $p < .01$ ). However, it was still worse to have an accented Given Obj NP along with the accented V than to have no accent on the Given Obj NP. B3 was rated .97 points higher than B1 ( $F(1,58) = 98.53$ ,  $MSe = 5.62$ ,  $p < .01$ ;  $F(1,35) = 65.47$ ,  $MSe = 5.17$ ,  $p < .01$ ).

### 4.3 Discussion

Generally speaking, subjects' linguistic judgments matched up well with their responses in the comprehension task. The main exception was that in the judgment task, they indicated that accenting both the V and the Obj NP when both were New was preferable to accenting only the Obj NP; whereas in the comprehension tasks, subjects did not show significant differences between these conditions. The linguistic judgment task in this experiment proved to be a sensitive index of subjects' preferences for sentence accent patterns. Broadly speaking, listeners preferred sentences in which everything that was New was accented, and everything that was Given was not accented. While less so than when their task was merely to comprehend the meaningfulness of a dialogue, listeners were somewhat tolerant of exceptions to this rule in certain cases: when a New V was not accented, as long as a New Obj NP in the same sentence was accented, or when a Given Obj NP was accented, as long as a New V in the same sentence was also accented.

## 5. General Discussion

Taken together, the results from these experiments provide strong empirical support for focus projection theory. Listeners were more likely (Experiment 1) and faster (Experiment 2) to accept a sentence as a meaningful part of a dialogue when a New Obj NP was accented; this was true regardless of whether the V was also accented (Experiments 1 and 2). They also gave higher appropriateness ratings to sentences in which a New Obj NP was accented than to those in which the New Obj NP was not accented, more so if the V was also accented. Thus, when they were trying to understand the meaningfulness of a dialogue, listeners did not seem to require that whatever was New be accented; rather, consistent with focus projection theory, certain constituents could carry focus for a focused VP. However, listeners did indicate a preference for every constituent that was New to be accented, including constituents such as the verbs in our experiments that should not need to be accented, according to focus projection theory, because of their syntactic role or surface position in the sentence.

With respect to Given information, listeners were less likely (Experiments 1 and 2) and slower (Experiment 2) to accept dialogues as meaningful, and they gave lower preference ratings (Experiment 3), when Given constituents were accented, especially if there was no other accent in the sentence. They were more tolerant of

accented Given constituents when New constituents in the same sentence were also accented, but they still preferred that only the New constituents be accented (Experiments 1-3).

These results indicate that the ease of understanding spoken discourse depends to a large extent on appropriate intonational marking of focus. Listeners are sensitive to the appropriateness of the accent patterns of sentences, and the relationship between focus and accent depends at least in part on the syntactic positions of the accented words.

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