### Prosodic Effects of Discourse Salience and Association with Focus

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Prosodic Effects of Discourse Salience and Association with Focus

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Abstract

Three factors that have been argued to influence the prosody of an utterance are (i) which constituents encode discourse-salient information; (ii) which constituents are contrastive in that they evoke alternatives; and (iii) which constituents interact with the meaning of focus operators such as only (i.e., they ‘associate’ with focus). One challenge for a better understanding of these factors has been the difficulty of finding a way to evaluate hypotheses quantitatively, since individual variation in productions is often large enough to wash out experimental effects. In this paper, we apply a methodology introduced in [1] which regresses out subject and item variation, uncovering otherwise hidden prosodic patterns that illustrate how the three factors interact in sentences containing single or multiple foci.

Index Terms: prosody, focus association, givenness, prominence, production

1. Prosodic Effects of Focus and Discourse-Salience

One of the goals of research on prosody is to determine the conditions which underlie prosodic prominence. A case where this is particularly important is in the theory of association with focus [2], the phenomenon in which the meaning of a sentence changes with the prosodic realization of material in the scope of certain focus-sensitive operators such as only:

\[\text{(1) a. Gramma only gave a bunny to Maryanne.} \]
\[\text{b. Gramma only gave a bunny to Maryanne.}\]

Pronunciation (1a), with prominence on bunny, seems compatible with a scenario in which Gramma also gave a bunny to John; (1b) does not. (1b) seems compatible with a scenario in which Gramma also gave a scarf to Maryanne; (1a) does not. In the first example bunny is focused and in the second Maryanne. The current study explores how prominence patterns reflect the intended meaning of sentences in which one or two focused elements associate with only. We use a normalization procedure from [1] which uncovers otherwise hidden prosodic effects.

1.1. Evoking Alternatives

One way to explain the difference between (1a) and (1b) is to analyze only as operating over alternatives to the sentence in it occurs. The alternatives for (1a) involve substitutions for bunny, while those for (1b) vary Maryanne. In the following, smallcaps denote constituents which evoke alternatives:

\[\text{(2) a. ‘Gramma only gave A BUNNY to Maryanne.’} \]
\[\text{Alternatives: \{ Gramma gave a scarf to Maryanne; } \]
\[\text{Gramma gave a cake to Maryanne; ... \}}\]

Sentences involving only are often analyzed as presupposing sentence without only (e.g., Gramma gave a scarf to Maryanne, in the case of (1a)), and asserting that no alternative to it is true [3]. According to this analysis, both (1a) and (1b) share the presupposition that Gramma gave a bunny to Maryanne, but they differ with respect to which alternative statements they exclude. The prosody of a sentence depends in part on which alternatives are contextually relevant; constituents which evoke alternatives are usually more prominent than those that do not.

1.2. Anaphoric Destressing

Another factor affecting prosody is that discourse-salient material is usually less prominent than discourse-new material (cf. [4] for overviews), a phenomenon often called ‘anaphoric destressing.’ Underlining marks discourse-salient material:

\[\text{(3) a. Why did Maryanne feel special?} \]
\[\text{b. Grandma gave a bunny to Maryanne.}\]

In a typical rendition of (3b), the noun phrase Maryanne is less prominent than the preceding a bunny because its referent is discourse-salient. However, in the following context the indirect object would typically be more prominent than the preceding object because it evokes alternatives:

\[\text{(4) a. Why did Maryanne feel special?} \]
\[\text{b. Grandma only gave a bunny to Maryanne.}\]

The prosodic realization of a constituent is thus affected by two factors: (i) Which constituents evoke alternatives? (ii) Which constituents encode information that is salient in the discourse? The current study systematically varies the information status (IS) of constituents along both dimensions. An introductory story made all of the discourse referents (e.g. John, Maryanne, bunny, and scarf) salient, and the set-up further manipulated the IS of the target sentence. Conditions 1 and 2 vary the IS of the indirect object Maryanne such that it is discourse-salient in both cases, but evokes alternatives in only in condition 2:

\[\text{(5) Story: It was Christmas, and Gramma was deciding what gifts to give to her grandchildren, John and Maryanne. She had knitted two scarves as gifts, and also purchased a couple of stuffed bunnies. She wrapped up a scarf and a bunny for John. Then she remembered how rude Maryanne had been at Thanksgiving.} \]
Table 1: Information Status by Condition

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<thead>
<tr>
<th>Condition</th>
<th>Direct Object</th>
<th>Indirect Object</th>
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<tr>
<td>1</td>
<td>GIVEN &amp; EVOKES ALT.</td>
<td>GIVEN &amp; EVOKES ALT.</td>
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<tr>
<td>2</td>
<td>GIVEN &amp; EVOKES ALT.</td>
<td>GIVEN &amp; EVOKES ALT.</td>
</tr>
<tr>
<td>3</td>
<td>given</td>
<td>GIVEN &amp; EVOKES ALT.</td>
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<tr>
<td>4</td>
<td>GIVEN &amp; EVOKES ALT.</td>
<td>GIVEN &amp; EVOKES ALT.</td>
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<tr>
<td>5</td>
<td>GIVEN &amp; EVOKES ALT.</td>
<td>GIVEN &amp; EVOKES ALT.</td>
</tr>
<tr>
<td>6</td>
<td>EVOKES ALT.</td>
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Table 2: Focus Association by Condition

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<th>Condition</th>
<th>Direct Object</th>
<th>Indirect Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>only</td>
<td>contrast</td>
</tr>
<tr>
<td>4</td>
<td>contrast</td>
<td>only</td>
</tr>
<tr>
<td>5</td>
<td>only</td>
<td>only</td>
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</table>

a. Condition 1: Set-up: Gramma didn’t give a scarf to Maryanne. Target: Gramma only gave a BUNNY to Maryanne.

b. Condition 2: Set-up: Gramma gave a scarf and a bunny to John. Target: Gramma only gave a BUNNY to MARYANNE.

In Condition 1, Maryanne is discourse-salient and does not evoke alternatives. In Condition 2, while also given, Maryanne evokes an alternative: John. In Conditions 3 and 4 the IS of bunny was similarly manipulated:

(6) Story: It was Christmas, and Gramma was deciding what gifts to give to her grandchildren, John and Maryanne. She had knitted two scarves as gifts, and had also purchased a couple of stuffed bunnies. She wrapped up a scarf and a bunny for Maryanne. Then she remembered how rude John had been at Thanksgiving.

a. Condition 3: Set-up: Gramma didn’t give a bunny to John. Target: Gramma only gave a bunny to Maryanne.

b. Condition 4: Set-up: Gramma gave a scarf to both Maryanne and John. Target: Gramma only gave a BUNNY to MARYANNE.

In Conditions 1-4, the discourse-salience of bunny and Maryanne is held constant while the evoking of alternatives is varied. In Conditions 5 and 6, on the other hand, the evoking of alternatives is held constant, but discourse-salience is varied. Earlier research has already shown that discourse-given material can remain accented and at the same time show quantitative signs of reduction compared to discourse-new accented material [5]. In Condition 5, both bunny and Maryanne associate with only and are discourse salient. In Condition 6, while both objects evoke alternatives, they are both discourse-new:

(7) Condition 5:
Set-up: Gramma didn’t give a scarf to Maryanne, and she didn’t give either a bunny or a scarf to John.
Target: Gramma only gave a BUNNY to MARYANNE.

(8) Condition 6:
Set-up: Gramma picked one present and gave it to her favorite grandchild.
Target: Gramma only gave a BUNNY to MARYANNE.

Table 1 summarizes the IS of the 6 experimental conditions.

1.3. Multiple Foci

In its simplest form, the alternatives theory of association with focus [3] predicts that any alternatives evoked in the scope of a focus-sensitive operator such as only must be considered in the alternatives that only excludes—they should all ‘associate’ with only. For example, the following sentence should indicate that Gramma gave only one thing to one person:

(9) Gramma only gave a BUNNY to MARYANNE.

However, it turns out that multiple focus constructions do not necessarily work like this [6]. Consider again our Condition 2 (5b): Despite the fact that both direct and indirect object evoke alternatives, only the direct object associates with only. Similarly, in Condition 4 (6b), only the indirect object associates with only. The fact that there can be constituents in the scope of only which evoke alternatives but do not associate with it presents a problem for the theory. [7] observed a related issue. In sentences with more than one focus operator (i.e., (10)), a focus can associate either with the higher focus operator (also) or the lower one only, but the focus operators don’t necessarily associate with both:¹

(10) We only₁ recovered the diary entries that Marilyn₁ made about John.
We also₂ only₁ recovered the diary entries that Marilyn₁ made about Bobby₂.
‘Also with respect to diary entries about Bobby, we only recovered the ones that Marilyn made.’

Rooth’s example suggests that the evoked alternative sets may have to be indexed with respect to the focus operator that quantifies over them. Similar to the paraphrase of Rooth’s example in (10), our Conditions 2 and 4 can be paraphrased using a topic construction. Condition 2 could be paraphrased: ‘As for Maryanne, Gramma only gave a bunny to her.’; Condition 4 could be paraphrased: ‘As for bunnies, Gramma only gave one to Maryanne.’ We can analyze the data by positing a contrast-operator which, like also in (10), associates with one focus, preventing only from associating with it. This is the analysis given to contrastive topics more generally in [9]: contrastive topics are focus-sensitive operators that outscope a lower focus operator.

(11) Condition 2:
Set-up: Grammar gave a scarf and a bunny to John.
Target: Gramma contrast₁ only₂ gave a BUNNY₂ to MARYANNE₁.

(12) Condition 4:
Set-up: Gramma gave a scarf to both Maryanne and John.
Target: Gramma contrast₁ only₂ gave a BUNNY₁ to MARYANNE₂.

The novel question in our experiment is whether the prosody of constituents that evoke alternatives is affected by which focus operator they actually associate with. Table 2 summarizes the focus association patterns of the three conditions in which the two objects both evoke alternatives and are discourse salient.

¹This may be not be possible with all kinds of focus operators, however, see [8].
Figure 1: An example of the picture array that subjects chose from to indicate their interpretation of the target sentence.

2. Method

2.1. Participants

10 pairs of English speakers from the MIT community participated in the dialogue experiment. Each participant received $15 for participating.

2.2. Materials

The stimuli consisted of three sections: Story, set-up, and target. The story provided a scenario for the action, and served, in all but Condition 6, to introduce two people (e.g. Maryanne and John) and two objects (e.g. a bunny and a scarf). The set-up determined the IS of the target sentence—the discourse salience of the people and objects, and which alternatives only associated with. The target always took the form: Actor only verbed a object to Name. The actor, object, and name were all 2-syllables with first-syllable stress. The verb consisted of one syllable. Length and metrical stress were matched across items. The target sentence were comprised mainly of sonorants, to facilitate automatic pitch extraction. There were 10 items in total in 6 conditions, making for a total of 60 stories.

2.3. Procedure

Two participants (a speaker and a listener) sat at two computers in the same room such that neither could see the others screen. On each trial, the speaker first read the story, set-up, and target silently. S/he then chose from an array of four pictures (Fig. 1) to assure they understood the context and gave the sentence the right meaning. The speaker then produced the set-up and target out-loud for the listener, who selected the picture s/he believed the target described. Trials for which the listener chose the wrong picture were excluded from analysis, as were productions with disfluencies. Using Praat ([10]), 24 acoustic measures were automatically extracted from each of five words in the target sentence (Gramma, only, gave bunny, Maryanne). A participant was a speaker for a subset of half the trials, the other and the interaction between them, predicted the 120 acoustic measures. From each model, we calculated the predicted value of each acoustic feature per item per speaker. The difference between the predicted and actual values (i.e. the residual measure) reflects acoustic differences not due to differences between speakers or items, or their interaction. We submitted these residual measures to a stepwise discriminant analysis, to independently determine which acoustic measures speakers used to differentiate productions. Eight of the original 120 acoustic measures (duration, mean pitch, pitch range, and maximum intensity from bunny and Maryanne, respectively) resulted in better-than-chance 6-way classification of the productions by condition; moreover, many conditions were now discriminated in pair-wise comparisons.

3. Results

In order to see whether the acoustic measures could discriminate the speakers’ productions, we entered all 120 predictors into a series of step-wise discriminant analyses. In initial analyses, neither the full set of 6 conditions, nor pairs of conditions, were successfully discriminated. To remove variance due to speakers and items, we followed [1] and computed linear regression models in which speaker (n = 20), item (n = 20), and the interaction between them, predicted the 120 acoustic measures. From each model, we calculated the predicted value of each acoustic feature per item per speaker. The difference between the predicted and actual values (i.e. the residual measure) reflects acoustic differences not due to differences between speakers or items, or their interaction. We submitted these residual measures to a stepwise discriminant analysis, to independently determine which acoustic measures speakers used to differentiate productions. Eight of the original 120 acoustic measures (duration, mean pitch, pitch range, and maximum intensity from bunny and Maryanne, respectively) resulted in better-than-chance 6-way classification of the productions by condition; moreover, many conditions were now discriminated in pair-wise comparisons.

3.1. Given vs. Given + Evokes Alternatives

Conditions 1 and 2 were well discriminated, Wilks’ lambda = .81, F(8) = 5.08, p < .001. A leave-one-out classification successfully classified 68% of all productions; 66% of condition 1; 70% of condition 2. Acoustic results demonstrated that, when the foci is discourse-salient but also evokes alternatives, it is produced with a longer duration, higher intensity, and wider pitch range than when it does not evoke alternatives (Fig. 2). The bar plots in all Figures are averages of the normalized measures over all items—we label them with the words from our particular examples to make the figures easier to interpret.

3.2. Given + Evokes Alternatives vs. Evokes alternatives

Conditions 5 and 6 were discriminated, Wilks’ lambda = .86, F(8) = 3.59, p < .001. Leave-one-out classification successfully classified 60% of all productions; 67% of condition 5; 52% of
Acoustic results demonstrated that, when the foci is discourse-salient but also evokes alternatives, it is produced with a longer duration, higher intensity, and wider pitch range than when it evokes alternatives but is discourse-new (Fig. 3).  

3.3. Association with only vs. association with contrast  

Conditions 2 and 4 were discriminated. Wilks’ lambda = .90, F(8) = 2.46, p < .05. In addition, leave-one-out classification successfully classified 55% of all productions; 51% of condition 2; 60% of condition 4 (Fig. 4). Acoustic results demonstrated that foci which are contrastive are on average produced with longer duration, higher pitch, higher intensity, and wider pitch range than foci which associate with only.

4. Discussion and Conclusion  

The results show that constituents which are discourse-salient but also evoke alternatives are more prominent than constituents that are discourse-salient and do not (Condition 1 vs. 2, Condition 3 vs. 4). Furthermore, discourse-new constituents which evoke alternatives are more prominent than discourse-salient constituents which evoke alternatives (Conditions 5 vs 6), showing that anaphoric reduction can be observed even on accented constituents that evoke alternatives. This is similar to the finding in [5] that accented words are reduced when discourse-salient. Our study did not look at the case in which a constituent is new and does not evoke alternatives. This IS was compared to constituents that are new and do evoke alternatives in [11], who found the latter to be more prominent.

With respect to multiple foci, we found that foci which associate with contrast are more prominent than foci which associate with only. This could either be due to the nature of the focus operators contrast and only themselves, or it could be a function of the scope of the focus operators (cf. [12] for a related claim on second-occurrence focus)—in our stimuli, contrast arguably always outscoped only. Our results show for the first time that such an effect exists, future study will have to distinguish the two possible accounts. A further methodological result is that regressing out subject and item effects following [1] can uncover effects that are other washed by variation.

5. Acknowledgements  

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6. References  