Prosody marks different kinds of informativity: Interactions between frequency, probability and focus

Iris Chuoying Ouyang and Elsi Kaiser
University of Southern California
chuoyino@usc.edu

Prosody has been found to encode the extent to which linguistic elements are informative. Prior work has approached informativity from two angles**: (i)** information theory/statistical probability and **(ii)** information structure/pragmatics. Prior work from the information-theory side has found that increased statistical probability (e.g. being high-frequency or contextually predictable) reduces words' prosodic prominence (e.g.[1,6]). Prior work from the information-structure side has found that pragmatic, information-structural salience increases prosodic prominence (e.g., words in narrow focus are more prominent than words in wide focus, e.g.[3]). However, little attention has been paid to the potential *interaction* between these two kinds of factors (though see [2] on givenness+frequency). This was the focus of our study.

We investigated whether **word frequency** and **contextual probability** modulate the prosodic effects of information structure, and whether they impact different categories of information structure in different ways. In a production study, participants (N=16) worked with a lab assistant as their partner: the partner (speaker A) asked questions and participants (speaker B) provided answers. Three question types were used to elicit focus: **new-information narrow focus**, **corrective narrow focus**, and **VP (wide) focus** (ex.1-3). Target objects differed in (a) word frequency (high, e.g. *cars/books*, or low, e.g. *cans/shells*) and (b) contextual probability (high, e.g. *cars/cans*, or low, e.g. *books/shells*). Contextual probability was estimated using a norming study; word frequencies are from SUBTLEXus [4].

1. Narrow+New: A: *What did Rita and Diane kick in the garage?* B: *They kicked [cars]$_{NewF}$ in the garage.*
2. Narrow+Corr: A: *I heard that Rita and Diane kicked dirt in the garage.* B: *No, they kicked [cars]$_{CorrF}$ in the garage*.
3. VP (wide): A: *What did Rita and Diane do?* B: *They [kicked cars in the garage]$_{VPF}$.*

Predictions: Early findings suggest low-frequency words exhibit smaller prosodic differences between focused and unfocused information [2]. Building on this, we predicted that the distinction between focus types would be masked or absent when the narrowly focused word was infrequent *or* contextually improbable, i.e., we expect *the prosodic effects of information structure to be obscured/weakened when there are other factors that also demand prosodic prominence.*

Analysis: F0's of utterances were converted into a semitone scale [8] and normalized by subjects using z-standardization. We tested three regions: pre-focus (verb), focus (object), and post-focus (preposition+article, e.g. *in the*). The post-focus region is of interest because pitch lowering right after the focused element is a cue for narrow focus (e.g.[5]). Pitch contours were compared at the alpha=0.05 level with Smoothing Spline ANOVA models [7].

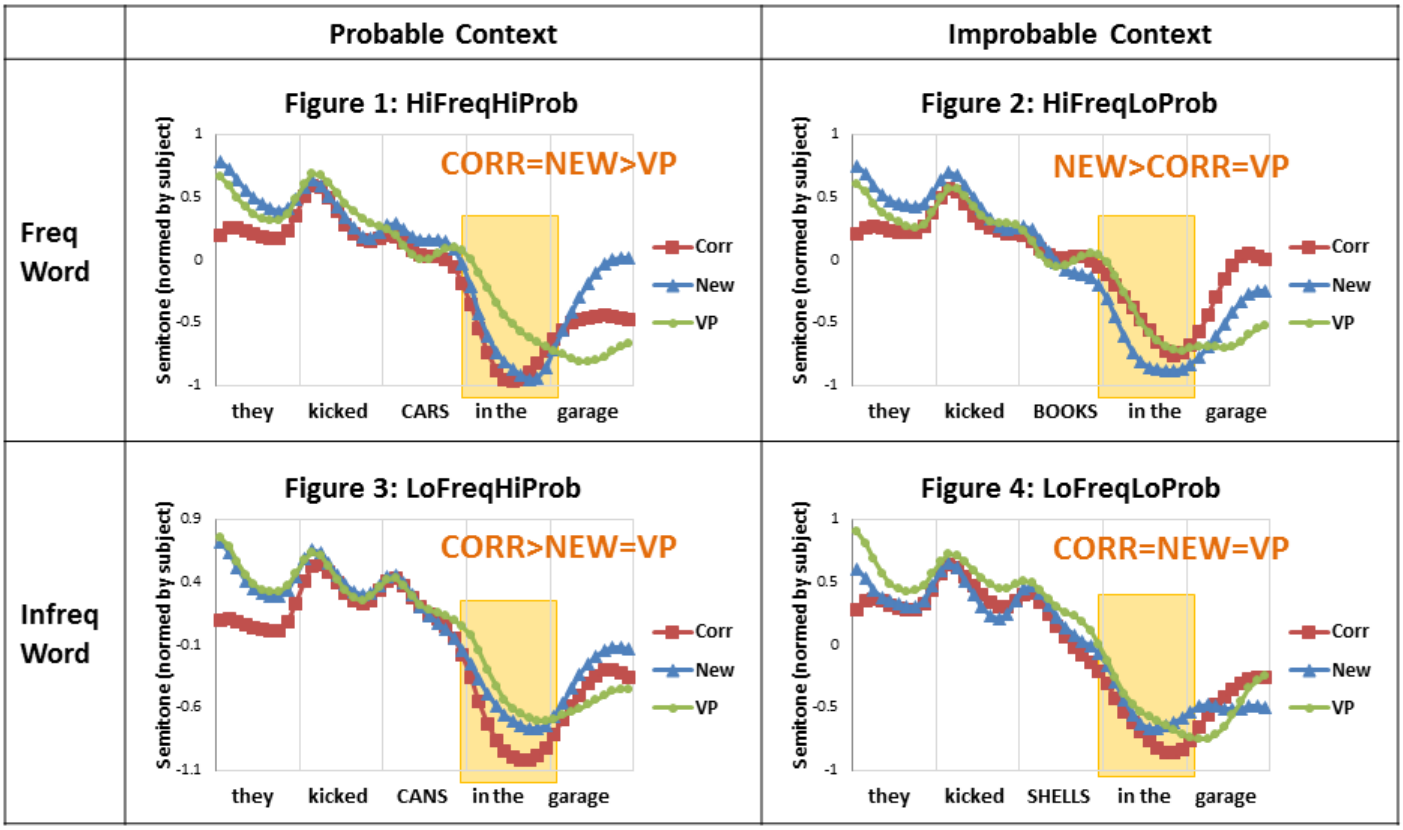
Results: Pre-focus and focus regions showed no significant pitch differences. However, in the <u>*post-focus region*</u>, frequency and contextual probability modulate effects of information structure on f0 (Figs 1-4, next page):

- When the focused word is *high-frequency and contextually highly probable*, new and corrective narrow focus have significantly lower pitch than VP focus (Fig.1). This fits with pitch lowering signaling narrow focus (as in [5]).
- When the focused word is *high-frequency but contextually improbable*, only new-information focus has significantly lower pitch; corrective focus does not differ from VP focus (Fig.2).
- When the focused word is *low-frequency but contextually highly probable*, only corrective focus has significantly lower pitch; new-information focus patterns with VP focus (Fig.3)
- When the focused word is *low-frequency and contextually improbable*, none of the three types of focus differs significantly from each other (Fig.4).

Discussion: ***As a whole, our results show that the prosodic encoding of information-structural categories depends on the word's frequency and contextual probability***. More specifically, we found that effects of narrow focus (i) start disappearing when another factor also demands prosodic prominence, i.e., when the focused word is infrequent or occurs in an improbable context, and (ii) completely disappear when there are two other sources of prosodic prominence (LoFreqLoProb). Interestingly, corrective focus appears to be impacted more by contextual probability, and new-information focus seems to be impacted more by word frequency. Why? Corrective focus patterns with VP focus in low-probability contexts, which may be due to the nature of correction. When the correct information is contextually improbable (*kicked <u>books</u> in the garage*), the conversational partner's misbelief (e.g. *kicked dirt in the garage*) may not be very surprising, perhaps motivating low prominence in the correction. Possibly for similar reasons, new-information focus does not differ from VP focus with low-frequency words. Intuitively, infrequent words are more informative. Compared to answers with frequent, less informative words (*kicked <u>cars</u> in the garage*), in answers with infrequent, more

informative words (*kicked cans in the garage*), it may be less surprising that the conversational partner has asked for the information, which could be motivating realization of new information with low prominence.

In sum, our work provides new insights into prosodic prominence by combining statistical (word frequency, contextual probability) and pragmatic factors (information structure). Our results show that the prosodic encoding of information-structural categories depends on word frequency and contextual probability. Crucially, most existing studies have examined probable contexts and have not manipulated frequency, which may explain why narrow focus has been found to bring greater prosodic prominence than wide focus. Our findings point to an interaction-based account: The prosodic profile of an utterance seems to reflect speakers' expectations/surprise about what the other person has in mind.



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