Intended scope interpretation impacts intensity and f0 in naturalistic speech

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Does a speaker's intonation reflect their intended interpretation for a scopally ambiguous utterance? For example, the utterance *Everyone didn't go*, which is ambiguous between *No one went* and *Not all went*, might associate a particular pattern of prosodic rises and falls with each interpretation. We might expect that speakers produce a difference in the utterance-final f0: a rise on the not all interpretation versus a fall on the none interpretation (Jackendoff, 1972; Ward and Hirschberg, 1985). But Syrett et al. (2012) report mixed findings in an experimental reading task. To what extent could we find the expected prosodic differentiation in naturalistic speech? In Attali et al. (2022), we gathered 390 *every*-negation productions from the 1990-2012 radio and TV transcripts in the Corpus of Contemporary American English (Davies, 2015) and crowd-sourced interpretation preferences of these productions in their linguistic contexts, finding a range of preferences. Here, we investigate these utterances' original intonations. We indeed find a greater utterance-final rising f0 and intensity for items judged to have meant not all as compared to none. This finding critically suggests that, despite great prosodic variability across speakers and sentences, naturalistic speech does contain potentially disambiguating information.

Background. Specifically, for constructions similar to *every*-negation (with the quantifier *all* instead of *every*), Jackendoff (1972) proposed that a falling contour must associate with the none interpretation, while a fall-rise contour must associate with the not all interpretation, because English intonation contains clues about information structure: the fall-rise contour is felicitous when negation is asserted, as it is by the not all interpretation. In one of the only studies addressing this hypothesis, Syrett et al. (2014) found that some speakers, when reading aloud these utterances (e.g., *All the magnolias didn't bloom*) in contexts that favored one interpretation over the other, consistently produced an utterance-final rise in contexts favoring the not all interpretation; but no reliable f0 pattern was found across speakers.

Methods. In an ongoing search for available original recordings of the *every*-negation utterances, we've so far found N=10 (that is, 10 different sentences by 10 different speakers). For each, we hand-annotated for word time stamps using Praat (Boersma and Weenink, 2021). We then used ProsodyPro (Xu, 2013) to extract several acoustic features per word: mean f0 (Hz), mean intensity (dB), and max f0 velocity (semitones/s, the max instantaneous rate of f0 change). To represent the speaker's intended scope interpretation, we used the crowd-sourced scope interpretation preferences of each item, which we had elicited on a sliding scale in Attali et al. (2022) (building on Attali et al. (2021)): this variable ranges from 0 (average cross-participant surface scope preference) to 1 (inverse scope preference). To control for item/speaker-specific variation in pitch/intensity, we included item as a random intercept in the mixed effects models below.

Results. We ran mixed effects models where intended scope interpretation predicted an utterance-final acoustic feature, using the lme4 package in R (Bates et al., 2015). In line with the hypothesis that a fall-rise contour should associate with the not all interpretation, we found that greater probability of the not all interpretation predicts positive utterance-final max f0 velocity; that is, it does predict an utterance-final rise in f0 (β=174.90, SE=47.31, p=0.000368). Probability of the not all interpretation also predicts an utterance-final rise in intensity (β=8.230, SE=1.916, p=4.27e-05) and a greater utterance-final f0 relative to utterance-initial f0 (β=84.84, SE=23.31, p=0.000448).

Discussion. These pilot findings converge to suggest that falling utterance-final f0 and intensity are more likely contained in the acoustic signal when a speaker produces the none interpretation, while a deviation from utterance-final fall is associated with the not all interpretation. In future work, we plan to increase the pool of original speech recordings, as well as investigate the extent to which listeners use this probabilistic acoustic signal to arrive at the speaker's intended interpretation.

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