The salience of "rhythmic" prenuclear accents: Evidence from an imitation study

Suyeon Im[1], José Ignacio Hualde[2], Jennifer Cole[3]
[1]*Hanyang University,* [2]*University of Illinois at Urbana-Champaign,* [3]*Northwestern University*
suyeonim@hanyang.ac.kr, jihualde@illinois.edu, jennifer.cole1@northwestern.edu

In English, words with a lexical secondary-primary stress pattern (*rèalístic)* can optionally realize a pitch accent on the secondary stress rather than the primary stress syllable. This accent placement, common in sentence-initial position, seems unrelated to meaning, possibly serving a rhythmic anchoring function [1, 2, 3]. We investigate the perceptual status of these "ornamental" [4] prenuclear accents through an imitation experiment. 33 native English speakers (23 f, 10 m) heard and repeated stimulus sentences that had one of three prenuclear accent patterns in a prosodic phrase spanning the subject NP, e.g., (*The realistic story*), with a nuclear accent on *story*. The initial content word (underlined) in prenuclear position was produced as **Unaccented** (*The realistic **stó**ry*); with a high pitch accent on the **Primary** stressed syllable (*The rèa**lís**tic stóry*); or with an **Early High** accent on the secondary stressed syllable (*The **ré**alìstic stóry*). Participants repeated each of 12 sentences (Ex. 1), 4 for each of the 3 accentual patterns, "in the way the model speaker said it". Imitation of prenuclear accent distinctions would be evidence for the perceptual salience of non-contrastive metrical structure cued by accent at the phrase level.

Imitated accent patterns were analyzed with mean F0 measures and full F0 trajectories. The mean F0 analysis (similar results with max F0) classified imitations based on the relative difference of mean F0 in three regions (stress feet) in the subject NP, e.g., [the rea] [listic] [story]. Imitations of Early High were most accurate (91%), while Primary (52%) and Unaccented (35%) patterns were less accurate. Errors favored the Early High pattern (Fig. 1). We also classified time-normalized F0 trajectories using k-means clustering (kml in R), taking 10 equi-distant F0 samples in each of the three analysis regions. The optimal solution had four clusters of F0 trajectories instead of the three patterns in the stimuli (Fig. 2). Additional cluster analyses were conducted on subsets of the imitated F0 trajectories grouped by stimulus accent pattern, and each yielded an optimal analysis with two clusters (A and B in each row in Fig. 3). The trajectories in the A panels are "accurate" in that they closely resemble the F0 contours of the stimulus pattern, while those in the B panels ("inaccurate") do not. Visual inspection of average F0 trajectories in the A and B groups reveal two new findings. First, the "inaccurate" imitations of Primary and Unaccented stimuli are not simply errorful productions of Early High, as suggested by our earlier mean F0 analysis. Rather, they appear to be contours that combine a weak Early High F0 peak with a second peak in the final region (*The **re**alistic **sto**ry*), yielding a hybrid pattern not present in the stimuli. Second, the "inaccurate" Early High imitations are more numerous (at 40%) than under the mean F0 analysis. They reveal yet another distinct accent pattern, which may be described as a falling accent (H+!H*) associated with the primary stress [rea**lis**tic]—absent the Early High accent . Overall, the Early High accent emerged as a strong attractor in the imitations, but was implemented with F0 trajectories that would be described differently in a phonological analysis, i.e. with different assignments of high-toned pitch accents.

Conclusion: Non-contrastive distinctions in prenuclear contours are salient to listeners, but the accentual events that are relevant to them may be of a broader type than their analysis using phonological (Autosegmental-Metrical) labels would suggest. English speakers appear to treat as equivalent tonal configurations that are objectively different but share some features, reminiscent e.g., of the segmental voiced/voiceless contrast. The predominance of realizations with an early accent indicates a preference for rhythmic anchoring, when subjects have recent exposure to patterns with and without the high accent at the left edge of the phrase.

References [1] Shattuck-Hufnagel, S. 1998. "Acoustic-phonetic correlates of stress shift." *JASA* 84.S1: S98-S98. [2] Beckman, M. & Edwards, J. 1994. "Articulatory evidence for differentiating stress categories." In Keating, P., ed., *Papers in Laboratory Phonology III*, 7-33. [3] Cole, J., Hualde, J. I., Mahrt, T. & Eager, C. 2015. "On the prominence of accent in stress reversal," *Proc, of ICPhS 18.* [4] Büring, D. 2007. "Semantics, intonation and information structure." In Ramchand, G. & Reiss, C. eds., *Oxford Handbook of Linguistic Interfaces*. 445–474.

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(1) *Example stimulus sentences. F0 analyzed in bracketed constituent; target word underlined.*
[The realistic story] included a few untrue elements about George Clooney's hometown.
[The systematic tutors] always give clear instructions that even a beginner could follow.

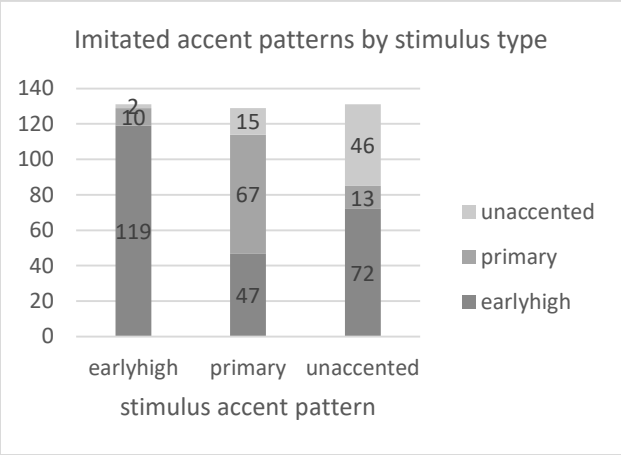

Figure 1. (left top) Imitations grouped by stimulus accent pattern (x-axis). Shading indicates the accent pattern of the imitated production according to the relative f0 mean values in three regions.

Figure 2. (left bottom) Output of kml cluster analysis over trajectories of f0 mean values from the three analysis intervals of the imitated target phrases. Colored lines show the mean trajectories for each of the four clusters in the optimal clustering solution. Black lines are the input trajectories.

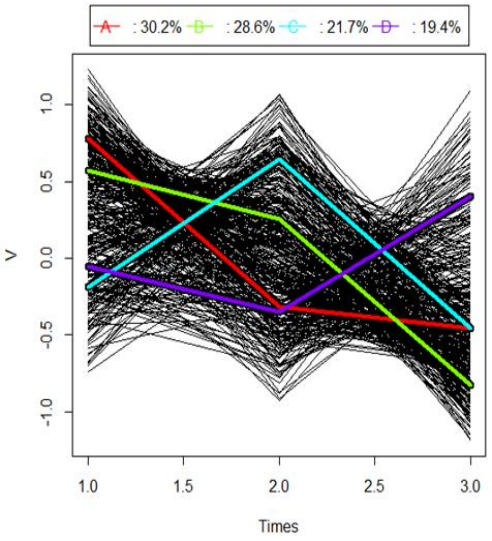

Figure 3. (right) Output of kml cluster analyses over trajectories of 30 time-normalized f0 values of imitated productions grouped by stimulus accent pattern. The red line marks the mean trajectory of each cluster, and black lines are the input trajectories.