Intonation as a speech segmentation cue: Effects of speech style

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To understand connected speech, listeners must segment it into words. Past research has shown that listeners use many types of information in segmentation (e.g. Cutler et al. 1996, 2002). However, there has been little investigation of whether listeners use intonation in segmentation, and relatively little work on segmentation of differing speech styles. This research addresses these issues, using Japanese. In Tokyo Japanese, there is a rise in pitch at the beginning of each accentual phrase ("APR," accentual phrase rise) (Pierrehumbert and Beckman 1988). Since accentual phrases must begin at a word boundary, listeners might use APRs to help them locate word boundaries. Warner and Arai (2001) found that if listeners hypothesized a word boundary at each APR, this would allow them to locate many of the word boundaries, while producing extremely few false positives (APRs not at word boundaries). A related perceptual study has confirmed that Japanese listeners do make use of APRs in locating words.

Segmentation research has focused largely on careful speech, but speech styles differ widely in ways that may affect the segmentation task. A particular segmentation cue may occur frequently in one speech style but rarely in another. We compared the locations of all word boundaries and all APRs in four Japanese speech corpora: newscasts, a language textbook, spontaneous monologues, and casual phone conversations. We evaluated how often word boundaries are accompanied by an APR. Since a pause is a strong boundary cue, we examined the words which do not follow a pause (the more difficult words) separately. Results appear below:

Speech Style	% non-post-pausal words with APR	% post-pausal words with APR	% all words that follow pauses	% APRs not at word boundaries
Newscasting	44%	98%	36%	0%
Textbook	38%	98%	38%	1%
Monologue	40%	88%	42%	3%
Conversation	37%	68%	32%	1%

Words not after pauses are accompanied by a pitch rise most often in newscasting speech. That is, when there is no obvious boundary cue (a pause), speakers supply pitch rises (an alternate boundary cue) more often in newscasting speech than in other styles. Also, words following pauses almost always have an APR in the more formal speech styles (news and textbook), but not in the less formal styles. Furthermore, monologue speech has the most pauses (because of the demands of speaking fluently with little planning) and conversation the fewest. Finally, very few APRs occur anywhere other than at a word boundary in any style.

These results show that segmentation cues differ in their potential usefulness depending on speech style. Second, speakers provide the intonational word boundary cue most often in exactly that speech style where segmentation is likely the most difficult otherwise (newscasting, with long strings of low-frequency words). Finally, in all speech styles, APRs have the potential to be quite a strong word boundary cue, relative to other known cues (McQueen 1998). Since listeners can listen to, and fluently parse, a great variety of speech styles, it is interesting to determine how speech style affects methods of parsing. Furthermore, investigation of this particular segmentation cue (pitch rises based in the intonational system) brings together the

study of phonetics and phonology of intonation with the psycholinguistic study of speech segmentation.

References

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