Testing the Relative Boundary Strength Hypothesis

What role does prosodic structure play in the recovery of syntactic structure during comprehension? Much recent work has addressed this question by exploring the interpretation of attachment ambiguities, in both online and offline tasks.[1,2,3] Many of these studies have been interpreted as supporting the relative boundary strength hypothesis: the claim that attachment depends on the strength of the boundary following the low attachment site, relative to the strength of the boundary following the high attachment site.[3] For example given utterance 1:

(1) You can feel $_{A}$ the cat $_{B}$ with the feather.

the strongest version of this hypothesis would make the following predictions

(2) a. If A > B, then attach low (modifier)
b. If B > A, then attach high (instrument)
c. If A = B, no preference

Other theorists, however, have argued that the absolute strength of the boundary preceding the low attachment site (B) is decisive—strong boundaries in this position favor the instrument analysis regardless of the earlier boundary.[4] Since sentences with strong boundaries at position B, rarely contain strong boundaries at position A, there are few studies which uniquely support either hypothesis (but see [3]).

To contrast these theories, we produced utterances with PP-attachment ambiguities using a variety of prosodic structures and then asked participants to interpret them. In three between-subjects conditions we varied the *magnitude* of the difference between the critical prosodic breaks. Within each condition we varied the *prosodic form* of the utterance in accordance with the relative boundary strength hypothesis (see Table 1).

An ANOVA analyzing the proportion of instrument responses (Table 1) produced main effects of *magnitude* and *prosodic form* and an interaction between them, justifying comparisons of the critical cells. These analyses suggest that both hypotheses are valid but incomplete. Many features of the data are consistent with both alternatives (e.g., the reliable differences between modifier and instrument utterances in all three *magnitude* conditions).

But some features are uniquely predicted by the relative boundary strength hypothesis. First, there were no reliable differences between the strong and weak prosody conditions, suggesting that ip and IP breaks were functionally equivalent in this context (all p's >.2). Second, in both the strong-prosody and weak-prosody conditions modifier utterances received fewer instrument interpretations than the neutral-no-break utterances ($p < .001$). Since both have ø breaks after the low attachment site, this demonstrates that the size of the earlier break influences interpretation.

However, other patterns in the data demonstrate that the absolute size of boundary B does play a privileged role. For example, the ip-break neutral utterances had more instrument interpretations than no-break neutral utterances ($p < .005$), indicating that the ip-break in position B discouraged low attachment even when an ip-break appeared in position A. Consistent with this, 2-break

modifier utterances, which included an ip-break at position B, were given more instrument interpretations than strong-prosody and weak-prosody modifier utterances which had no break in this location (p's >.005). We conclude that the correct theory of the prosody-syntax interface will have to account for both kinds of effects.

Table 1: Prosodic structures for each stimulus (ToBI break indices) and the percentage of instrument responses (high attachments)

	Modifier	no-break Neutral	ip-breaks Neutral	Instrument
Strong Condition	A=4 B=1, 46%	A=1 B=1, 69%	A=3 B=3, 76%	A=1 B=4, 83%
Weak Condition	A=3 B=1, 39%	A=1 B=1, 62%	A=3 B=3, 74%	A=1 B=3, 84%
2-Break Condition	A=4 B=3, 69%	A=1 B=1, 68%	A=3 B=3, 80%	A=3 B=4, 86%

1. Snedeker, J., Trueswell, J., (2003). Using prosody to avoid ambiguity: Effects of speaker awareness and referential context. *Journal of Memory and Language, 48*. 103-130.

2. Schafer, A., Speer, S, & Warren, P. (2005). Prosodic influences on the production and comprehension of syntactic ambiguity in a game-based conversation task. In Tanenhaus & Trueswell (Eds.) *Approaches to Studying World Situated Language Use*. Cambridge: MIT Press.

3. Carlson, K., Clifton, C., Fraiser, L. (2001). Prosodic boundaries in adjunct attachment. *Journal of Memory and Language, 45*. 58-81.

4. Marcus, M., & Hindle, D. (1990). Description theory and intonation boundaries. In G. Altmann (Ed.), *Cognitive models of speech processing*, Cambridge, MA: MIT Press.