

## Implementing and testing theories of syllable structure

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While researchers agree that the nucleus “goes with” the coda rather than the onset in English CVC syllables containing a lax vowel, at least two ways to implement this notion in a theory of syllable structure have been proposed. One view is that the rime is assigned a node in the tree structure while the body (onset+nucleus) is not (Figure 2A, e.g., Fudge 1987). Since a node is something that can be associated with something else, this theory predicts that a constituent (e.g., an affix) should be easier to associate with another constituent (e.g., a rime) than with a segment string that crosses a constituent boundary (e.g., a body). The alternative is that the nucleus-coda link is stronger than the onset-nucleus link (Figure 3A, Vennemann 1988, Lee 2006). Under this view no difference in associability between bodies and rimes is expected.

An experimental method to evaluate models of syllabic constituency based on evidence from associability is introduced. The method, XOR learning, is designed to distinguish between associability of a syllabic constituent and associability of its component segments. Subjects learn to associate the whole with a different response than the response both of its parts have been associated with. For instance, if subjects have learned that /CæC/ stems and /CVʃ/ stems co-occur with /mɪn/, they subsequently learn that /Cæʃ/ words co-occur with /num/.

We apply the method to the onset-rime organization of English CVC syllables with a lax vowel, showing that with the same amount of training native English speakers learn rime-affix associations but do not learn body-affix associations (generalization accuracy of learned rime-affix associations to novel syllables is 74% while generalization of body-affix associations is 50% accurate, as shown in Figure 1). This difference in associability between bodies and rimes is observed in the absence of differences between onsets and codas, the only parts that bodies and rimes do not share. Prefixes and suffixes are not found to differ in associability, indicating that the difference in associability between rimes and bodies is not due to the fact that the rime follows the body. Suffixes follow prefixes but do not differ from them in associability.

A computational framework for modeling syllable structure is presented. A syllable is represented as a network consisting of nodes representing units extracted from the signal and links connecting those nodes to each other. During processing, activation is assumed to spread between the connected nodes. The higher the resting activation level of a syllabic constituent, and the more activation it receives from other nodes, the easier it is to associate with other units that are presented at the same time, such as affixes.

We show that in order to predict that the rime is easier to associate with an affix than the body is while codas are as associable as onsets, one needs to either assume that the rime node has a higher resting activation level than the body node or that segment→rime connections are stronger than segment→body connections (Figure 2B). Strengthening the nucleus-coda connection relative to the onset-nucleus connection does not produce the observed asymmetry in associability between the rime and the body even if activation from the segments can reach the constituent nodes (Figure 3B).

Given our result that rimes are more associable than bodies overall and Lee’s (2006) finding that individual rimes and bodies vary in how much they behave like a unit in serial recall, we argue that an adequate model of syllable structure should be gradient and hierarchical at the same time. As Lee (2006) argues, co-occurrence should influence constituency but its influence should be manifested in an increase of the resting activation level of the appropriate constituent node and/or part-whole connection strength, not segment-segment connection strength alone.

References:

- Fudge, E. 1987. Branching structure within the syllable. *Journal of Linguistics*, 23, 359-77.  
 Lee, Y. 2006. Sub-syllabic constituency in Korean and English, PhD Dissertation, Northwestern University.  
 Vennemann, T. 1988. The rule dependence of syllable structure. C. Duncan-Rose and T. Vennemann, eds. *On language*, 257-83. London: Routledge.

Figure 1. Rimes are more associable than bodies

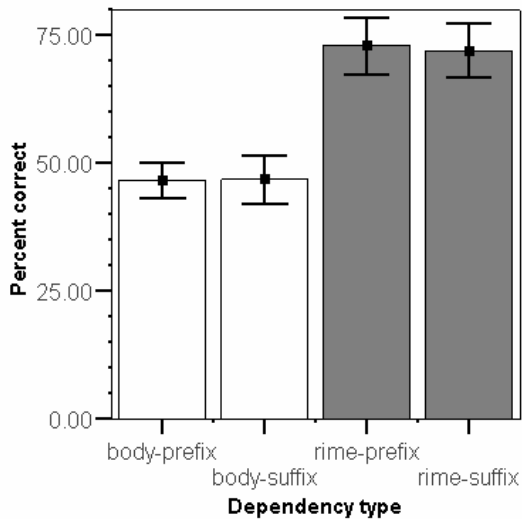


Figure 2. Models that can explain the data

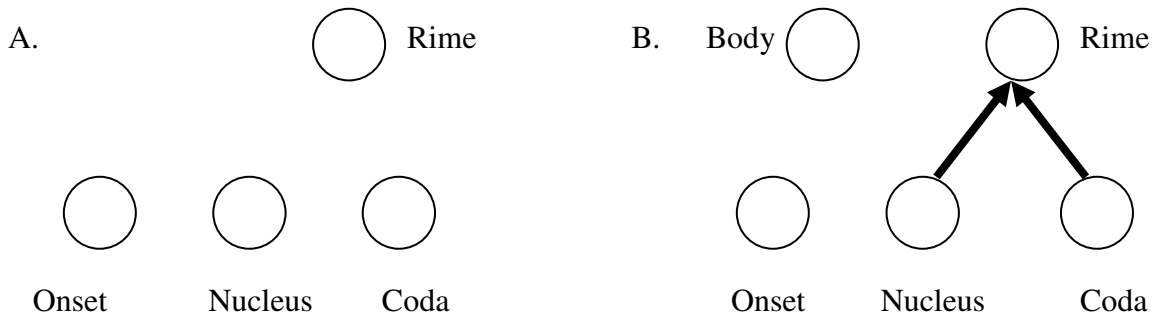


Figure 3. Models that cannot explain the data

