

A String Theory of Syllables

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I. Is phonology {different, the same}?

How different are phonology & syntax?

Bromberger & Halle (1989) vs. van der Hulst (2005), Anderson & Ewen (1987)

Phonology *looks* a lot like syntax on the surface:

- Syllable = phrase (e.g. Levin 1985, Carstairs-McCarthy 1999): see §III
- Assimilation = agreement (cf. Samuels 2007a on harmony)
 - **im**practical vs. ***in**practical; **he** walk-**s** vs. ***he** walk-**ø**
- Onset Maximization = EPP
 - All syllables need onsets; all sentences need subjects?
- Phonotactics = subcategorization/selection
 - #tr vs. *#rt; Put the ball on the table. vs. *Put the ball.
- Possibly more

But if we look a little deeper, differences start to appear; identifying these is one goal of my larger project (Samuels, in progress). Today, the take-home message: syllables are *not* like syntactic phrases. In fact, there are no discrete syllables.

II. What properties do current theories not explain?

General questions [that I will try to answer]:

1. Why is syllabification never contrastive? (Hayes 1989, Blevins 1995)
2. Why are judgments on phonotactics clear but syllable boundaries not? (Steriade 1999, Blevins 2003)
3. Why don't processes like infixation, reduplication, etc. make clear use of syllables? (Moravcsik 1978, Yu 2007, Samuels 2007b)
4. Why do some segments appear not to be syllabified? (Hyman 1985, Vennemann 1988)
5. Why do codas/word-final consonants and onsets/word-initial consonants behave alike? (Kurylowicz 1948, Scheer's 2004 coda vs. coda mirror)

Cross-linguistic typology: onsetless, branching onset, simple coda, branching coda, superheavy, appendix...

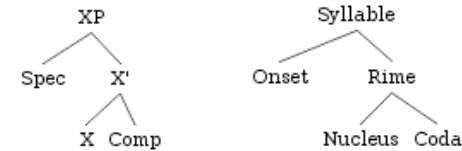
6. Why, if syllabic structure is part of UG, is there all this variation beyond CV?

Proposed internal structure: onset, nucleus, body, margin, pre-margin, margin core, head, coda, rime, mora...

7. Can these replace the syllabic node entirely? (GP; Aoun 1979, Harris 1994)
8. Which of these are actual constituents? (see Blevins 1995: 212)
9. Where do onset/coda asymmetries come from?

III. Syllables are not like phrases

(1) Traditional (Fudge 1969; Rennison & Neubarth 2003 explicitly X')



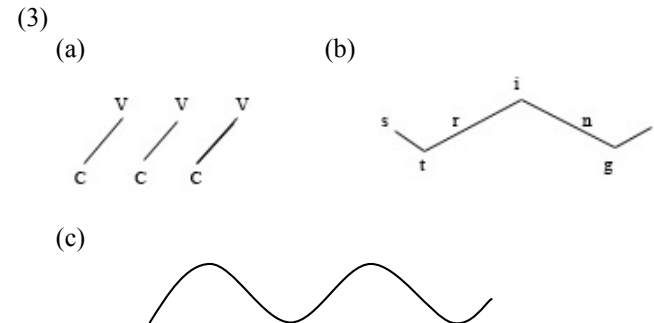
(2) Mirror Theory (Brody 2000, van der Hulst & Ritter 2003)



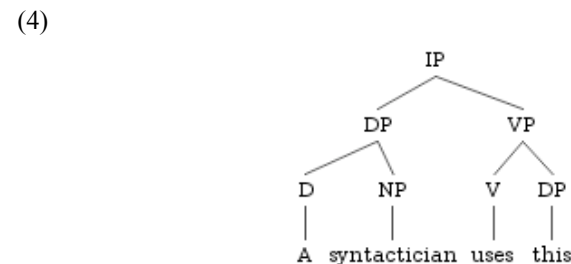
Syntax yes, phonology no: Endocentricity, headedness, recursivity (Tallerman 2006, Carr 2006, Hornstein 2005)

Phonology yes, syntax no: Sonority, ambisyllabicity

Syllable shapes range from (3a) to (3b), but when multiple syllables are concatenated, they all produce the basic sonority profile in (3c):



Contrast the shape in (3b) with (4), a typical syntactic structure:



IV. A string theory of syllables

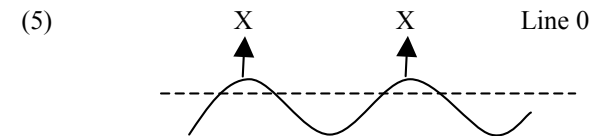
“Just by virtue of seeking detectable changes in the acoustic signal one would create as an epiphenomenon, i.e., automatically, a sequence showing local maxima and minima in vocal tract opening or loudness. In a similar way one could find ‘peaks’ (local maxima) in a string of random numbers as long as each succeeding number in the sequence was different from the preceding one.” (Ohala & Kawasaki-Fukumori 1997: 356)

- a. Wavelike sonority profiles (Lepsius & Whitney 1865, Saussure 1916) as in (3c) are an inevitable consequence of differentiating the acoustic signal. This differentiation is itself an inevitable result of perception, production, and parsing factors.
- b. Given that the figure in (3c) is a wave, it can be broken up into periods (basically, Pike 1947 minus the “chest pulses”). This invariant property helps with one of the primary tasks of language acquisition & perception: identification of word boundaries. Let’s assume that one word = one period, which reduces the problem of finding word boundaries to finding local maxima/minima in the sonority wave. The main strategy: make word edges maximally different from word middles, and from each other. There are several ways to ensure unambiguous identification, some better than others:
 - i. Allow only CV – cut after you hear a vowel. [More generally: tag every word-end with a special marker – cut after that marker.]
 - ii. Allow C_1VC_2 ; pick C_1 and C_2 from disjoint sets – cut after you hear C_2 .
 - iii. Fixed placement of stress (if a substantial portion of words have >1 stressable element). Only stress counting from the *back* of the word allows for progressive rather than retroactive cuts.
 - iv. Make word beginnings & ends mirror images – cut retroactively when you “bounce,” e.g., the Sonority Sequencing Principle.
- c. When a word is sufficiently long, it will subsume >1 period of the wave. Now the strategies that used to always pick out word boundaries sometimes pick out sub-lexical chunks, a.k.a syllables! (A 2000-year-old intuition supported by modern studies, e.g. Cairns et al. 1997, Gambell & Yang 2004, Swingley 2005.) This parsing happens when it can, and doesn’t when it can’t: ambisyllabicity and variable judgments are the result of failure to parse (Steriade 1999). You don’t get a choice of parses, so syllabification can’t bear lexical contrasts.
- d. Finding troughs is harder than finding peaks (known at least back to Smalley 1968, Kahn 1976). Peaks are a “closed class” of [quasi-]“functional items” (i.e., segments with sonority $>n$). Not all languages use the failsafe disambiguation strategies in (b)—evolution *favors* those properties, but doesn’t *require* them. Therefore, phonological processes can’t normally depend on accurate trough location, and when they can, this fact is typically obscured (Samuels 2007b).

Now we ask: *could this be all there is to syllables?* I say yes. Guiding question: to determine “how little can be attributed to UG while still accounting for the variety of I-languages attained” (Chomsky 2007: 4).

An inspirational quote from Kahn (1976:33ff): “There need not correspond to every pair of adjacent syllables a well-defined syllable boundary.... It would seem reasonable to maintain, then, that while *hammer* is bisyllabic, there is no internal syllable boundary associated with the word. As an analogy to this view of syllabic structure, one might consider mountain ranges; the claim that a given range consists of, say, five mountains loses none of its validity on the basis of one’s inability to say where one mountain ends and the next begins.” But Kahn still wanted to assign structure, and I don’t think it’s necessary.

Lexical representations are linear strings, but some phonological processes (such as stress assignment) can access sonority profiles. In particular, everything above a language-specific sonority cutoff is transferred to the metrical grid, and the distance between these peaks determines metrical weight:



The number & sequence of segments in a period emerges in a self-organizing system from a number of articulatory (articulatory OCP – Walter 2007; jaw cycle – Redford 1999) and perceptual (asymmetric cues – Ohala 1990, Côté 2000; perceptual metathesis – Blevins & Garrett 2004) factors combined with memory limitations (subitization – Kaufman 1949; Magical #7 – Miller 1956). See Redford et al. (2001) for computer simulations producing an accurate distribution of syllable shapes & frequencies from constraints similar to these.

V. Explanation without syllabification

The phenomena used to motivate the syllable fall into three basic types (as in Kenstowicz 1994):

1. Phonotactics: segment sequencing constraints
2. Economy: rules simplified by references to syllable boundaries
3. Explanatory adequacy: operations best understood in terms of syllables

Even early proponents of the syllable conceded that “all phonological processes which can be stated in a general way with the use of syllable boundaries can also be stated without them” (Vennemann 1972). The issue is not one of necessity.

- Steriade (1999), Côté (2000), & Blevins (2003) argue that **phonotactics** are best understood as string-based and syllable-independent (Steriade’s Segmental Autonomy); syllable-based accounts are in many cases

inadequate and fail to capture emergent universals. Heinz (2007) has great success modeling phonotactics with bigram and trigram languages.

- The **economy** argument cuts both ways. A UG without syllable structure is more economical than one with it: the traditional model of syllables (or sub-syllables) requires radically enriching lexical representations and/or positing a phonological module that will syllabify and re-syllabify strings as warranted.
- Appealing directly to principles of perception, production, cognitive organization, etc. is (at least) as **explanatory** as appealing to syllables. Whether these operate synchronically and/or diachronically is another issue.

VIII. Conclusions

- If I'm on the right track, "syllables" are the inevitable result of perception, memory, and parsing, but they're not part of "narrow phonology." Here and below, there is no constituency, just linear strings of segments in the style of Raimy (2000). Phonological representations are much "flatter" than previously thought, as argued by Neeleman & van de Koot (2006). Peaks (vowels) provide the interface between linear phonological structure and hierarchical prosodic structure. Phonological processes therefore must be reformulated in a way consistent with this picture. This is the effort undertaken by Samuels (in progress).
- Already there have been successful accounts of phonological phenomena consistent with this view—see references above re: phonotactics. Long-distance dependencies in phonology can be computed over linear strings, using simple search & copy algorithms (Mailhot & Reiss 2007, Samuels 2007a). I argue (Samuels 2007b) that the attested typology of affixation and reduplication—which crucially do not refer to syllables—can be generated with the same search procedure, combined with a concatenation process.

IX. References

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