Recursivity in phonology – what can it mean below the word?

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In the wider area of linguistics, recursivity as a feature of formal grammars is generally accepted, though there is violent disagreement about whether, as Chomsky (1999) claims, recursion, in the form of Merge, is part of fundamental human cognition. Its acceptance in formal grammars does not entail that actual human language has recursion: while every child can understand and produce *iterative* or *tail-recursive* structures such as the English folk poem 'The house that Jack built' (Fig 1), where a main clause can be forgotten as soon as its sub-clause is entered, nobody naturally uses more than two or very occasionally three levels of centre-embedding (Karlsson 2007), although deeper constructed examples may be comprehensible (Fig 2). It can therefore be questioned whether the speaker's natural grammar (which is not the same as the artificial grammars used by deliberate intent in writing) is indeed recursive, rather than having explicit rules for level 1 and 2 and perhaps 3. Nonetheless, I will not raise that question here.

Supra-word prosody is, in principle, amenable to a similar treatment: prosodic phrases might be formally unboundedly embeddable, though whether any human would realize more than two levels other than as a deliberate artistic construct is doubtful. Below the word, however, I argue that whether recursivity exists is simply a meaningless question, as there is no possible test for it. I examine briefly some proposals for recursion below the word.

A prominent proponent of recursive syllables is van der Hulst (2010), who posits that (a) codas may be seen as degenerate syllables (as in GP) *subordinate to the nucleus* (as not in GP); and (b) dactylic feet should be represented as in Fig 3. van der Hulst states that all V's are the same category, the labels being purely for the reader's convenience, so while he describes this as level 2 recursion of syllables, it is in fact level 4 recursion of the V category. There is no real evidence of actual level 4 recursion in syntax (where unbounded recursion is in principle possible), and minimal evidence of level 3 recursion, and it seems implausible that prosody should be more recursive than syntax. van der Hulst argues that his analysis captures the special nature (in rhyming etc.) of the initial onset: it is directly dependent on its head, rather than deeply embedded. It is unclear why this special nature is more transparent than just being the initial syllable onset in a traditional ternary foot (Fig 4).

The key argument against a recursive analysis is the very essence of recursion itself: if a class X is defined by recursive constructors from some base elements, then all elements of X must behave identically with respect to class operations such as embedding (Fig 5). If such operations can count the depth of embedding, we are no longer dealing with the class X, but with its individual 'approximants' $X_0, X_1, X_2, \ldots$, each of which is a finite non-recursive structure. In the case of van der Hulst's proposal, we may better call the approximants 'nucleus, rhyme, syllable, foot, superfoot' (see *op. cit.* p. 313) than claim there is a single class V.

A very different use of recursion below the word is the use of tree structures to represent the phonological content of a segment: feature geometry, element theory in general and GP2.0 in particular. The deepest feature tree I am aware of is Güldemann's (2016) proposal for common Khoisan phonology, which uses binary trees of depth nine to represent segments. Nonetheless, this is a way to organize a fixed, finite, set of features, rather than an in-principle unbounded use of recursion. Pöchtrager's (Kaye and Pöchtrager 2013) use of structure reaches depth 2 or 3 (Fig 6), but it appears it could go deeper to accomodate more complex vowel systems. Here again, the limit is imposed by the human ability to distingish sounds, rather than by our general difficulty in managing deep stacks of information, so I would argue that this too is not true recursion – but it is a better candidate than prosody, provided one buys the element-theoretic argument.

In summary, a convincing argument for recursion below the word requires at least *potentially* unbounded recursion, which does not exist.

This is the farmer sowing the corn,
That kept the cock that crowed in the morn,
indefinitely extensible
… the cat,
That killed the rat,
That ate the malt
That lay in the house that Jack built.

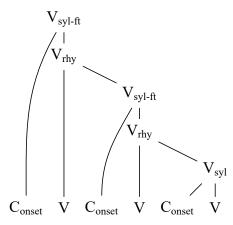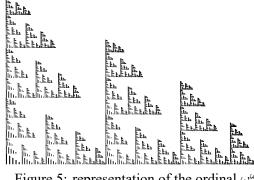Figure 1: extreme tail recursion (*traditional*)

Entweder
 die Sprache,
  die Kinder
   von ihren,
    sich an den Haaren zerrenden
     Eltern
    lernen,
   ist Deutsch,
oder sie sind dumm.

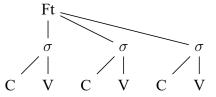Figure 2: extreme centre embedding (Hurford 2012, 257)

Figure 3: redrawn ex. 13 of van der Hulst 2010

Figure 4: ternary dactyl

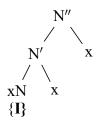Figure 5: representation of the ordinal ω^ω

Figure 6: segment structures in GP2.0

References

Chomsky, Noam (1999). *Derivation by Phase*. MIT occasional papers in linguistics. MIT, Department of Linguistics.

Güldemann, Tom (2016). Phonological regularities of consonant systems in genetic lineages of Khoisan. In Vossen, Rainer and Wilfrid Haacke (Eds.), 2016. Rüdiger Köppe Verlag. Original work published 2001.

Hurford, James R. (2012). *The Origins of Grammar: Language in the Light of Evolution II*. OUP Oxford.

Karlsson, Fred (2007). Constraints on multiple center-embedding of clauses. *Journal of Linguistics 43*(2), 365–392.

Kaye, Jonathan and Markus A. Pöchtrager (2013). GP 2.0. *SOAS Working Papers in Linguistics 16*, 51—64.

van der Hulst, Harry (2010). A note on recursion in phonology. In *idem* (Ed.), *Recursion and Human Language*, Studies in generative grammar. De Gruyter Mouton.