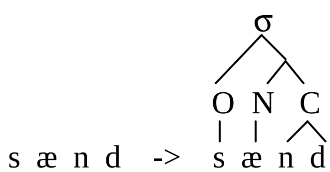
Against Syllabification

Chris Golston, Heinrich Heine University
Tilburg Conference on the Derivational Residue

0. Introduction*

Any theory of phonology with more than one level of representation comes face to face with the issue of syllabification in (1):

(1) Syllabification: How do forms acquire prosodic structure?



In this paper I argue that the process of syllabification is best understood as a non-issue. Its very existence relies on an assumption for which there is no evidence, the claim that prosodic structure is acquired at all. Syllabification is only necessary given the two assumptions in (1), the first of which I'll show to be wrong:

(2) PROSODIC UNDERSPECIFICATION

a. Underlying forms are not syllabified.
b. Surface forms are syllabified. (So there must be syllabification.)

A major indication that something about (2) is amiss comes the fact that it entails the unlikely claim made in (3):

(3) THEOREM OF IMPOSSIBILITY

Every underlying form is an impossible surface form and vice versa.

---

* This paper was prepared as part of SFB 282 Theory of the Lexicon, a federally funded German research project. I'd like to thank my colleagues Marcus Walther and Richard Wiese for their help on a number of matters. They probably agree with little of the paper, however, and should not be held accountable for any of it.

IMPOSSIBILITY immediately calls into question the psychological reality of Prosodic Underspecification as sketched in (2). If understood as a psychologically real model, IMPOSSIBILITY seems to require (3):

(4) Speakers cannot store things that they can say and vice versa.

How or why a species would develop a language system as inefficient as this is not clear. Why should something as fundamental to language as the syllable be left out of underlying form?

The goal of this paper is to bring syllable structure into underlying representation and avoid the THEOREM OF IMPOSSIBILITY. The keys ideas are that the linear order of syllabic positions within a syllable is predictable (5) and that the linear order of sounds within a syllabic position is predictable (6):

(5) Universal left-right order of syllable constituents

Within Syllable:	Onset > Nucleus > Coda

(6) Universal left-right order of sounds[1]

Withing Onset and Coda:	less sonorant > more sonorant
Within Nucleus:	more sonorant > less sonorant

Given that the information in (5) and (6) is not contrastive in any language, we may safely factor it out of underlying representation, along with the linear order it entails. Briefly, we know the answer to (7) because we know that the principles of linearization in (5) and (6) hold in English:

(7) Think of an English word in which

[¾] is in the nucleus
[m] is in the coda
[p] is in the coda
[t] is in the onset
[s] is in the onset

Given the syllabic organization of a set of sounds the linear order is completely predictable. This paves the way for a theory of representation in which there is no distinctive ordering of sounds; only syllables

---

[1] Here and elsewhere I use the neutral term *sound* rather than *segment*. The means of representation argued for here uses no segments, root nodes or paths (Archangeli and Pulleyblank 1995), only features and the syllable nodes Onset, Nucleus and Coda. I will not try here to justify the exclusion of structure between features and these nodes, something which would lead far beyond the topic of this paper.

may be distinctively ordered with respect to one another and many languages do not even allow this. A similar argument has been made within Direct Optimality Theory (Golston 1995) where linear order plays no role whatsoever; a subsidiary point of this paper is that such a means of representation is for the most part not tied to Direct OT, to OT in general, or to any other approach to phonology. Rather, it is a means of representation available to any theory, derivational or constraint-based, monostratal or polystratal: most lexical organization is syllablle-based, not linear. The main difference between Direct OT and other theories of phonology is that the former requires no distinctive ordering of sounds or syllables whle the latter require distinctive ordering only of syllables. No language makes distinctive use of the linear order of sounds.

The paper, however, *is* organized linearly. I begin by showing that there is no empirical evidence for (2a) and a good deal against it (¤1). I then sketch a very lean theory of represention that incorporates syllable structure and demonstrate that it obviates the need for stipulating the linear order of sounds within a lexical formative (¤2). Implications for phonological theory are dealt with next (¤3), followed by a short conclusion (¤4).

1. Evidence for and against underlying syllable structure[2]

I begin with a simple observation:

(8) There is no empirical evidence against underlying syllable stucture.

There are a number of quasi-theoretical considerations that have led linguists to eschew underlying syllabification (see eg Blevins 1995), but they all address having *both* syllable structure *and* the linear order of sounds specified underlyingly, a possibility obviously fraught with redundancy and one which I will not pursue either. Rather I show that the only need for distinctive linear order involves the ordering of syllables, not of any sub-syllabic entities.

So what evidence is there in favor of underlying syllable structure? Here we can distinguish two broad types, linguistic and psycho-linguistic evidence.

1.1 Pyscho-linguistic evidence for underlying syllables

---

[2] This section relies heavily on parts of Golston (1995b).

The best evidence we have in this area comes from when speakers have problems in accessing words; this arises in tip-of-the-tongue (TOT) states when a speaker can't remember a word and from speech errors in which a word is mis-selected. Studies of both show that syllable structure is stored as part of the mental representations of words. To the extent that we may use stored forms as evidence for underlying forms, this can be taken as evidence for the psychological reality of underlying syllable structure.

TOT States

Brown & McNeill (1966) showed that speakers who cannot think of a word tend to know (i) the initial sound or onset (ii) the number of syllables and (iii) the stress pattern.

(9) 'What do you call the thing sailors navigate with?'

		Onset	Syllables	Stress
Wrong but common answers:	sextet	s	2	(x.)
	secant	s	2	(x.)
Correct answer:	sextant	s	2	(x.)

Subsequent research has confirmed the results (see Levelt 1989, 320 for references); this is clear evidence that the syllable count of a word is stored in addition to its segmental make-up. TOT states are precisely those in which most of the featural make-up of the word is not retrieved, so it cannot be that a speaker who knows the number of syllables in a word does so on the basis of its sounds.

A related bit of evidence is that speakers can generally complete tasks such as the following relatively easily:

(10) How many syllables in

Tilburg
Abernathy
Alaska

Tasks that require counting sounds, on the other hand are noticably more difficult:

(11) How many sounds in

Tilburg
Abernathy
Alaska

This is surprising if speakers store words in terms of sounds and quite expected if they store them in terms of syllables.

Malapropisms

Sound-related substitutions (Fromkin 1973) or malapropisms (Fay & Cutler 1977) are speech errors based on phonological similarity alone. Typical cases include (from Fay & Cutler):

(12) Malapropisms

<u>Intended</u>		<u>Spoken</u>
week	>	work
open	>	over
constructed	>	corrected

As we saw with TOT states, onset, syllable count and overall prosody match up in the intended and spoken utterances, a general property of malapropisms. The usual explanation of this is that the spoken word is wrongly accessed because of its similarity to the intended word. This is possible only if speakers store the information that makes such pairs similar.

1.2 Linguistic evidence

Two types of phenomena call for representing syllable structure underlyingly: reduplication and minimality requirements. Both are well-known in the literature, but it seems that they have not been taken as evidence for underlying syllable structure in the past. The goal of the present section is to lay out how they provide such evidence.

Reduplication

Since Marantz's influential article on reduplication appeared in 1982 it has become a commonplace to treat reduplication as the affixation of an empty template (McCarthy & Prince 1986, Steriade 1988). The import of such analyses for the present discussion lies in the nature of such a reduplicative template. In whatever shape it takes—syllable, heavy syllable, foot, word—it is a piece of pure prosody. The prosodic part is obvious and the underlying nature of it should be too: if the sole underlying representation of a reduplicative morpheme is an element of prosody, the case is made that prosody is underlying. The fact that most cases of reduplication involve *syllable* sized templates provides ample evidence for underlying syllable structure.

McCarthy & Prince (19xx) have recently proposed a non-templatic analysis of reduplication in OT. But their analysis has the equivalent: a constraint that requires the reduplicant to be of a certain prosodic size (syllable, foot, word). Whether the shape of a morpheme is expressed templatically or in terms of constraints, the fact that the only invariant property of a morpheme may be its prosodic category (light syllable, etc.) is enough to make the claim I am after here. Far from being a purely surface phenomenon, syllable structure (and other units of the prosodic hierarchy) can signal meaning as well as any (other) distinctive feature. This is the basic tenet of Prosodic Morphology (McCarthy & Prince 1986, 1990, 1993, 1995).

Root Shapes

Minimality requirements on roots provide a different type of evidence that syllable (and other prosodic) structure is part of underlying representation.

Most work on minimality in Prosodic Morphology has been concerned with a foot minimum: many languages require that lexical roots be minimally bimoraic, a property of feet. But languages which require roots or words to consist of exactly a syllable are just as common. Chinese and Vietnamese are well-known cases of languages in which morphemes and syllable are coextensive. It cannot be an *accidental* fact that every lexical morpheme in a language happens to surface with a single sonority peak, but representation in terms of segmental strings is unable to account it.

Sanskrit (Steriade 1988) and Proto-Indo-European (Golston 1995a) are similar in this regard; but in these languages it is only lexical roots that must consist of a heavy syllable. PIE had the following root shapes:

(13) Proto-Indo-European root shapes

(C)VC
(C)VR
(C)VRC

What the shapes in (13) have in common is that they are all and only the closed syllables allowed in PIE: this generalization and no other captures the fact that CV, CVV, CVCR and CVCV are impossible PIE roots. This is exactly like reduplicative templates but with featural distinctions. Again, it is hard to see how underlying syllable structure or the equivalent could not be implicated in a description of the PIE facts.

Sanskrit provides a similar case. When the laryngeal consonants of PIE disappeared in Sanskrit they went away with compensatory lengthening of the preceding vowel. This resulted in a templatic requirement that Sanskri roots be bimoraic and monosyllabic (Steriade 1988):

(14) Sanskrit root shapes

(C)VV
(C)VR
(C)VC
(C)VVC
(C)VRC

Now if roots are represented underlyingly without any syllabic structure present, this clear generalization goes unaccounted for—it cannot be an accident and it simply is not a fact about stems or words in Sanskrit, which commonly are polysyllabic.

Finally, Golston (1991) has argued that affixes may be subject to minimal size requirements as well. English, Ancient Greek and Latin derivational affixes all consist of at least a single syllable, something not true of inflectional affixes like *-s*, and *-d*:

(15) Productive derivational affixes are minimally a syllable (English, Latin, Ancient Greek)

Again, this seems to be a fact about prosodic structure in underlying forms, not in derived ones.

So much for evidence that languages make use of syllable structure in underlying representations. We turn now to how we can make use of this in designing a psychologically plausible and economic means of representation.

2. Representation with syllable structure

In this section I develop a syllabically informed method of representing Sanskrit roots (2.1). The analysis has straightforward application to monosyllabic languages like Vietnamese, of course, and I will show that it can easily be extended to languages with polysyllabic morphemes as well (¤2.2).

The driving principle will be the extraction of linear order through recognition of the universal linearity statements about sounds and syllables discussed above and repeated below for convenience:

(16) Universal left-right order of syllable constituents

Within Syllable:	Onset > Nucleus > Coda

(17) Universal left-right order of sounds

Withing Onset and Coda:	less sonorant > more sonorant
Within Nucleus:	more sonorant > less sonorant

Again, we may use the principles of linearization in (16) and (17) to factor out the non-distinctive aspects of linear order in lexical forms.

2.1 Sanskrit roots

Representative examples of Sanskrit root types are given in (18), arranged in terms of increasing complexity of rhyme. (18a) has no coda; (b) has a single sonorant coda; (c) and (d) a single obstruent coda; (e) a complex coda.

(18) Sanskrit Roots

a.	(C)V:	sta:	‘stand’	
b.	(C)VR	gam	‘go’	(R = Sonorant)
c.	(C)VC	aj	‘drive’	(C = Obstruent)
d.	(C)V:C	sa:d^h	‘succeed’	
e.	(C)VRC	band^h	‘bind’	

Let’s begin with a symmetrical CVC root like *gam* ‘go.’ Nothing has to be said about the linear order of these sounds given their syllabic affiliation. Once we know that [m] is in the coda, that [g] is in the onset and that [a] is in the nuclues, the linear order of these sounds falls out from the linear order of Onset, Nucleus and Coda. (Further underspecification of prosodic structure will be discussed below.)

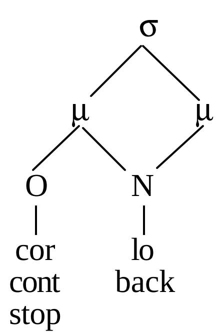
(19) [gam]
{dor, voi, stop} ∈ Onset
{lo, back} ∈ Nucleus
{lab, nas} ∈ Coda

The only possible linearization for such a form in Sanskrit is [gam]. Note again that there is no linear order stated in (19) whatsoever.

The efficiency of syllabic representation is clearest in forms with complex onsets, nuclei and codas. In a root like *sta:* ‘stand,’ for instance, the order of [s] and [t] is not contrastive and need not be given as part of underlying representation:

(20) [sta:]
{cor, cont, stop} ∈ Onset
{lo, back} ∈ Nucleus

(21) [sta:]



Again, there is thus no need to specify any of the featural ordering in [sta:], all of which falls out from universal and language particular well-formedness conditions. Nor is there any need here for segments or root notes or the like: general principles of phonology yield (21) directly from (20).

Similar considerations allow us to represent *band*^{h} ‘bind’ as (22):

(22) [band^h]
{lab, voi, stop} ∈ Onset
{lo, back} ∈ Nucleus
{cor, nas, stop, voi, spread} ∈ Coda

Again, the order of [n] and [d^h] is not contrastive within a syllable in Sanskrit (or any other language); there is thus no need to extrinsically order the features that make up these sounds.

Before turning to other issues, it will be instructive to see just how inefficient traditional linear representation is compared to the syllabic representation proposed here. Note that the spare-looking segmental representation *band*^{h} is merely shorthand for a sizable list of extrinsic linear precedence statements:

(23) [band^{h}]

voi > lo	lo > cor	nas > stop
lab > lo	lo > nas	nas > voi
stop > lo		nas > spread

The reason that stipulative linear ordering is such an inefficient way of representing a lexical form is that it takes advantage of none of what we kow about sonority sequencing and syllable structure. Indeed, the relative efficiency of syllabic representation increases with the complexity of the syllable involved.

There are many ways of expressing the information in (23), of course. An obvious way is to group the set of features into subsets (segments) and order those usbsets:

(24) [band^{h}]

{voi , lab, stop}	=	w
{lo}	=	x
{cor, nas}	=	y
{stop, voi, spread}	=	z

w > x
x > y
y > z

This cuts down the number of explicit statements that needs to be made from 8 to 7. The problem of course is that the ordering of the features that make up [n] and those that make up [d^{h}] still need to be extrinsically ordered. This is not required in a syllable-based approach because the linear order of features within an onset, nucleus or coda follows from general principles, as does the linear order of onsets, nuclei and codas.

But the problem with segmental representation of Sanskrit roots goes beyond mere inefficiency. The basic issue of course is that there is no way to keep pseudo-roots like **bad*^{h}*n* or **sata* or **mga* out of underlying representation. For although these are all perfectly awful syllables they are all perfectly well formed segment strings. Segmental represenation in terms of unsyllabified strings can neither represent Sanskrit roots efficiently nor account for why impossible roots are non-occurring.

Syllable-based representation, on the other hand, is highly efficient precisely because it makes full use of the one-syllable restriction on roots.

Underspecification of syllable structure

The representations I've proposed so far contain some unnecessary information and it will be worth considering how to reduce this to a minimum. Given that the unmarked place for vowels is in the nucleus and the unmarked place for consonants is in the onset, we should be able to mark only those features that occur in the coda and leave the rest unspecified. We might then represent *band^h* as in

(25) [band^h]
{lab, voi, stop}
{lo, back}
{cor, nas, stop, voi, spread} $\in$ Coda

This is the approach taken in Golston 1995b. But without some of the assumptions made there, this option runs into problems with the resyllabification of stem-final consonants in words like the following:

(26) [va.c-as] 'voice-GEN SG'

If the linear order of stem-final [c] is given by its affiliation to the coda in underlying representation, nothing in the present approach[3] guarantees that its linear order will remain when the segment resyllabifies into the onset of the vowel-initial suffix syllable. The suffixed form in (26) has two onsets [v] and [c] whose order follows from nothing. Since [ca.v-as] is not a possible variant of [va.c-as], something other than the coda consonant must be marked.

If we assume, following Inkelas 1995, that non-alternating structure is underlying, this problem does not occur. The non-alternating onset affiliation of [v] is underlying and [c] is underspecified for syllable position. This guarantees the linear order [vac-] regardless of whether [c] surfaces in onset or

---

3 In Direct OT the issue is solved by means of distinctive constraint violation, the sole means of representation within the theory. The post-vocalic position of [c] in vac is underlyingly encoded as a distinctive violation of a number of Align-Feature constraints which jointly demand that occur at the left edge of the root. This is only possible with distinctive constraint violation, something not presupposed in the present paper.

coda position. We are thus left with a three possibilities. We may underspecify all non-distinctive syllable affiliation, marking only onset consonants (27):

(27) [band^{h}]
{lab, voi, stop} ∈ Onset
{lo, back}
{cor, nas, stop, voi, spread}

We may mark only those syllable position which are stable, leaving codas unspecified (28):

(28) [band^{h}]
{lab, voi, stop} ∈ Onset
{lo, back} ∈ Nucleus
{cor, nas, stop, voi, spread}

Or we can mark only those sounds whose syllable affiliation is stable, leaving the final stop unspecified (29):

(29) [band^{h}]
{lab, voi, stop} ∈ Onset
{lo, back} ∈ Nucleus
{cor, nas} ∈ Coda
{stop, voi, spread}

I will not pursue these separate possibilities here; the point is that each of them is more efficient than segmental representation because each of them factors out predictable information about linear order.

2.2 Polysyllables

How do we represent polysyllabic words like *banana*? While this is not a possible root in Sanskrit, Chinese or Vietnames, it is in other languages. Since the linear order of syllables with respect to one another is not predictable from general principle, I propose that languages like Dutch, Japanese and Crow do make distinctive use of the linear order of syllables:

(30) pity (syllabic representation)

{lab, stop, hi} > {cor, stop, hi}

This is still quite distinct from segmental representation, of course, as comparison of (30) and (31) makes clear.[4]

(31) pity (segmental representation)

{lab} > {hi}
{stop} > {hi}
{hi} > {cor}
{hi} > {stop}
{cor} > {hi}
{stop} > {hi}

The point is that even in polysyllabic words, syllabic representation is much more efficient than that segmental representation.

We see then thar far from complicating underlying forms with predictable information, underlying syllable structure allows us to significantly reduce the amount of information that must be given underlyingly. The crucial step is realizing that underlying forms need not fully specifiy the linear order of the sounds they consist of, most of which is not contrastive. The representations proposed here require no redundant information whatsoever, only a minimal amount of information about features and syllable affiliation. In languages with monosyllabic formatives there is no distinctive use of linar order whatsoever.

2.3 A possible objection

I'd like to take a moment to counter an obvious objection to the non-linear representation I've proposed here. It regards the issue of strict adjacency requirements on (some) types of assimilation. Nasal assimilation in English provides a good example. Consider the well-known alternations in (32):

(32) in-sect
im-pact
in-spect

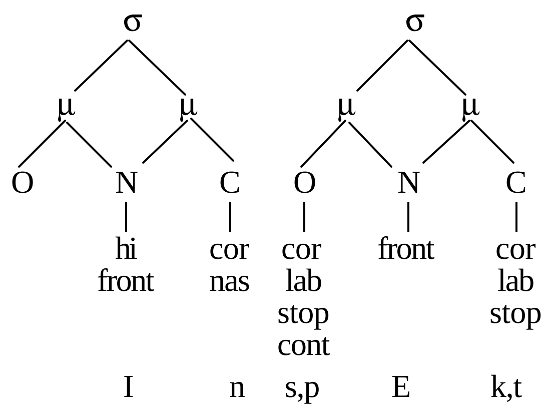
The prefix in *insect* and *inspect* ends with a coronal [n] because the following segment [s] is coronal; the prefix in *impact* ends in an [m] because the following segment [p] is coronal. This require strict adjacency of the nasal and the following obstruent to which it assimilates. And exactly this type of

---

[4] In Direct OT the features for the final two syllables distinctively violate Feature-Alignment constraints and need not be extrinsically ordered. (See note 3.)

strict adjacency is not available in the type of syllable representation I've argued for here. Consider the representation of *inspect* in (33):

(33) *inspect*



What keeps the [n] from getting the labial place feature of the following [p] if not adjacency? How do we capture assimilation of lab in *im-pact* but not in **im-spect* if not in terms of strict linear order?

We do of course need to have features linearized in surface representation, and it is precisely the surface linear order rather than the underlying linear order which is at issue. Consider a tableau of candidates for the input *in-spect*:

(34) tableau for *inspect*

	SONSEQ	CODACOND
☞ In-spEkt		
Im-spEkt		*!
Im-psEkt	*!	

The first candidate wins because it it is better formed than its competitors. The second loses because the place feature of [m] is not licensed by the following [s]—note that this adjacency is purely a matter of surface represenation, not underlying representation where the features for [m], [p] and [s] are all adjacent. The third candidate does have a properly licensed labial feature in the coda but loses out because of the impossible onset [ps]. A surface-oriented analysis of the facts does not require adjacency of [n] and [s] underlyingly.

This does not require an OT analysis. A parallel derivation can be made within Lexical Phonology by order ing the linearization of segments before the nasal assimilation rule. The first rule of phonology will then be linearization rather than syllabification; otherwise, analyses with underlying syllabified representations are the same as those with underlying linear strings of segments.

I conclude that this sort of data, at least, poses no problems for the present analysis.

3. Implications for Theory

In this section I look briefly at the role syllabification plays in *SPE* (3.1) in Lexical Phonology and Optimality Theory (3.2) and in Declarative Phonology (3.3). Each of these approaches to phonology has taken a different view of syllabification, none of which is the one argued for here.

3.1 No syllable structure anywhere

A very principled (if misguided) approach is to deny the existence of syllable structure everywhere in the phonology, the tack taken by Chomsky & Halle (1968) in the *Sound Pattern of English*. Syllabification cannot be a problem if it doesn't take place. Over twenty years of research on the issue has shown—one hopes conclusively—that this is the wrong way to proceed. If there are any supporters of syllable-free phonology left in the world the burden of proof may safely be left with them—this is not a viable answer to the problem of syllabification.

3.2 Syllable structure only at the surface: LP and OT

The more familiar way to deal with syllabification is to derive it from a set of rules (Steriade 1982; Levin 1985), templates (It™ 1986, 1989), principles (Clements & Keyser 1983, Clements 1990) or general function (Prince & Smolensky 1993) on the way from underlying forms to surface forms (see Blevins 1995, 221 ff. for an overview) The drawbacks of such analysis have perhaps not been fully appreciated.

A general theoretical liability of syllabification is that it bifurcates representation across different levels of the phonology. Within both LP and OT underlying forms are represented according to different principles than surface forms are—in particular, they are represented without syllable structure while surface forms are represented with it. This is IMPOSSIBILITY: every UR is an impossible SR and vice versa. IMPOSSIBILITY leaves both LP and OT without a coherent account of phonological representation. Beyond this shared problem, LP and OT have theory-specific problems that arise from the syllabification to which we now turn.

Lexical Phonology

Syllabification plays a major role in LP in deriving fully prosodified surface forms from linear strings of segments. In this section we shall consider how it interacts with two principles of LP, Structure Preservation and the Strict Cycle Condition.

Structure Preservation (Kiparsky 1981, 1985), a principle which bans the creation (in the lexical phonology) of structure which is not possible in underlying forms. There are various formulations of SP some narrow, some more general. The narrow view (31) is that the lexical phonology doesn't generate segments that aren't contrastive:

(35) Structure Preservation (narrow): No lexical rule generates *segments* prohibited underlyingly.

Structure Preservation is meant to keep a lexical rule of English, for instance, from creating voiceless sonorants or nasalized vowels since the latter are not possible in UR. A more principled account of SP treats it as a general ban on non-contrastive structure:

(36) Structure Preservation (broad): No lexical rule generates *structures* prohibited underlyingly.

If syllable structure is not contrastive or underlying, syllabification be ruleld out of the lexical phonology by (36). This entails that no lexical phonological rule can refer to syllable structure, bringing us back to *SPE* and the problems discussed above.

One way out of this dilemna is to restrict Structure Preservation to its narrow reading; this leaves us with no account of why syllable structur is prohibited underlyingly but allowed as a lexical rules. A more principled approach would be to allow syllable structure underlyingly; but once we admit syllable structure into underlying form there's no need for a general process of syllabification. We only need re-syllabification and we only need it across morpheme boundaries.

The Strict Cycle Condition prohibits (cyclic) lexical rules from applying in non-derived environments (Kiparsky 1982a). Taken at face value it prohibits (37a) from acquiring syllable structure until it is affixed (37b):

(37) a. Alabama *-> [A.la.ba.ma]
b. Alabama-n -> [A.la.ba.ma-n]

The point is of course that the SCC cannot be taken at face value because we known that both words in (37) surface with four syllables. Of course the SCC can be (and has been) complicated to allow syllabification in non-derived environments—essentially by claiming that a syllabified form isn't distinct from an unsyllabified form (Kiparsky 1982)—but this offers very little in the way of insight. Once we allow syllable structure into underlying form, syllabification goes away and takes with it any need to needlessly complicate the SCC.

Optimality Theory

In Optimality Theory (Prince & Smolensky 1993) syllable structure is assigned to underlying forms by a general function GEN. This is done in a single step without rules, templates or principles: any syllabification can be produced because an independently needed set of ranked and violable well-formedness constraints correctly selects the optimal (actual) form from among the others.

A suprising fact about the present architecture of OT is that most of its constraints are in principle unable to evaluate the input representations of the grammar. This includes constraints like ONSET and NOCODA, neither of which have anything to say about input like /k¾t/ or /¾kt/, which have no onsets or codas to evaluate in OT. The syllabification function of GEN is thus needed just to make evaluation *possible*. This extends the derivational residue withinin OT to the entire vocabulary of a language. Because every UR is an impossible SR, every SR must *ex hypothsi* be derived. Even short, non-alternating forms like *if* or *am* or *my* must be derived because their underlying forms cannot be evaluated by the grammar.

It should be noted, however, that nothing in the basic principles of OT dictates anything about the form that underlying representations take. This is because at present OT has no theory of representation at any level, an unfortunate state of affairs. What OT has instead is Freedom of Analysis:

(38) Freedom of Analysis: Any amount of structure may be posited.

In Prince & Smolensky 1993 Freedom of Analysis is a property of GEN: it means that on the way to surface structure GEN may supply candidates with any and all segmental, featural and prosodic material.

My proposal here amounts to generalizing Freedom of Analysis to underlying as well as surface repesentation. Inkelas (1994) has already argued that the principle of Lexicon Optimization dictates underlying represenation of non-alternating prosodic structure and I would merely add that nothing prevents this. Once we extend Freedom of Analysis to UR we open the possibility of underlying syllable. It is perhaps worth noting that underlying prosodic structure has already been incorportated into most work in OT in the form of underlying moras.

2.4 Syllable structure at the *only* level of representation

Monostratal theories of phonology like Declarative Phonology (Scobbie 1992) do away with syllabification by doing away with all phonological processes. If phonology amounts to a number of surface true statements about the featural and prosodic make up of words within a language, the process of syllabification goes the way of the dinosaur.

This is a very principled solution to the problem, but not one without its difficulties. At least some studies in this framework devise formal algorithms for yielding a syllabified string from an unsyllabified string (Walther 1992, 1993) and it is generally true of work in DP that it uses distinctive linear segment order to identify morphemes.   If the present proposal is on the right track, DP must be encoding a good deal of information redundantly by having both syllable structure and linear order represented. As far as I know, nothing prevents DP from incorportating syllabified representations and doing away with distinctive linear order, but this would seem to militate against the need for declarative syllabification.

4. Conclusion

I have proposed that syllable structure is part of underlying representation. This has a number of results for phonological theory.

(39) For Lexical Phonology, it

- allows for a general statements of the Strict Cycle Condition, and
- allows for a general statement of Structure Preservation.

(40) For OT, it

- allows constraints to directly evaluate underlying representations, and
- reduces the role of GEN significantly.

(41) For multi-stratal theories generally, it

- allows for a unified theory of representation at all levels,
- avoids the empirically vacuous THEOREM OF IMPOSSIBILITY.

(42) For all theories of phonology that recognize the syllable, it

- simplifies lexical representation significantly, and
- does away with distinctive linear ordering of sounds, and
- brings UR into line with what people actually seem to store in their heads.

The alternatives to underlying syllable structure (no syllables anywhere, syllables only on the surface, syllable structure and linear order jointly), on the other hand, seem to be empirically inadequate, theoretically unmotivated, highly redundant, psychologically implausible or some combination of the above.

References

Browman, and L. Goldstein. 1986. Towards an articulatory phonology. *Phonology Yearbook 3,* 219-254.

Brown, R. and D. McNeill. 1966. The “tip of the tongue” phenomenon. *Journal of Verbal Learning and Verbal Behavior, 5,* 325-337.

Clements , G. N. 1990. The role of the sonority cycle in core syllabification. In J. Kingston and M. Beckman (eds.), Papers in Laboratory Phonology 1: Between the Grammar and Phyusics of Speech (pp. 283-333). New York: Cambridge University Press.

Fujimura, O. & J. B. Lovins. 1978. Syllables as concatenative units. In A. Bell & J. B. Hooper (eds.) *Syllables and sounds.* Amsterdam: North-Holland.

Golston, C. 1991. *Both Lexicons*. Unpublished UCLA doctoral dissertation.

Golston, C. 1995a. Prosodic constraints on roots and words. Paper presented at the Berlin conferences on Interfaces in Phonology.

Golston, C. 1995b. Representation as Pure Markdness. Ms, Heinrich Heine University. [Available as ‘Direct Optimality Theory,’ Rutgers Optimality Archve].

Inkelas, Sharon. 1994. Lexicon optimization and underspecification theory. Ms, University of California, Berkeley/Rutgers Optimality Archive.

It™, J. 1986. Syllable theory in prosodic phonology. Doctoral dissertation, University of Massachusetts, Amherst. New York: Garland Press, 1988.

It™, J. 1989. A prosodic theory of epenthesis. *NLLT* 7:217-259.

Levin, J. 1985. A metrical theory of syllabicity. Doctoral dissertation, MIT.

Selkirk, E. 1984. On the major class features and syllable theory. In M. Aronoff and R. T. Oehrle (eds.), *Language sound structure: Studies in phonology presented to Morris Halle by his teacher and students.* Cambridge, MA: MIT PRess.

Steriade, D. 1982. *Greek prosodies and the nature of syllabification*. Unpublished MIT doctoral dissertation.

Steriade, D. 1988. Reduplication and syllable transfer in Sanskrit and elsewhere. *Phonology 5,* 73-155.

Walther, M. 1992. Deklarative Silbifizierung in einem constraintbasierten Grammatikformalismus. Diplomarbeit Nr. 862, Institut fŸr Informatik, UniversitŠt Stuttgart.

Walther, M. 1993. Declarative Syllabification with Applications to German. In M. Ellison and J. Scobbie (eds.), *Computational Phonology*, Edinburgh Working Papers in Cognitive Scinece 8.

<golston @ling.uni-duesseldorf.de>