Sign-Based Morphology:
a declarative theory of phonology-morphology interleaving

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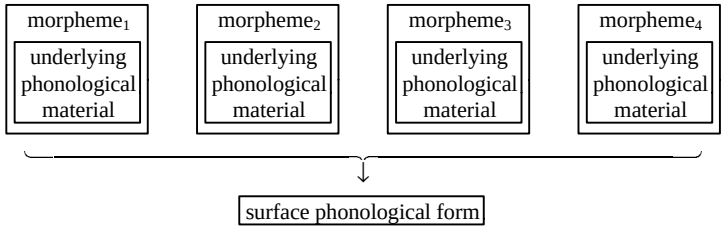
1. Setting the stage

The issue: Is phonology-morphology interleaving derivational?

When the issue of serialism is discussed, the issue of cyclic application of phonology is often not distinguished from rule ordering within a cycle, the assumption being that both are equally unacceptable in a parallelistic approach. However, these two issues are of course logically independent. The aim of this paper is to show that phonology-morphology interleaving ("cyclicity" and "level ordering") effects can be captured in a strictly declarative approach to morphology.

The non-interleaving model: a direct mapping from the set of underlying phonological strings to the surface phonological string, no intermediate strings:

(1)

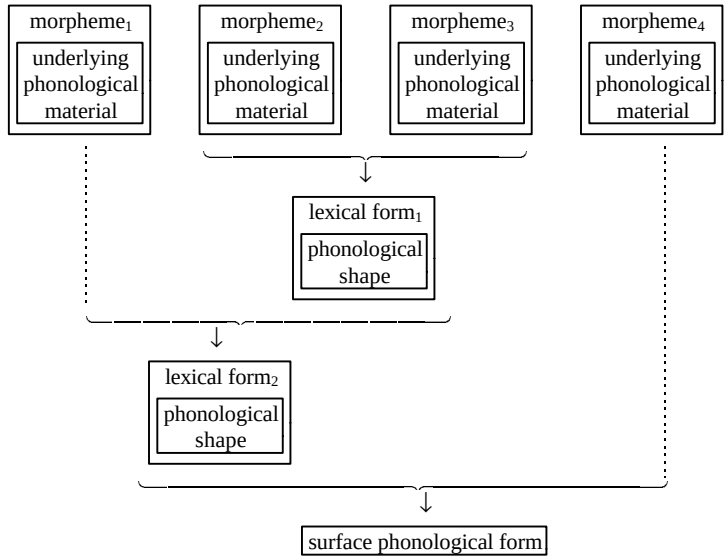


- Is there a form that consists of some other combination of morphemes than 1-4 that has an effect on the surface phonological form?

Interleaving ("cyclicity" or "level ordering"): There are forms consisting of a subset of the morphemes 1-4 whose shapes have an effect on the surface form

In a constituent structure model, these forms are subconstituents of the mother node; that is intermediate morphological constituents. The non-ointerleaving model holds it that only the terminal nodes in the morphological constituent structure are arguments to the phonological mapping—although the mapping is often made sensitive to the intermediate constituents, e.g., by defining "domains" on the basis of these constituents, or by letting alignment constraints refer to the edges of such constituents.

(2)



Common stance: Interleaving is:

- Inherently derivational (Bird 1990, Scobbie 1991, Lakoff 1993, Karttunen 1993, Kennedy 1994, Myers 1994, Zec 1994, etc.)
- Unnecessary (Cole 1990, Bird 1990, Scobbie 1991, Lakoff 1993, Karttunen 1993, Kennedy 1994, Myers 1994, Zec 1994, Cole and Coleman to appear, etc.)

The claim of this paper: both of the above assertions are false.

Part of the disagreement here is terminological rather than substantive. I use the term "cyclicity" to refer to a particular kind of phonology-morphology interaction, not to the SPE-style analysis of the same. Cole and Coleman's (1993) proposal is in fact quite similar to the one made here.

2. Interleaving effects

Observation: interleaving effects result from syntagmatic relations between lexical entries (this use of the term "syntagmatic" wil be discussed below).

2.1 Necessity

The purpose of this section is to show that constraints on intermediate morphological constituents are relevant to the ultimate surface outcome. My aim is to demonstrate this in a way that is independent of how such constraints are to be implemented.

Assuming a constituent based approach: evidence for constraints on some intermediate morphological constituent having an effect on the ultimate form.

Although constituent structure notation will be used in this paper (due to its visual appeal), the approach developed is in fact closer in spirit to the "realizational" view of morphology. See Appendix 1.

2.1.1 Turkish minimal size (Itô and Hankamer 1989, Inkelas and Orgun to appear):

(3)

a) monomorphemic forms		b) suffixed forms (min 2σ)	
ye	'eat!'	*ye-n	'eat-pass'
do:	'musical note do'	*do:-m	'do-1SGPOSS'
yut	'swallow!'	yut-ul	'swallow-PASS'
sol	'musical note sol'	sol-üm	'sol-1SGPOSS'

Repair (Orgun and Inkelas 1992, Inkelas and Orgun to appear) by adding more affixes:

(4) a) repair not possible: b) repair possible

* do:-m	'do-1SGPOSS'	* ye-n	'eat-PASS'
* do:-m-u	'do-1SGPOSS-ACC'	ye-n-ir	'eat-PASS-IMPRF'
sol-üm-ü	'sol-1SGPOSS-ACC'	yɨka-n-ɨr	'wash-PASS-IMPRF'

- The (b) forms make sense in a non-interleaving approach: the whole word is grammatical if it is two syllables.

Why then is **do:-m-u* ungrammatical?

- Answer: this must be related to the fact that **do:-m* is ungrammatical.

Interleaving: N+POSS+CASE is derived from (or related to) N+POSS. Here, since N+POSS does not exist, N+POSS+CASE cannot be derived from (or related to) it.

(5)

N	ev	do:
N+POSS (min 2σ)	ev-im	*do:m
N+POSS+CASE	ev-im-i	—

(the forms in (4) a) repair not possible: b) repair possible b) are deferred to section 3.1, example (36))

2.1.2 Schizophrenia

Schizophrenia: segments showing the effects of a syllabic position that differs from their surface syllabic position.

Kashgar Uighur (Orgun 1994) (vowel in surface closed syllable undergoes open syllable raising):

Raising: a → ɨ in stem final open syllables when followed by a suffix.

(6)

kala	'cow'	kalɨ-ɣa	'cow-dative'
tuxa	'chicken'	tuxɨ-dan	'chicken-ablative'
qazan	'pot'	qazɨn-i	'pot-possessive'
bala	'child'	balɨ-si	'child-possessive'
ana	'mother'	anɨ-lar	'mother-plural'
ameriqa	'America'	ameriqɨ-da	'America-locative'

Elision: ɨ → ∅ between identical consonants when permitted by syllable structure.

(7)

balɨlar + i	→	ballɨri	'child-pl-possessive'
balɨlar + i + ni	→	ballɨrɨni	'child-pl-possessive-acc'
kalɨlar + ni	→	kallarni	'cow-plural-acc'

This is a chain alternation: a → ɨ → ∅. The pattern of counterfeeding (e.g. in *balɨlar*, **ballar*) versus feeding (e.g. in *ballɨri*, **balɨlɨri*) itself receives a most satisfactory account in an interleaving approach. See Orgun 1994 for discussion of this point.

Schizophrenia arises through the interaction of raising with elision:

(8) qazan + i + ni → qazɨnni 'pot-possessive-acc'

Why is the underlined vowel high? (cf. qazan + ni → qazanni 'pot-acc')

- As in Turkish, N+POSS+CASE is derived from (or related to) N+POSS. Here, *qazɨnni* is derived from (or related to) *qazɨni*. That the root *qazan* 'pot' has a low vowel is not relevant. (See Hall 1994 for more examples of schizophrenia.)

2.1.3 Sensitivity to the direction of branching

2.1.3.1 Mandarin 3rd tone sandhi (Shih 1986, Sproat 1992)

(9) 3 → 2 / __3 (ǎ≡3, á≡2)

(10) zǐ 'purple' + cǎo 'grass' → zícǎo 'Lithospermum erythrorrhizon'

Sensitivity to direction of branching.

(11)

[[rǔan	[zǐ	cǎo]]	→	rǔanzícǎo
3	3	3		323
soft	purple	grass		Arnebia euchroma

(12)

[[mǎ	wěi]	zǎo]	→	máwéizǎo
3	3	3		223
horse	tail	alga		kelp

- Interleaving: The three-member compounds are derived from (or related to) the inner two-member compounds. Phonological properties of the ROOTS are irrelevant.

(13)

[[rǔan	zícǎo]	→	rǔanzícǎo	Note: environment for sandhi
3	23		323	not met

(14)

[máwěi	zǎo]	→	máwéizǎo	Note: environment for sandhi
23	3		223	is met

2.1.3.2 Slave continuant voicing alternations (Rice 1988, 1989)

The initial continuant of the second member of a compound is voiced. The initial continuant of the first member is voiceless (outranked by faithfulness, thus there are morphemes with consistently voiced or voiceless initial continuants).

(15) Possessed nouns with voiced initial continuants (underlined) (Rice 1988: 376)

Nonpossessed	Possessed	
ʃi	gah ʒin-é	'(rabbit's) song'
łuh	dezonah luz-é	'(child's) spoon'

(16) Compounds with voiced initial continuants (Rice 1988: 186, Rice 1989: 376)

kw'ih	'mosquito'	ʍé	'skin'	kw'ih-wé	'mosquito netting' (Bl)
sah	'bear'	θeh	'skin'	sah-ðeh	'bearskin'
tenih	'pot'	sél	'hook'	tenih-zél-é	'pot handle'

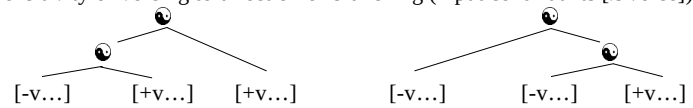
(17) Failure of voicing to apply to possessed compounds (second stem in a right-branchoing three-stem structure) (Rice 1989:34, 189, 190)

	Nonpossessed	Possessed (needs prefix)	Gloss
i)	sa-dzeé	se-sa-dzeé	'(my) watch, clock'
cf.	sa	se-za-á	'(my) sun, month'
ii)	łeh-t'éh	se-łéh-t'éh-é	'(my) bread' (Sl)
cf.	łéh	se-léz-é	'(my) flour'
iii)	sah-ðeh	se-sah-ðéh-é	'(my) bear skin' (Sl)
cf.	sah	se-zah-é	'(my) bear'

(18) Voicing applies in left-branching compounds (second member in a left-branching three-stem structure) (Rice 1989:186, 187).

da	'face'	xá	'hair'	bee	'knife'	da-ɣá-bee	'razor'
						da-ɣá	'beard'
deʃi	'wood'	tée	'mat'	ʍé	'skin'	deʃi-té-wé	'rug' (Hr)
tsá	'beaver'	ʍé	'skin'	detʃin	'stick'	tsá-wé-detʃin-é	'stretcher for furs'

(19) Sensitivity of voicing to direction of branching (input continuants [∅voice])



- Continuant voicing: [∅voice…][∅voice…] → [-voice…+voice…]

When a lexical entry of this form combined with another in a three-member structure:

- [∅voice…][-voice…+voice…] → [-voice…-voice…+voice…] (right-branching)
- [-voice…+voice…][∅voice…] → [-voice…+voice…+voice…] (left-branching)

2.2 Formal properties

- Interleaving effects are unidirectional;
- It is the morphologically more complex form that is affected:
  In Turkish, the form **do:-m-u* is ungrammatical because **do:-m* is.

(20) English (Raffelsiefen 1992, Orgun 1995)
re- verb nominalization:

fill	refíll	réfill
do	redó	rédò
make	remáke	rémàke

(21) Polysyllabic *re-* verbs do not have zero nominalizations:

redistribute	recrudesce	re-enter	reinter	reproduce
reconfigure	recriminate	re-establish	reinterpret	requicken
reascend	recycle	re-examine	reinvest	restudy

- The ungrammaticality of the morphologically more complex deverbal noun does not cause the morphologically simpler *re-* verb ungrammatical (cf. Turkish, where the ungrammaticality of the morphologically simpler possessed noun causes the morphologically more complex accusative form to be ungrammatical).

(22) In Uighur, the form *qazɨnni* has a high vowel in its penultimate syllable because the simpler form *qazɨni* has one.

(23) Impossible Uighur': Because *qazan+i+ni→qazanni* has a low V, so does *qazan+i→qazani*, although *-ni* normally triggers raising: *tuxa+ni→tuxɨni*.

(24) Also impossible Uighur'': Because *qazan+lar+i+ni→qazanlɨrini* has a low vowel, *qazan+i+ni→qazanni* has a low penultimate vowel.

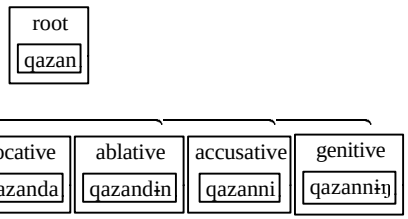
Counting the number of common morphemes two forms have may lead to this wrong result: *qazan lar+i+ni* shares three morphemes with *qazan+i+ni*, while *qazan+i* shares only two. Yet the former two forms are not "related" for the purposes of phonology. This is because the former two forms are not syntagmatically relatable.

There are chains of such relatedness:

- The form *qazɨni* has an initial [q] because *qazan* has one (etc.)
- The form *qazɨnni* has an initial [q] (and a penultimate [ɨ]) because *qazɨni* has one.
- The properties of *qazan* are irrelevant as far as *qazɨnni* is concerned.

☞Interleaving effects result from syntagmatic, not paradigmatic, relations in the lexicon.
Explication of the sense of the term "paradigm" employed here:

(25) A paradigm:



Kinds of effects one might expect in a paradigm:

- The root will have an effect on the derived forms (can be seen as syntagmatic);
- One of the derived forms might affect the root (back-formation or reanalysis);

- Any of the derived forms might affect the others. There is no guaranteed directionality to this kind of effect (also happens diachronically; paradigm leveling).

☞These are not "interleaving" effects.

- These effects are never thought to be derivational.
- The formalism to be introduced in this talk can deal with this kind of effect quite satisfactorily (see Koenig and Jurafsky 1994, Riehemann 1994).
- When one of these effects obtains, we have a case of language change.
- The resulting synchronic system can be (and often is) modeled syntagmatically.

3. Formalism

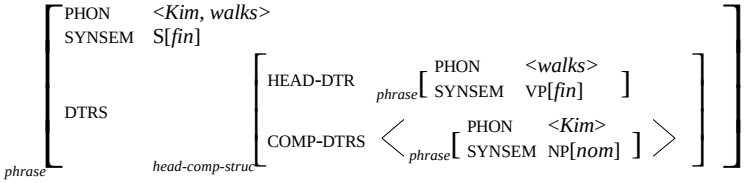
Desidarata:

- Account for the fact that "interleaving" effects are unidirectional, from morphologically simple to complex forms ("inside-out" effects).
- Account for the fact that there are "chains" of such unidirectional effects (as in the Uighur example).
- Account for "noncyclic" effects (as in the Turkish minimal size data).

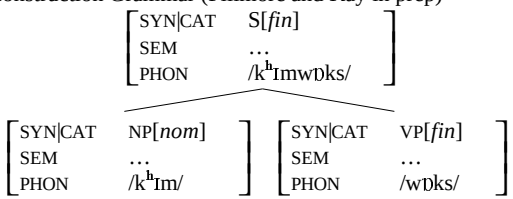
3.1 Sign-based linguistics

Basic model: a constituent based understanding of linguistic structure.
Distinguishing property: every node in a constituent structure is a complex of syntactic, semantic, and phonological information (i.e. a "sign").

(26) HPSG (Pollard and Sag 1994)



(27) Construction Grammar (Fillmore and Kay in prep)



- The SEM attribute of the top node is the meaning of the form.
- The PHON string of the top node gets pronounced.
- The constituent structure can be seen as a statement of how the top node is licensed: It is possible for the pairing of phonology and meaning in the top node to exist because the signs represented by the intermediate nodes exist, and the top node's features are related to the intermediate nodes' features in appropriate ways.

Sign-based grammars are declarative.

- A declarative grammar is a set of local tree licensing statements (Gazdar et al. 1985).
- Local tree: one node and its immediate constituents.
- A constituent structure in which every local tree is licensed (i.e. every mother node is related to its daughters in appropriate ways) represents a grammatical construct.

"Local tree licensing statements" are statements of what signs can be sisters to each other, and what features their mother must have. Examples:

- Head feature principle
- Adjunct principle

- Semantics principle
- Subcategorization principle

(28) The PHON string of the mother node must be related to the PHON strings of its daughters in some appropriate way. We will notate this as a function φ.

The choice of function is crucial. See section 4.

(29)

SYN|CAT	S[*fin*]
SEM	…
PHON	φ(/k^{h}ɪm/, /wɒks/) = /k^{h}ɪmwɒks/

SYN|CAT	NP[*nom*]
SEM	…
PHON	/k^{h}ɪm/

SYN|CAT	VP[*fin*]
SEM	…
PHON	/wɒks/

A local tree is licensed if:

- All the syntactic, semantic, etc. "feature percolation" constraints are obeyed.
- The PHON strings of the daughter and mother nodes are such that PHON_{mother} = φ(PHON_i), where *i* ranges over the daughters.

(30)

SYN|CAT	*noun*
SEM	'my do (Acc)'
PHON	/do:mu/

SYN|CAT	*noun*
SEM	'my do'
PHON	/do:m/

Invitation to sign-based linguistics

The sign-based approach to linguistics contrasts with what I call "terminal-based" approaches, in which only the terminal nodes are taken to be information bearing. Nonterminal nodes are abstract organizing units.

A terminal-based representation of the sentence *Kim walks*:

☯

SYN|CAT	NP[*nom*]
SEM	…
PHON	/k^{h}ɪm/

SYN|CAT	VP[*fin*]
SEM	…
PHON	/wɒks/

The PHON strings of the terminal nodes get pronounced after being processed by the phonological module. The SEM values of the terminal nodes are put together in the semantics module to compute the meaning.

Are there any truly terminal-based approaches to linguistics?

NO!

Every constituent structure based view of linguistics uses feature percolation.

- Category labels instantiate Head Feature percolation (especially clear if the breakdown [±N, ±V] is used).
- Within ostensibly terminal-based approaches, feature percolation is often used when convenient (see Lieber 1980 for an articulated theory; but examples abound).
- Pinker (1995) writes: "Take the English noun phrase. A noun phrase (NP) is named after one special word, a noun, that must be inside it. The noun phrase owes most of its properties to that one noun. For example, the NP *the cat in the hat* refers to a kind of cat, not a kind of hat; the meaning of the word *cat* is the core of the meaning of the whole phrase. Similarly, the phrase *fox in socks* refers to a fox, not socks, and the entire phrase is singular in number (that is, we say that the fox in socks *is* or *was* here, not *are* or *were* here), because the word *fox* is singular in number. This special noun is called the "head" of the phrase, and the information filed with that word in memory "percolates up" to the topmost node, where it is interpreted as characterizing the whole phrase as a whole." (106-7)
- Pinker describes head feature percolation, but of course some of the features of a nonterminal node will depend on non-head daughters as well (e.g. the difference between *the fox* and *a fox*)

Question: Exactly which set of features may nonterminal nodes bear?

The only non-arbitrary answer seems to be: All of them!

Hence Sign-Based Linguistics.

SYN|CAT	*noun*	SYN|CAT	…	SYN|CAT	…
SEM	'do'	SEM	…	SEM	…
PHON	/do:/	PHON	/m/	PHON	/u/

See appendix 1 for a discussion of the SYN and SEM features of affixes.

- This structure does not represent a grammatical construct of Turkish (**do:-m-u*)
- The structure is not licensed because the node **do:m* violates a phonological constraint: all nodes of this type must have a PHON string that contains two syllables.

(31)

SYN|CAT	*noun*
SEM	…
PHON	/kurumu/

SYN|CAT	*noun*
SEM	…
PHON	/kurum/

SYN|CAT	*noun*	SYN|CAT	…	SYN|CAT	…
SEM	…	SEM	…	SEM	…
PHON	/do:/	PHON	/m/	PHON	/u/

- This does not represent a possible construct of Turkish.
- The node *kurum* is not properly related to its daughters (φ(/do:/, /m/) ≠ /kurum/)
- *kurum-u* 'organization-acc' IS a possible Turkish word. However, the structure above does not represent the licensing of this word.

(32)

SYN|CAT	*noun*
SEM	'my sol (Acc)'
PHON	/solümü/

SYN|CAT	*noun*
SEM	'my sol'
PHON	/solüm/

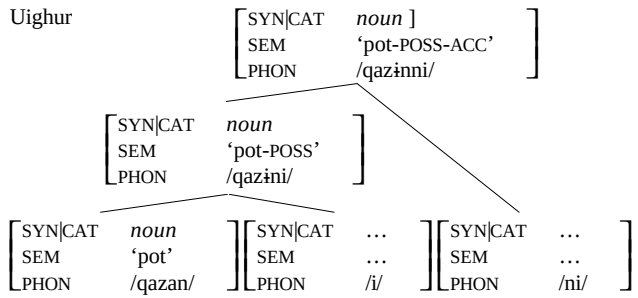
SYN|CAT	*noun*	SYN|CAT	…	SYN|CAT	…
SEM	'sol'	SEM	…	SEM	…
PHON	/sol/	PHON	/üm/	PHON	/ü/

- This represents a grammatical form of Turkish (*sol-üm-ü*).
- Every node is related to its daughters appropriately.
- Every node obeys all relevant phonotactic constraints (including minimality).
- The grammar tells us if a given construct is grammatical, not how to build constructs.
- This is what a declarative grammar is!

☞This formalism derives interleaving effects as an automatic consequence:

- We have seen an account of the impossibility of repair of subminimal Turkish nouns.

(33) Uighur



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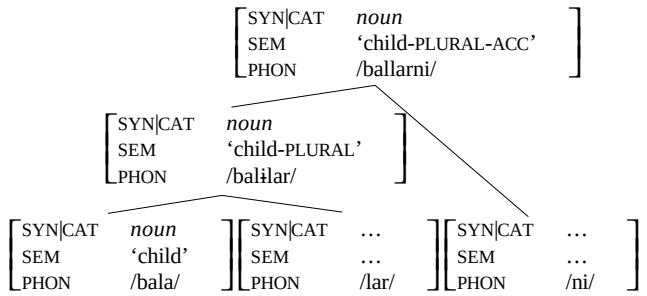


- We have dispensed with the notion that “interleaving is derivational”: interleaving effects are an automatic consequence of a sign-based declarative approach to morphology.
- “Is interleaving necessary?” is therefore the wrong question to ask. The right question is: “Are constituent structures necessary?” (since interleaving effects come for free once we assume constituent structures). Some other valid questions: “Is interleaving ever harmful?”, “What additional mechanisms are necessary?”.

How “free” is interleaving?

The mechanism that relates the syntactic and semantic features of mother nodes to the features of their daughters (certain “feature percolation principles”) appears at first sight to be different from the mechanism that relates the phonological string of a mother node to the phonological strings of its daughters (the function φ, which would be a set of ranked constraints if Optimality Theory is assumed). How “free” is it to capture interleaving effects then? First, it should be noted that syntactic and semantic “feature percolation” constraints are equivalent to two-level correspondence constraints of the kind used in Optimality Theory — that is to the faithfulness constraints in Optimality Theory. The unification based formalism is then nothing but a special restrictive kind of the general Optimality Theoretic mapping. Second, Krieger, Pirker and Nerbonne 1993 have shown that a two-level phonological mapping can be represented as an AVM, the same way syntactic and semantic feature structures are represented.

Conclusion: interleaving does not add to the complexity of the overall grammar. The two-level constraints required to implement interleaving in the phonology-morphology interface are independently needed for syntactic and semantic feature percolation.

Thus, interleaving effects indeed come for free once constituent structures are used. The simple-looking head-feature percolation mechanism that tells us that the syntactic category of an XP is the same as the syntactic category of its head daughter is all that is needed!

☞This formalism also derives noncyclic phonological effects.

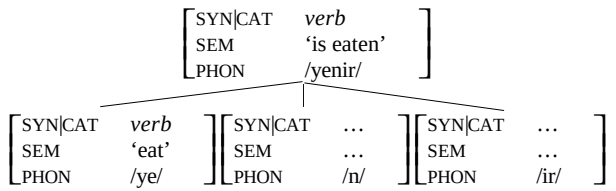
Recall: “Repair” is possible for subminimal Turkish verbs.

(35) *ye-n ‘eat-pass’ ye-n-ir ‘eat-pass-imprf’

Claim: *n*-ary branching structures must be allowed for *n*>2 (see Orgun 1994, 1995a,b).

- *ye-n-ir* has a ternary branching (i.e. “flat”) structure:

(36)



- There is no node here that violates the disyllabic minimal size condition.
- Orgun 1994, 1995a,b shows that the flat versus branching structures posited here are independently motivated by purely morphosyntactic evidence.

3.2 Word based morphology?

Assumption: The signs in a constituent structure are possible surface forms (Aronoff 1985; see Benua 1995, McCarthy 1995, for a less naive position. Note: Aronoff 1994 abandons this position).

Note: This is a stipulation that is independent of the sign-based architecture. That is, the model developed in this paper could incorporate the stipulation that all nodes in a constituent structure are words (see appendix 1 for the treatment of affixes that would be required in such an approach) (equivalent to the strictly word-based view of Aronoff 1985), or the weaker stipulation that all nonterminal nodes are words (equivalent to the Benua-McCarthy model). Since the word-based hypothesis is a stipulation that does not follow from anything in the Benua-McCarthy approach as well, the conclusion that is reached in this section (that not all morphology is word-based) is consistent with their general approach.

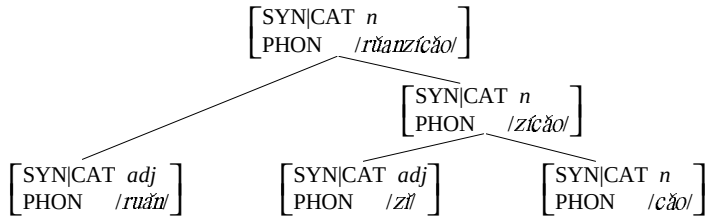
Notes on the Benua-McCarthy approach: In this approach, a number of stipulations are made: in an output-output correspondence, the morphologically simpler form has logical precedence: only the morphologically more complex form may violate wellformedness constraints so as to better satisfy identity constraints. Furthermore, output-outputcorrespondences are always stated between exactly two forms, such that the morphologically more complex form may not access the subconstituents of the “base” it is in correspondence with.

In the sign-based approach proposed here, these facts follow automatically from the basic architecture of the model—it is not necessary to stipulate them. The approach presented here has the further advantage that it can derive the lack of “cyclic” (or output-output-correspondence) effects in certain forms, where the lack of such effects correlates with independently motivated flat constituent structures. It is not clear how such “noncyclic” effects could be derived in the Benua-McCarthy approach.

It is the purpose of this section to challenge one additional stipulation in the Benua-McCarthy approach, namely that all output-output correspondences are enforced between surface forms (i.e., independent words).

Example: Mandarin

(37)



- The forms *ruǎn, zǐ, cǎo, zícǎo, rǔanzícǎo*, are all Mandarin words.
- Interleaving effects can be seen as a result of relationships between surface forms.
- This would eliminate all abstractness from the lexicon.

However: there is evidence that lexical entries are not necessarily surface forms.

3.2.1 More on schizophrenia: Turkish voicing alternations.

Obstruents alternate in voicing according to syllabic position: voiced in onset, voiceless in coda. But underlyingly voiceless obstruents do not voice (Lewis 1967, Underhill 1976, Kaisse 1986, Rice 1990, Kopkallı 1994, Inkelas and Orgun to appear).

(38)

	Alternating	Voiceless
Nominative	kanat	sanat
Accusative	kanad↨	sanat↨

Final plosives of regular 1-σ roots are consistently voiceless (Inkelas and Orgun to appear)

(39)

Nominative	at	kat
Accusative	at↨	kat↨

- If accusatives were derived from the (surface form of) nominatives, then every root should behave like the monosyllabic ones.

(40) sanat + ↨ → sanat↨ kanat + ↨ → *kanat↨

☞What is going on?

- Accusatives are not derived from a surface form. They are derived from a lexical entry that represents a generalization over surface forms: /kanaD/.

☞Why do monosyllables behave differently?

- Constraints on voicing: voiced in onset, voiceless in coda (outranked by faithfulness).
- The /D/ of /kanaD/ is not syllabified, therefore not subject to the voicing constraints.
- The final consonant of a monosyllabic form IS syllabified due to a bimoraic minimal size condition (see Orgun and Inkelas 1992, Inkelas and Orgun 1993, 1994, 1995, to appear for independent motivation and analysis. cf. Itô and Hankamer 1989). Since the final plosive of a monosyllabic form is a coda, it is voiceless.

Two ways in which lexical entries may differ from surface forms:

❶ The final plosive is not specified for voicing.

❷ The final consonant is not syllabified.

(problem for Aronoff 1985, not for McCarthy 1995, Benua 1995)

3.2.2 A bound constituent as a "cyclic domain" (i.e. a lexical entry from which others are derived, to which others are related, or over which others are built):

The Bantu verb stem passes all tests: it is a domain for many phonological processes (e.g. various tonal alternations), and is also targeted by reduplication (also see Hyman 1994, Orgun 1995 for arguments for interleaving effects within the verb stem; the arguments will not be repeated here as they are rather lengthy. The Cibemba case discussed in Hyman 1994 and Orgun 1995 is partricularly interesting). Yet the verb stem is not a possible word: it must occur with obligatory prefixes. A word based approach to morphology might lead one to the mistaken conclusion that the recursive (constituent structure) implementation of interleaving effects proposed here is wrong:

Luganda (Hyman and Katamba 1993, Peterson 1994)

te-	ba-	a-	gul-	ye	'they did not buy'
	|	|	|	|	
	H	H	H	H	
neg	3p subj.	near past	buy	tense	
			neg		

te-	tu-	a-	gul-	ye	'we did not buy'
	|	|	|	|	
	H	H	H	H	
neg	1p subj.	near past	buy	tense	
			neg		

- *tebáágúlye* and *tetwáágúlye* are presumably related to each other, but certainly not syntagmatically related.
- (erroneous) conclusion: The approach to interleaving effect presented here is wrong.

☞Although *gulye* is not a possible word (surface form), it is a lexical entry. The words *tebáágúlye* and *tetwáágúlye* are syntagmatically related to this lexical entry (stem).

- Whenever a relatedness effects is observed between forms that are paradigmatically related to each other (such as the two Luganda forms above), the source of the effect should be contained within the bound stem that the two forms are based on.
- The existence of lexical entries that are not possible surface forms should not be surprising. Compare with syntax: many of the constituents in a typical sentence are possible utterances on their own (e.g., NP, VP, N). But others are not (e.g. determiners). Similarly, in a morphological constituent structure, many of the constituents are possible words on their own, but some are not.

Other examples of lexical items that are not possible surface forms:

- Infl constituent in Sekani (Halpern 1992)
- In Navajo (McDonough 1990)
- In Shona (Myers 1992)
- In Slave (Rice 1993)
- In Nimboran (Inkelas 1993)
- Derivational morphology in any language with obligatory inflection (e.g. Latin)

(problem for Benua 1995, McCarthy 1995, as well as Aronoff 1985)

☞Interleaving effects arise from relationships between lexical entries. These lexical entries are not necessarily actual or possible independent words (or "surface forms").

3.3 Extras (pointers to related work)

This approach derives various other properties of the phonology-morphology interface:

(41)		No Interleaving	Interleaving
	Nonderivational?	✓	✓(this paper, Orgun 1994, 1995)
	Differences between cyclic vs. noncyclic effects?	By brute force (not constrained by morphological structure)	Follow from morphological structure (this paper, Orgun 1994, 1995)
	Inside-out effects?	×	✓(this paper, Orgun 1995)
	Bracket Erasure effects?	×	✓(Orgun 1995)
	NDEB effects?	At best by brute force	✓(Kiparsky 1993)

	Restrictions on cyclic phonology?	×	No reference to internal structure (Riehemann 1994, Orgun 1995)
	Restrictions on non-cyclic phonology?	×	No reference to intermediate domains (Orgun 1995)
	Identical behavior of underlying and derived structure?	×	✓ (Orgun 1994)
	Predicts that bound morphemes are not cyclic domains?	×	✓ (Orgun 1994, 1995)
	Phonological strings free of morphological information?	×	✓ (Orgun 1994)
	Deals successfully with partial regularities, marginally productive patterns, positive exceptions	×	✓(Koenig and Jurafsky 1994, Riehemann 1994)
		No interleaving	Interleaving

4. Conclusion: is there a derivational residue?

- The answer depends solely on the choice of function φ, NOT on interleaving.

Some choices for φ	Comments
SPE rules (Chomsky and Halle 1968)	Derivational. Suffers from empirical drawbacks. Linguistically not very interesting.
Finite State Transducers (Schützenberger 1961, Elgot and Mezei 1965)	Nonderivational. Formal properties known. Simple. Linguistically not very interesting. Shown by Krieger, Pirker and Nerbonne 1993 to be representable as AVMs.
2-level Optimality Theory (McCarthy and Prince 1994, 1995)	Nonderivational. Formal properties uncertain due to rapid rate of innovation. Linguistically insightful.
Extended concatenation (with disjunctions and defaults) (Bird and Klein 1994)	Nonderivational. Desirable computational properties. Some argue this to be the only choice that is "in the spirit of a monostratal approach to grammar". Accounts for only a limited range of schizophrenia effects (through ambisyllabicity—Coleman 1995).

5. Appendix: Realizational morphology

Although constituent structure notation was used in this paper, the approach presented in fact has a lot in common with realizational approaches to morphology.

Choices for the representation of affixes in Sign-Based Morphology:

(42) a) Affixes are terminal constituents.
b) Affixal material is introduced by φ.
c) Affixes are arguments to φ in affixation constructions.

6. References

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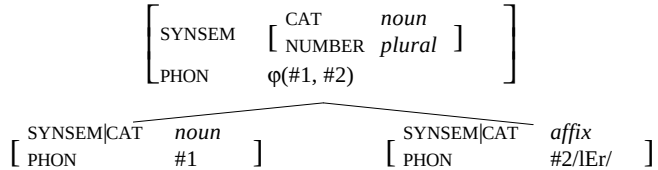
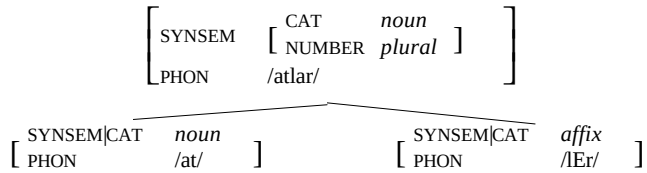
5.1 Affixes as terminal nodes (signs): (Turkish plural suffix *-ler~-lar*)

(43)



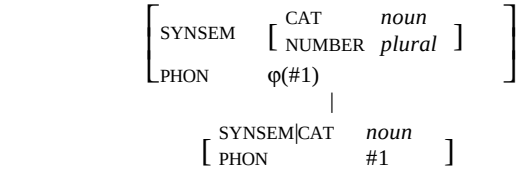
In (43) the indices #1 and #2 indicate identity. The INPUT-PHON list of the mother node could have as well be written as <#1, /lEr/>. The subscript annotation on the PHON value is a reminder that indicates some phonological alternations enforced by φ, here, vowel harmony. In (44), I show a word (*atlar* 'horses') licensed by this affixation construction:

(44)



5.2 Affix material introduced by φ (realizational morphology):

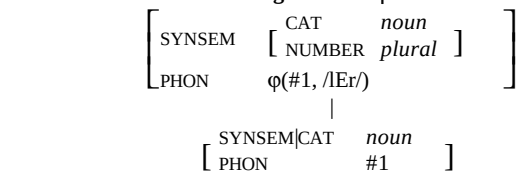
(45)



φ concatenates /lEr/ to the base.

5.3 Affix material introduced as an argument to φ:

(46)



5.4 Comparison:

(47)

φ must do:	5.1, 5.3	5.2
Phonotactics (phonological wellformedness)	Yes	Yes
Faithfulness and other correspondence constraints	Yes	Yes
Truncation and other prosodic circumscription	Yes	Yes
Addition of material for nonphonotactic reasons	No	Yes

- 5.1 is the approach in Orgun 1994a,b. Similar to "item-and-arrangement".
- 5.2: Riehemann 1994. Similar to realizational morphology (Anderson 1992).
- 5.3 is the approach taken in Koenig 1995 and Orgun 1995. It draws on the insights of 5.1 and 5.2, and avoids pitfalls that they are subject to.

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