All that glistens is not gold: against autosegmental approaches to initial consonant mutations

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GLOW 31, Newcastle University
March 26, 2008

1 Plan of talk

- Brief introduction to current thinking on (initial) consonant mutation;
- Body of the talk: autosegments are difficult to reconcile with the language's grammar
  - ☞ Agreement and prefixes in Fula?
  - ☞ Multiple allomorphs and agreement in Celtic?
  - ☞ Ordering paradoxes in Celtic
- Mutation happens in the lexicon!

2 The proposal

In order to get questions out of the way, here is a short summary of the proposal I am going to make:

- The cases I am considering here (and **only** these cases) present more than a few problems when dealt with through featural prefixation;
- I suggest that this difficulty has two main sources:
  - Synchronic mutation processes conflate several historical processes, each of which is "natural" enough but which do not have a common phonological rationale;
  - The grammar of the language is such that it has no morphosyntactic processes that could give rise to the posited prefix;
- I argue therefore that instead of trying to fit these processes into a phonological framework it is better to view mutation as accounted for in the lexicon;
- This means that mutation is already accounted for in the input to the phonology during lexical insertion;

- The productivity of mutation rules is a product of generalization over an inheritance-network lexicon;
- Most importantly: the lexicon is not simply a list of forms but it has an internal structure which makes it easier to organize learning and retrieval.

What I am **not** suggesting:

- That a phonological account is impossible for the cases I present below, or indeed for other "mutation" cases (a fraught term in itself!);
- That the lexicon has a rule component for generating new forms (à la Hayes, 1990);
- That there is a *post-phonology* declarative Control module (à la Bye, 2007);
- That all morphology is word-based and mutation is no different from things such as Case (à la Green, 2007).

3 Existing approaches

The generative approach to initial consonant mutation was at first naturally with rules (cf. Rogers, 1972 on Scottish Gaelic).

Problems with rules:

- The patterns are often impossible to capture with a single rule: Rogers (1972) needs fourteen for Scottish Gaelic, which gives rise to problems of ordering, free rides etc.;
- The triggering context for them is not clear; most works use diacritics à la Hamp (1951), but everyone agrees this is not particularly insightful.

Lieber (1983, 1987) introduces autosegmental representations; another work in this vein is Swingle (1993); Wolf (2007) is the latest spirited defense of autosegments.

Table 1: Welsh

	Plosives						Nasal	Liquids	
"Radical"	pʰ	tʰ	kʰ	b̥	d̥	g̥	m	ɬ	rʰ
Soft mutation	b̥	d̥	g̥	v	ð	∅	v	l	r

Lieber uses an autosegment $\begin{bmatrix} -cont \\ -voice \end{bmatrix}$ and the Duplicate Feature Filter:

No segment can have more than value for a feature

If a segment is underlyingly specified for a feature, the autosegment cannot contribute a value for this feature due to the DFF.

Thus, voiced stops are specified as $\begin{bmatrix} \text{Place} \\ -cont \end{bmatrix}$. The [+cont] of the autosegment cannot dock because of the DFF, so only the [+voice] docks, producing voicing. "Voiced" stops are specified as $\begin{bmatrix} \text{Place} \\ +voice \end{bmatrix}$, so only [+cont] docks, giving spirantization.

There remain two big questions:

- Where do the floating features come from?
- How does one ensure they surface?

In this talk I attempt to show that the first of these questions cannot get a satisfactory answer for at least some of the languages with initial consonant mutation.

4 Fula: prefixes and agreement

The pattern of consonant mutation in Fula (Arnott, 1970; Klingenheben, 1963; Paradis, 1992; Breedveld, 1995) is as follows:

Table 2: Fula initial consonant mutation

Grade	Voiced				Voiceless		
Continuant (F)	w	r	y	[ʔ], w, y	f	s	h
Plosive (P)	b	d	j	g	p	c	k
Nasalized (N)	mb	nd	nj	ng	p	c	k

The conditioning for mutation is as follows.

All nominal forms belong to a certain *class*. Pairs of classes are traditionally known as *genders*, and within a gender each class is marked as referring to either singular or plural.

Each noun has a suffix associated with its class (suffixes undergo significant morphophonological changes, cf. Churma, 1988, but this is irrelevant here). Moreover, each class is associated with one of the three "grades" in Table 2, as shown in Table 3

Table 3: Classes and grades in Fula

Sg		Pl	
Class	Grade	Grade	Class
O	P	F	ƁE
ŋGEL KAL ŋGUM	P	F	KO
ŋGA	N	N	KO
NDE	F		
NDI	N		
NDU	F		
ŋGA	N		
ŋGE	F		
ŋGO	F		
ŋGU	N		
ŋGAL	P	P	ƊE, ƊI
ŋGOL	P		
KA	N		
KI	P		
KO	F		
KOL	P		
ƊAM	N		
ƊUM	P		

- *debb-o* 'woman', plural *rew-ɓe*
- *yim-re*, 'song', plural *gim-e*
- *wam-nde* 'donkey', *mbammb-a* 'big donkey'

The verbal form has the structure Root (+ Extensions) + TAM (+ Subject clitic).

Forms with subject clitics are mutually exclusive with forms with no subject marking, which necessarily have an overt subject. This is illustrated by the verb *war-* 'come' in Table 4.

Table 4: A Fula verb subparadigmn

	Sg		Pl	
	PRAE	ENCL	PRAE	ENCL
1	mi warii	mbarii-mi	min mbarii	—
			en mbarii	mbarii-ɗen
2	a warii	mbari-ɗaa	on mbarii	mbarii-ɗon
3	o warii	—	ɓe mbarii	—

Table 4 exemplifies the basic rule of mutation for verbs.

☞ If the form has a subject clitic, it always has the N grade;

☞ If the form has no subject clitic, it has the F grade in the singular and the N grade in the plural.

Now suppose that mutation is handled by autosegments: for Lieber (1987), these are $\begin{bmatrix} +cont \\ -nas \end{bmatrix}$ for F, $\begin{bmatrix} -cont \\ -nas \end{bmatrix}$ for P and $\begin{bmatrix} [+nas][-nas] \\ -cont \end{bmatrix}$ for N. Paradis (1992); Breedveld (1995) assume that F is underlying, so maybe there are only two.

4.1 Nouns

In nouns, this probably means that class markers are circumfixes. This is a sore blow to realizational theories of mutation à la Kurisu (2001). These rely on constraints such as RealizeMorpheme which override some faithfulness constraints. This is shown on the tableau for Pseudo-Fula. IdentF is a non-committal shorthand for faithfulness to all features except [cont].

Table 5: Pseudo-Fula

/rebb-, CLASS/	IdentF	RealizeMorpheme	Ident(cont)
a. rebb-		*!	
b. r̥ebb-	*!		
c. ☞ debb-			*

However, this is clearly wrong: if Fula class markers are circumfixes, the candidate with mutation is always harmonically bounded by one without mutation by virtue of better faithfulness:

This point is also made by Wolf (2007) regarding Luo and Nuer (which have mutation-inducing suffixes).

Ways to save the realizational account:

Table 6: Fula

/rebbo, CLASS/	IDENTF	REALIZEMORPHEME	IDENT(cont)
a. ☞ rebbo			
b. r̥ebbo	*!		
c. ☹ debbo			*!

- Use alignment constraints to force mutation on the left edge, even though then it is not clear why the suffixes don't go away;

- Introduce a different interpretation of the morphology: for example, take the "class" notion out and have inflectional classes (the traditional "gender") and [Sg] and [Pl] features (cf. Trommer, 2007); the arbitrary "class" features still remain in the ranking;

If suffixes seem to be genuine class markers, mutation is not: the expected regular plural of *yiite* 'fire' is *giite*, which only differs in grade. This is the dispreferred form, and most dialects use the morphologically anomalous *giit-e-li* with two suffixes: Koval' (1997) argues that mutation is "not enough" to mark class. I suggest it shows that mutation does not mark class at all, and for the purposes of morphology *yiite* and **giite* are in fact noncontrastive.

If mutation in Fula nouns is induced by prefixes, then these are *the only prefixes* in the language. This is a very important generalization, and I submit that it is not to be sacrificed to the idea of autosegments.

4.2 Verbs

Mutation in forms with clitics is apparently handled in the same way, with subject circumfixes. The same reasoning applies here.

With regard to the preposed-subject forms, the prefixes must apparently be construed as number agreement.

- There are no other traces of subject-verb agreement. Moreover, paradigm in Table 4 shows that all Fula clauses have only one morpheme referring to the subject, which seems to point to lack of agreement;

- Number may not play any role in Fula grammar at all: all agreement (in the nominal domain) makes reference to class, whereas number is emergent from class and gender (but cf. above).

Especially telling is the gap at cliticized 3sg subjects. Apparently non-locutor subjects always move out of postverbal position.

The solution that I propose for Fula is based on subcategorization: suffixes impose lexically determined requirements on stems (Carstairs-McCarthy, 1987; Stump, 1995). This accounts for the nouns and cliticized subjects straightforwardly. With preposed subjects we may have to assume that these requirements are imposed before the subject markers move out of the postverbal positions. (Under the copy theory of movement, this may be even more straightforward).

The contrast between the singular clitics (F-grade) and preposed subjects (N-grade) must be explained with reference to their feature structure: apparently they have different features (connected with focus) which drive movement or lack thereof. These features allow for different subcategorization frames.

5 Multiple allomorphs

This part of the talk is concerned with multiple allomorphs of triggers which the autosegmental theories force to postulate in cases where there is no surface difference. The examples come from the Brythonic Celtic languages Welsh and Breton.

Consider again the soft mutation of Welsh (Table 7)

Table 7: Welsh soft mutation

	Plosives						Nasal	Liquids	
"Radical"	p^h	t^h	k^h	$b_\circ$	$d_\circ$	$g_\circ$	m	ɬ	$r^h_\circ$
Soft mutation	$b_\circ$	$d_\circ$	$g_\circ$	v	ð	∅	v	l	r

It is not clear straight away how these changes can be described in a uniform way in terms of features. For the sake of the argument, I grant the following:

- A single feature bundle can produce the relevant changes in the stops, without causing a chain shift and taking care of all the laryngeal features;
- The same bundle can effect the spirantization of [m] but not [n]: [ð] is available in Welsh;
- The same bundle can deal with the "liquids": there is very good evidence that [ɬ] is phonologically a spirant, not an unvoiced liquid, which opens up a can of worms (why don't we have [f]→[v]?). On the other hand, $[r^h_\circ]$ patterns with the unvoiced sonorants.

Let us call this magic bundle L. Among other things, soft mutation is caused in the following contexts:

- Feminine singular nouns undergo it after the definite article *y(r)*. However, [ɬ] and $[r^h_\circ]$ are exempt from soft mutation in this context: *cath*, *y gath* 'the cat', *cathod*, *y cathod* 'the cats'; but *y llyfrgell* 'the library' (also feminine);
- Masculine singular nouns and all plurals are unaffected by the definite article: *ci*, *y cî* 'the dog', *cŵn*, *y cŵn* 'the dogs';
- Preposed adjective modifying feminine singular nouns undergo "full" soft mutation (Morgan, 1952): *y lom aelwyd* 'the poor (*llom*) hearth';

Now assume that L triggers the full range of mutations listed in Table 7. If we think, following Hamp (1951); Wolf (2007), that autosegments are attached to the right edges of triggers, we get the following derivation:

yL cath → *y Lcath* → *y gath*

Where does the L come from? The natural answer is that we have a sort of gender agreement, like the selection of articles in the Romance languages (French *le* versus *la*). One objection to this sort of thinking is entirely parallel to the one I have referred to above in Fula: there is no other evidence that this sort of gender agreement obtains in Welsh (granted, Welsh does have a limited sort of noun–adjective agreement).

Second, it is not entirely clear how the L works. What happens if it is juxtaposed to a non-mutating segment? One solution implies that the L-less allomorph is selected before such words. This is possible, but not optimal: see below on look-aheads.

Table 8: Soft mutation of nasals

/m [−nasal +cont]/	*[ð]&IDENT[nas]	MAXFLT	IDENT[nas]	*[ð]
a. m		*!		
b. ☞ v			*	

/n [−nasal +cont]/	*[ð]&IDENT[nas]	MAXFLT	IDENT[nas]	*[ð]
a. ☞ n		*		
b. ð	*!		*	*

Alternatively, the constraint ranking may force the non-realization of L's features, but that needs a lot of theoretical machinery. Consider again the mutation of nasals: [m] mutates but [n] does not. For a feature bundle $\begin{bmatrix} -nasal \\ +cont \end{bmatrix}$ to produce [v] but not [ð] we probably need Local Conjunction (Table 8).

Similar solutions are available for other mutations which affect natural classes incompletely.

How can the same ranking can cause the mutation and non-mutation of [ɬ] and [r̥ʰ]? (Remember that the article only gets the [fem sg] feature bundle, whether the following word is an adjective or a noun does not seem to be relevant here). I conclude that we must have at least two types of mutation-triggering feature bundles: let's call them L and L'.

At this point we have the following selection criteria for the multiple allomorphs of the definite article:

- The allomorph y is selected before masculine singular and all plural nouns and adjectives (and possibly before nouns and adjectives starting with non-mutable consonants irrespective of gender and number);
- The allomorph yL is selected before feminine singular adjectives;
- The allomorph yL' is selected before feminine singular nouns.

The whole procedure is doubled by the postvocalic form of the article: [r] (orthographic *'r*), which exhibits identical mutation behaviour. Note that *a priori* this is in fact unexpected: if mutation is due to the lexical form of the trigger, the fact that [ə] and [r] cause identical mutations is in fact a random coincidence.

Other approaches:

- All instances of the article bear the L mutation diacritic, but morpheme-specific reranking blocks mutation in some contexts, or rather something like MAXFLT is promoted in the [fem sg] context (this suggestion is due to Bruce Morén p. c.; I am not aware of any published work taking this route). This still requires at least three different rankings. Note that for Breton reranking is needed anyway: Wolf (2007) describes the mixed mutation with the constraint NO VACUOUS DOCKING ranked low, but he also proposes that chain shifts (which happen in Breton) need highly ranked NOVACDOC;

Let us now turn to Breton. The mutation corresponding to the Welsh soft mutation is presented (in a simplified way!) on Table 9

This is very much the same messy situation, with slightly different features. The rules for selection run as follows:

- Select the allomorph *ar* before masculine singular nouns as well as all plurals except masculine animates. The allomorph *ar* causes no mutation except spirantization of [k] to [x] (with further voicing to [ɣ] or [ɦ] in some dialects);

Table 9: Breton lenition

	Stops							Nasal	Spirants			
Radical	p	t	k	b	d	g	gw	m	f	s	ʃ	x
Lenition	b	d	g	v	z	ɣ/x	w	v	v̥	z	ʒ	ɣ/ɦ

- Select the allomorph *arL* before all other nouns.

The incoherence of the category of feminine singular and masculine animate plurals might in fact prompt one to wonder whether it is one category or two happening to require the same mutation behaviour (as they are historically).

The Breton definite article also has surface allomorphy: *al* is used before *l* (some dialects reported to have soft mutation of *l* as well), *an* is used before vowels and *n, t, d, h*, and *ar* is used elsewhere.

The autosegmental approach forces us to postulate the following procedure:

- Look up the gender and number of the noun/adjective;
- When inserting the article, select an agreeing form with the relevant autosegment based on the grammatical and phonological characteristics of the following word;
- During phonological computation, attach the features of the article to the following noun.

It could be argued that the autosegments represent agreement morphemes (like Spanish *l**a**s*, *l**o**s*). It is difficult to reconcile with the differing behaviour of the article before nouns and adjectives in Welsh.

Most importantly, there exists a body of psycholinguistic research (Tainturier et al., 2005; Thomas and Gathercole, 2007) which shows that mutation is a cue for gender in Welsh, but not its exponent: children acquire mutation much later than gender, and it is possible to have good access to the mutation system with severe impairment of the gender system.

Under the autosegmental account, mutation is an epiphenomenon of the properties of the trigger, and the differing forms on the surface are due to the fact that the trigger selects different allomorphs. However, the properties of the trigger are, in turn, read off the properties of the target.

This is a very convoluted way of saying that feminine singular nouns mutate and masculine ones don't. Autosegmental accounts force us to lump several historically distinct processes into one feature change: every single process may be "natural" enough, but their composition is not necessarily so. The lexical insertion account I suggest below is much more straightforward.

- Welsh soft mutation also happens in an environment where any sort of affixation is unexpected (originally proposed by Borsley and Tallerman, 1996, now see Borsley et al., 2007 for the most up-to-date discussion):

  > XP triggers soft mutation on the initial consonant of the right-adjacent constituent which it c-commands

6 Ordering paradoxes

Hannahs and Tallerman (2006) describe the allomorphy of the Welsh article. As noted above, in Welsh soft mutation [g] disappears: words like *gardd* 'garden' have vowel-initial forms like *ardd*. The presence or absence of an onset influences the form of some proclitics: *yr ardd* 'the garden' versus *y gêm* 'the game'.

It turns out there are two types of such interaction in Welsh. The definite article *y(r)* is sensitive to the post-mutation form, as shown above. On the other, the negative complementizer *na(d)* is sensitive to the pre-mutation form: *na chafodd* 'that (s)he did not get', but *na all* 'that (s)he cannot' (from *gall* '(s)he can'). Hannahs and Tallerman (2006) propose multi-layered lexical insertion:

Table 10: Lexical insertion in Welsh

	NEG be.able.PRS.3SG	DEF garden
Insertion of *nad*	na gall	—
Mutation	na all	ardd
Insertion of *y(r)*	—	yr ardd
	na all	*yr ardd*

I present a similar case from (Standard) Irish; Scottish Gaelic is similar.

The past tense stem is formed by lenition (a type of mutation) of the first consonant of the stem: *bris* 'break', *bhris* [vʹrʹiʃ] 'broke'. Vowel-initial stems prefix d': *oscail* 'open', *d'oscail* 'opened'. In Irish [f] is dropped during lenition (but still written *fh*). In the past tense [f]-initial stems are prefixed with *d'* too: *fág* 'leave', *d'fhág* [dɑːg] 'left'.

So far the situation is easy to describe in terms of a prefix *dL*: underlying *dLbris* cannot surface as **dbhris* because of onset restrictions, whereas in *dLfág* and *dLoscail* nothing of the sort happens. However, this solution cannot predict the contrast between *fl-*/*fr*-initial and *f*-initial stems: *d'fhliuchaigh* [dʹlʹuxə] 'dampened' but *líon* 'filled'. The previous account predicts *dl*-initial words in both of these cases.

There are two ways of capturing this. One is allomorph-based: the past tense marker has two allomorphs, one with [d] and one without. The former is selected before vowels and [f]. This is an *ad hoc* solution: these sounds do not form a natural class, and the only reason we lump them together is that in lenition contexts they do not correspond to a consonant. This is just a look-ahead: there is no special reason for this distribution to hold. The argument is essentially circular: the mutation pattern is due to the distribution of autosegments, which is in turn determined by how the mutation works (cf. Prince and Smolensky's (1993) critique of "Bottom-up Constructionism").

I suggest that we are dealing with the requirement that past tense forms have a filled consonantal slot at the left edge competing with the requirements of mutation.

- For consonant-initial verbs, the mechanics are straightforward: mutation does not lead to deletion of consonants, hence both requirement are satisfied;
- For vowel-initial stems, an empty slot is created and filled by [d] through epenthesis;
- For [f]-plus-vowel-initial stems, the slot vacated by [f] is filled by epenthetic [d];
- For [f]-plus-liquid-initial stems, the situation is essentially the same: the empty slot formerly belonging to [f] is filled by [d].

This is formalized in OT as follows: let us have constraints like Max(Root) (or a constraint against empty root nodes, if we follow Ní Chiosáin, 1991 in assuming all Irish vowel-initial words have unpronounced C-nodes on the left edge) and Dep(Root), and a diacritic constraint Past which bans onsetless vowel-initial forms in the past tense. I assume that the requirement to insert mutated forms in the past tense is undominated and do not take into account candidates without mutation. Table 11 summarises the derivations:

The crucial property of this analysis is shared with that of Hannahs and Tallerman's (2006) for Welsh: mutation must happen *before* the supposed trigger is inserted. In other words, if the

Table 11: Past tense formation in Irish

/briʃ/, /vriʃ/, Past	Past	SyllStruc	Max(Root)	Dep(Root)
a. ☞ vriʃ				
b. dvriʃ		*!		*

/oskəlʲ/, Past	Past	SyllStruc	Max(Root)	Dep(Root)
a. oskəlʲ	*!			
b. ☞ doskəlʲ				*

/fɑːg/, /ɑːg/, Past	Past	SyllStruc	Max(Root)	Dep(Root)
a. ɑːg	*!			
b. ☞ dɑːg				*

/fʲlʲuxə/, /lʲuxə/, Past	Past	SyllStruc	Max(Root)	Dep(Root)
a. lʲuxə			*!	
b. ☞ dʲlʲuxə				

/lʲiːn/, Past	Past	SyllStruc	Max(Root)	Dep(Root)
a. ☞ lʲiːn				
b. dʲlʲiːn				*!

trigger's shape is determined by the target's post-mutation form, this means that the trigger is inserted after the target: but how does mutation happen in the first place then?

7 The proposal

I propose that at least in the cases discussed above it is advantageous to view mutation as being totally outside of the phonological component. I suggest that the input of the phonology already has mutation accounted for. In other words, rather than computing *cath*, *gath*, *nghath* and *chath* from a single input *cath*, the phonology takes those four forms as possible inputs depending on what the lexical insertion component tells it.

- ☞ A lexical insertion component which knows about the phonology is not controversial *per se*: cf. the selection of *a* versus *an* in English, and Paster (forthcoming) on subcategorization;
- ☞ The allomorphs of Fula stems are subcategorized for by suffixes and need not be computed, they are selected by lexical insertion and the phonology has nothing to say about that selection;
- ☞ The account of Welsh and Breton mutations after the article mirrors the traditional one to the letter: select different forms *after the definite article* (the allomorphy of which is reduced to one or three phonologically defined variants);
- ☞ The Irish ordering paradox shows how mutation is fed into the phonology, which imposes its own restrictions (in this case on syllable structure). Crucially, the suggestion that mutation is independent of [d]-epenthesis is borne out by the past impersonal forms, which require the former but not the latter (apparently by morpheme-specific reranking).

The autosegmental account also fails to explain some other facts:

- Why do multiple triggers in a language all converge on a small number of autosegments they can bear? In Welsh more than ten prepositions trigger the soft mutation: why don't they all trigger different ones, if mutation is an idiosyncratic property of the trigger? However, if words have only so many forms to choose from, this follows naturally;

- The selection account gives a better explanation to "mixed mutations": "some consonants undergo one type of (otherwise existing) mutation, e. g. soft and others undergo another type of (otherwise existing) mutation". Wolf (2007) has an account, but the coincidence in his account is purely fortuitous, whereas in the insertion account it is the same as above;

- Why is mutation only initial (right-edge mutation can be mobile)? All phonological accounts which rely on constraint ranking to do this view this as an accidental gap: if the ranking of right-alignment constraints which allows for mobile mutation (Akinlabi, 1996) is possible, why isn't it possible for left-alignment constraints? If mutation is part of the leixcon, the explanation is outside of the phonology (and I believe it to be connected with processing and learning, and to lie outside of the grammar);

8 Quick recap

- I do not claim it is impossible to tackle these cases autosegmentally: for example, it is obvious that many shortcomings are only due to deficient feature theories;

- I do suggest that rather than trying to fit these cases into our assumptions about morphophonology it is better to take a different perspective involving lexical insertion;

- This shows the need for a better theory of lexicon and its interface with phonology. My answer is an inheritance-network lexicon with subcategorization frames activated at the point of lexical insertion (*before* phonology). Regularity of mutation is explained via productive generalization over the lexicon (à la exemplar-based approaches). Retrieval is simplified by using the nodes of the inheritance network.

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