Liquids and spirants: a phonological perspective

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1 Aim of the talk

In this talk I concentrate on the (synchronic) phonological relationships of "liquids" and spirants (fricatives). Examples include:

- Spirants as the outcome of liquid palatalization (Polish, Czech, Upper Sorbian, Scottish Gaelic, Jita, Bemba);
- Liquids alternating with spirants in postconsonantal position (Lower Sorbian, Osage);
- Liquid-spirant alternation depending on the neighbouring vowel (Panamint).
- Liquids and spirants in variation as the "continuant" counterparts of stops (Basque, Breton);
- Spirants as unvoiced liquids (Welsh, Breton, possibly Nivkh);

In this talk I argue for the superiority of a substance-free approach to phonology (using the Parallel Structures Model of Morén, 2003) based on some of these cases.

- Once only phonological facts are taken into account when constructing the phonology, phonetic ones become less relevant for phonological representations;
- The notion of a phonological natural class is divorced from that of a phonetic natural class;
- The division of labour between phonology and phonetics is changed to enlarge the domain of the former.

The talk is structured as follows:

- I review the types of liquids-spirant interaction that have been attested;
- I concentrate on one case, that of Lewis Gaelic, and show how its sonorant system may be implemented in PSM

- I argue that the closs of "rhotics" (or "liquids") must be defined in an inductive way (*contra* strongly phonetically based approaches such as that of Walsh Dickey, 1997 but in line with work such as that of Wiese, 2001);
- I review some of the implications of this account for the phonology-phonetics division of labour.

2 Some data

This is not a full database! Additions more than welcome.

2.1 Palatalization

The palatalization of rhotics in particular has been a hot topic, cf. Walsh Dickey (1997); Hall (2000). Here I am not concerned with rhotic resistance to palatalization, but rather with cases where it does happen but yields a different segment (on the phonetic dispreference for palatalized trills, see e. g. Solé, 2002)

2.1.1 West Slavic

This is probably the best known case (cf. Żygis, 2004).

- Polish: /rʲ/→ʒ, as in *kora* 'bark', loc. sg. *korze*;
- Czech: /rʲ/→ř ([r̝]): *vydra* 'otter', adj. *vydřin*;
- Upper Sorbian: /rʲ/→[ʃ], at least diachronically: *tři* 'three', cf. Polish *trzy*.

In these cases we are always dealing with posterior coronal fricatives.

2.1.2 Celtic

- Scottish Gaelic has a number of outcomes for palatalized /rʲ/:
  - Isle of Lewis (Borgstrøm, 1940; Oftedal, 1956): /rʲ/→[ðʲ], e. g. [ɔːr] 'gold', gen. sg. [ɔːðʲ];
  - Other Hebridean dialects: /rʲ/→[r̝]
  - Gillies (1993) notes, without references, realizations such as [j], [l] and [z] apart from the true [rʲ]

2.1.3 Bantu

Palatalization (known as "consonant mutation") is very widespread in Bantu. Two examples:

- Jita (Downing, 2001): /r/→[s], omu-twaːra 'to marry', omu-twaːs-i 'bridegroom'l
- Bemba (Kula, 2000): /r/→[ʃ], kula 'grow', kusha 'cause to grow';

Other sounds as possible outcomes of the palatalization of /r/ mentioned by Walsh Dickey (1997, 100) include [ɻʲ] (Southeastern Tepehuan) and [dʃ] (Carib); I do not consider them here.

2.2 Postconsonantal position

In this case liquids and spirants alternate depending on whether the left context is vocalic or consonantal. The examples I have are:

- Osage (Quintero, 2004): [r] is the allophone of [ð] after an unspecified labial (the only context where either may appear postconsonantally): *b-ríištą* 'I'm finished', where *b-* is the 1sg prefix. Another process involving postconsonantal [ð] in Osage is the fusion of [kð] to [l]: thus the verbal base *ðiiškí* 'launder', reflexive *liiškí*, formed with the prefix *kik-* (the first syllable is deleted for unclear reasons; Quintero, 2004, 239). Wolff (1951) notes that other possible realizations of /bð/, depending on dialect and speaker, are [bl] and [bəð].

- Lower Sorbian: at least diachronically, /r/→[ʃ] after unvoiced stops irrespective of palatalization: *tšawa* 'grass', Upper Sorbian *trawa*. I have not been able to find examples of alternations in the literature.

2.3 Vowel backness

- Central Numic (e. g. Panamint): /t/→[ɾ] intervocalically after back and central vowels and /t/→[ð] after front vowels (Armagost and McLaughlin, 1992): [siðɨhi ðɨhɨyanna] 'these deer', but [siði ɾihɨya] 'this deer'.

2.4 Continuancy

These cases abound (cf. van de Weijer, 1995). Two examples:

- Ondarroa Basque (Hualde, 1991): [ð] and [r] are in "free variation" [whatever that might mean] as allophones of /d/ intervocalically;

- Vannetais Breton (Jackson, 1967): as in other Breton dialects, a process of initial mutation turns voiced stops into continuants. The normal outcome for /d/ is [z], but certain Vannetais dialects (e. g. Pluméliau) the outcome is [ð]. In yet other dialects, [r] is possible instead of [ð] or, as in Cléguérec, in variation with [ð]: according to Thibault (1914), both [ma ra] and [ma ða] are possible for written *ma za* 'if (s)he comes'.

2.5 Voicing

While unvoiced liquids such as [l̥] and [r̥] do exist, where the liquids have a voicing vontrast it is often spirants that take part in it.

- Welsh (Ball and Müller, 1992): it is possible to view [ɬ] as the unvoiced counterpart of [l], even though there are sound arguments against it as well;

- Lorientais Breton (Cheveau, 2006): [χ] is the unvoiced counterpart of the (only) rhotic [ʁ], as demonstrated by the voicing alternations: [χefyʒjət] 'réfugiés', [wɛj tə ʁəfyʒjə tyzən] 'allés se réfugier là-bas';

- Nivkh (Shiraishi, 2006): [t] is spirantized to [r], while [tʰ] is spirantized to something like [r͡ʃ].

3 A closer look at Scottish Gaelic

In this section I present a fragment of Scottish Gaelic phonology relevant to the discussion at hand, namely the phonology of the sonorants. The presentation is couched within the Parallel Structures model.

The data are from the dialect of Bernera, Isle of Lewis in the Western Isles. The main source is Borgstrøm (1940), supplemented by phonetic data from Ladefoged et al. (1998).

3.1 The data

Table 1: The consonants of Scottish Gaelic

	Plain			Palatalized			Velarized	
	Labial	Coronal	Velar	Labial	Coronal	Velar	Coronal	Glottal
Stops	p^h p	t^h t	k^h k	(p^{hj}) (p^j)	t^{hj} t^j	k^{hj} k^j		
Nasals	m	n			n^j		($n^ɣ$)	
Fricatives	f v	s	x ɣ	(f^j)	ʃ	ç $ɣ^j$		
Rhotics		ɾ			$ð^j$		$ɾ^ɣ$	
Approximants		j						h
Laterals		l			l^j		$l^ɣ$	

- The contrast in stops is one of aspiration: "aspirated" stops have long voice onset time, "non-aspirated" ones also have positive VOT, but it is much shorter;
- Ladefoged et al. (1998) find no evidence for contrastive [$n^ɣ$], but I assume its existence following Borgstrøm (1940);
- An additional type of segment exists in the dialect resulting from assimilation of a nasal with a following stop. Borgstrøm (1940) views them as nasals followed by short oral stops (aspirated or unaspirated), but I follow Ladefoged et al. (1998) in interpreteing them as breathy voiced nasals: [p^hanə] 'pan' (*pana*), [m̤ɦianə] 'the pan' (*am pana*). Ladefoged et al. (1998) do not give phonetic data on the non-aspirated correspondents; I interpret them as non-aspirated breathy voiced nasals;
- Borgstrøm (1940) follows traditional in speaking of "lenited" and "non-lenited" coronal sonorants. In Table 2 I give a description of the coronal sonorant system. In the notation of Borgstrøm (1940), non-lenited sonorants are written in capital letters.

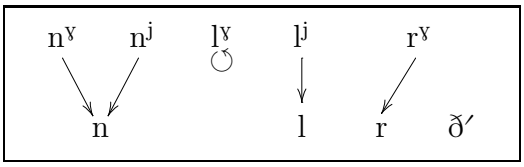
Another relevant piece of data concerns initial clusters. Table 3 shows the clusters allowable in initial position in contexts other than those of initial consonant mutation. Table 4, on the other hand, shows those clusters which are possible in the context of mutation.

Table 2: Coronal sonorants in Bernera

Notation	Borgstrøm's (1940) description, adapted	Ladefoged et al. (1998)
N	Laminal, back of the tongue kept low	[nˠ] (not found)
n	Alveolar, no velarization or palatalization	[n]
N′	Laminal, strongly palatalized	[nʲ] or [ɲ]
L	Laminal, middle of the tongue kept low, back slightly raised	[lˠ]
L′	Laminal, strongly palatalized	[lʲ]
l′	Alveolar, non-palatalized	[l]
R	Trilled, posterior (almost retroflex), back of the tongue lowered	[ɾˠ]
r	Alveolar, no velarization or palatalization	[ɾ]
ð′	Dental palatalized fricative	[ðʲ]

Some more relevant facts:

- Non-lenited sonorants are far more common word-initially in non-mutation contexts; lenited sonorants in non-mutated contexts are only allowed in a few words such as prepositions and adverbs. Both lexical classes historically tended to undergo lenition;
- Morphosyntactic lenition affects different types of sonorants differently:



- Crucially, the velarized consonants are the default option word-initially, whereas the plain ones appear almost exclusively in the marked context of initial consonant mutation. Velarized and palatalized sonorants are also less restricted in nonderived initial clusters: in particular, they are allowed after [s];
- Coronal sonorants are devoiced word-finally and in positions adjacent to voiceless consonants;
- Stop + nasal clusters historically give stop + rhotics + nasal vowel sequences: [kðʲɛ̃ːv] 'bone' from earlier *cnàim*;
- Initial mutation of [m] involves spirantization to [v] and nasalization of the following vowel: [maʰk] 'son', vocative [(ə) vĩʰkʲ];
- Vowels before "tense" (non-lenited) sonorants in the coda are diphthongized e. g. [kʰʲiəlˠ] 'sense', gen. sg. [kʰʲeːlə].

My interpretation of these data is as follows:

- The sonorants are most often not specified for voice, getting the voicing from their surroundings;
- The "non-lenited" sonorants, given their distribution, are in fact less marked than "lenited" ones. Here phonetics (with the strong velarization and palatalization) goes against phonology;

Table 3: Non-derived initial clusters in Gaelic

Bi-consonantal clusters								
First / Second	p	p^h	t	t^h	k	k^h	m	f
j	pj	p^hj					mj	fj
$ɾ^ɣ$								
ɾ	pɾ	p^hɾ	tɾ	t^hɾ	kɾ	k^hɾ	mɾ	fɾ
$ð^j$	p$ð^j$	$p^h ð^j$			k$ð^j$	$k^h ð^j$		f$ð^j$
$l^ɣ$	p$l^ɣ$	$p^h l^ɣ$	t$l^ɣ$		k$l^ɣ$	$k^h l^ɣ$		f$l^ɣ$
l^j								
l	pl	p^hl			kl	k^hl		fl
$n^ɣ$								
n^j								
n								

Tri-consonantal clusters								
Second / Third	p	p^h	t	t^h	k	k^h	m	f
None	sp		st, $ʃt^j$		sk, $ʃk^j$		sm	
j	spj						smj	
$ɾ^ɣ$								
ɾ			stɾ					
$ð^j$	sp$ð^j$				sk$ð^j$			
$l^ɣ$								
l^j								
l						skl		
$n^ɣ$								
n^j								
n								

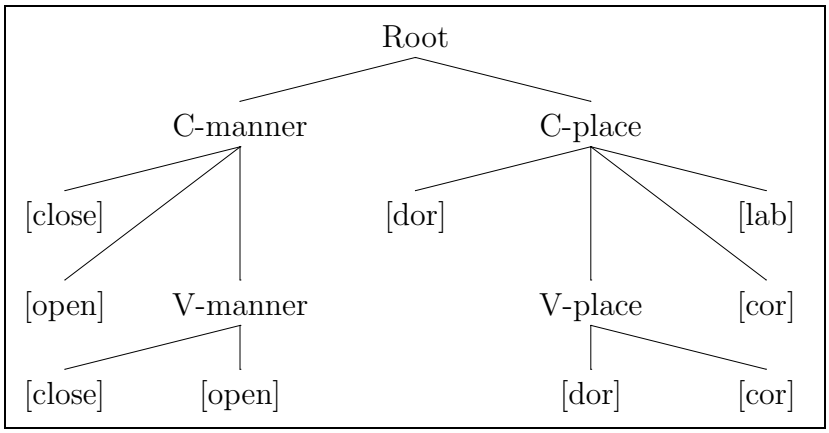
Sibilant + sonorant clusters								
Second / First	$l^ɣ$	l^j	l	$n^ɣ$	n^j	n	$ɾ^ɣ$	ɾ
s	s$l^ɣ$			s$n^ɣ$				stɾ
ʃ		$ʃl^j$			$ʃn^j$			

- Lenited and non-lenited sonorants are distinguished by the presence or absence of marked movement of the back of the tongue: upwards for the lateral and downwards for the nasal and rhotics. "Plain" sonorants are thus marked with the feature [dorsal] which is connected with dorsum movement—but the movement is interpreted differently for different classes! Cf. Morén (2006) for another case of language-specific implementation of [dor].
- "Lenition", at least with regard to sonorants, consists of adding [dor], with constraints on the inventory doing the rest of the job.

Table 4: Initial clusters in mutation contexts

First / Second	f	x	v	ɣ	h	s
None	f	x	v	ɣ	h	
j	fj		vj		hj	
ɾˠ						
ɾ	fɾ	xɾ	vɾ	ɣɾ	hɾ (ɾ̥h)	
ðʲ	fðʲ	xðʲ	vðʲ	ɣðʲ		
lˠ	flˠ	xlˠ	vlˠ	ɣlˠ		
lʲ						
l	fl	xl	vl	ɣl		
nˠ						
nʲ						
n						
p						sp
t						st
k						sk

The (preliminary and partial) feature geometry for Scottish Gaelic is as follows:



The relevant representations are outlined in Table 5. Importantly, the diaritic /ˠ/ has different meanings in the underlying representation ("any dorsal action relative to the unmarked state") and in phonetics ("velarization").

In this model, coupled with an OT constraint module which rules out illicit representations, many phenomena of Scottish Gaelic are explained in the following way:

☞ Lenition is simply the addition of V-place[dor]. This gives the following results:

- The behaviour of the rhotic is explained straightaway: the addition of V-place[dor] to the rhotic gives precisely the representation of /rˠ/, i. e. [r];
- The unmarked nasal and the unmarked lateral show contrasting behaviour in lenition: the lateral is unchanged, whereas the nasal simply adds a V-place[dor] feature. The palatalized lateral simply adds V-place[dor], whereas the palatalized nasal adds V-place[dor] but loses V-place[cor]. This is explained by the constraint ranking:
  - ∗ The underlying representations /lˠ/ and [nˠʲ] are impossible, which is accounted for by conjoining the relevant constraints (let's call them *F);

Table 5: Scottish Gaelic sonorants

Manner	UR	Phon	C-manner		V-manner		C-place			V-place	
			[op]	[cl]	[op]	[cl]	[lab]	[cor]	[dor]	[cor]	[dor]
Closed approximant	/l/	[l$^{\text{ɣ}}$]		✓		✓		✓			
	/l$^{\text{j}}$/	[l$^{\text{j}}$]		✓		✓		✓		✓	
	/l$^{\text{ɣj}}$/	[l]		✓		✓		✓		✓	✓
Open approximant	/r/	[r$^{\text{ɣ}}$]	✓			✓		✓			
	/r$^{\text{ɣ}}$/	[r]	✓			✓		✓			✓
	/r$^{\text{ɣj}}$/	[ð$^{\text{j}}$]	✓			✓		✓		✓	✓
Nasals	/n/	[n$^{\text{ɣ}}$]	✓	✓		✓		✓			
	/n$^{\text{j}}$/	[n$^{\text{j}}$]	✓	✓		✓		✓		✓	
	/n$^{\text{ɣ}}$/	[n]	✓	✓		✓		✓			✓
	/m/	[m]	✓	✓		✓	✓				

  - In the case of /l$^{\text{ɣ}}$/ (the expected outcome of the lenition of /l/), it is better not to change at all than to epenthesize V-place[cor]:
    *F≫Dep(V-place[cor]), Max(V-place[dor])
  - In the case of the banned /n$^{\text{ɣj}}$/, it is best to lose V-place[cor]:
    *F≫Max(V-place[dor])≫Max(V-place[cor])
- Alternatively, the nasals may be placeless, but this raises representational issues beyond the scope of this talk.

☞ The behaviour of nasals is easily explained: the nasalization of the vowel represents delinking of C-manner[closed] and its relinking to the vowel

- Because nasals are more complex than rhotics, clusters with them are banned. This is repaired by delinking C-manner[closed] (which gives rhotics), but Max(C-manner[cl]) forces its retention on the vowels;
- The mutation of [m] is a separate process (see tomorrow's talk), but it also results in creating an illicit feature combination which is repaired in an identical way.

- Diphthongization of vowels before tense sonorants is an explanandum. A preliminary suggestion is as follows: *contra* Smith (1999), I assume that the "tense sonorants" (unmarked in PSM) do not given enough weight to the stressed syllable and therefore a glide (essentially a V-place[dor]) is epenthesized to satisfy SWP. This requires further work in light of the multiplicity of the patterns.

4 Discussion

How are these data relevant to the categorical vs. gradient debate?

- A substance-free approach radically restricts the categorical domain. The Parallel Structures Model has a (rather small) phonetic residue, but the amount of phonetic information available in the phonology is drastically reduced;
- The push-forward model of phonology is retained, at the expense of a non-trivial, learned phonetic implementation module;
- The structure of phonological representation is connected with the phonetics and other "performance" factors (such as frequency) only indirectly.

4.1 Deduction versus induction

- The innate-features model (Jakobson et al., 1951; Chomsky and Halle, 1968) presupposes a **deductive** model of phonological thinking, where a pre-defined set of possible representations is matched with uniformly interpreted phonetic representations;
- Other phonological models, such as those of the Toronto School (Dresher et al., 1994), the Emergent Features Theory (Mielke, 2004), the Parallel Structures Model (Morén, 2003, 2006) and radically substance-free phonology (Blaho, 2008) take an **inductive** approach where representations are wholly or in part built on the basis of language-specific data (inventories, variation, alternations)

I submit that an inductive approach allows to capture data such as those discussed in this papers more straighforwardly:

- By discarding the idea that a phone such as [ð] has a featural representation "set in stone" as a "voiced non-strident coronal non-lateral non-nasal fricative", we capture the multiplicity of its phonological guises. In the Parallel Structures Model, [ð] can be any of the following:
  - {manner[open]} (a placeless fricative)
  - {place[cor]} (a mannerless coronal consonant)
  - {manner[open]}{place[cor]} (a coronal fricative)
  - {manner[open][lax]}{place[cor]} (a coronal lax fricative)
  - {manner[open]{manner[closed]}}{place[cor]} (a very open approximant)
  - {manner[open]{manner[closed]}}{place{place[cor]}} (a palatalized very open placeless approximant)
  - and quite a few others...
- This gives a much larger field of possible phonological natural classes. A reviewer of the abstract asks what type of natural classes would be disallowed under the proposal
  - In a theory which does not sever the phonetics-phonology connection fully, such as the PSM, certain representations would be impossible for certain types of segments: e. g. it does not seem very feasible to have a {C-manner[closed]} representation for [ð]. The job of figuring this out, however, lies outside phonology with the phonetics-phonology interface.
  - Other than that, the range of possible natural classes is constrained by the representational assumptions of the theory and by the learning system (if a representation is unlearnable, it is not predicted to exist). The latter is outside of the domain of phonology.
- The substance-free approach to the phonology of rhotics is not new. Wiese (2001) proposes to define rhotics in terms of sonority, as sounds intermediate between laterals and glides on the sonority scale.
  - He only briefly considers cases such as that of Scottish, when non-rhotic sounds pattern with rhotics. I take these to be highly significant;
  - If Scottish [ð] can be said to be quire sonorous (cf. the existence of the approximant [ð̞] of Danish), it is quite hard to view sounds such as Polish [ʒ] and Lorientais Breton [χ] as "sonorous", yet they pattern with rhotics in many relevant respects. Cf. also Rice (2005) on the non-universality of rhotics as more "sonorous" than laterals;

  - What Wiese (2001) really seems to be saying is that the definition of "rhotic" is inductive, based on the actual pattern of one language. This sentiment is very close to substance-free phonology;
  - In fact, if sonority is also derived from featural structure (e. g. defined as the prominence of [open]), then rhotics are simply defined as segments patterning together with /r/ in those respects which are relevant for prosody in the language at hand. This is (almost) the substance-free definition.

- Some of the advantages of the substance-free approach to cases such as Gaelic:
  - The phonology does not care for the phonetic implementation of palatalization in rhotics. This brings to light the essential (near-)identity of the phonological systems of different dialects: recall that cross-dialectally the realization of the palatalized rhotic ranges from [ʒ] all the way to [j];
  - The leeway in the phonetics-phonology connection allows a straightforward description of "funky" features such as [tense] in Gaelic;
  - The phonological description only concerns itself with phenomena that are relevant to the whole system, not with describing and explaining minutiae of substance.

- The above does **not** mean that the minutiae are irrelevant. What does it mean?
  - The phonological computation is categorical;
  - Phonetic phenomena (including what we call the phonetics-phonology interface) are important, but not directly relevant to the phonology;
  - The phonetics-phonology interface is not innate and universal. but must be learned;
  - This learning process is where the phonetics influences the phonology;
  - This phonetics-phonology interface is the place where the insights such as those of Blevins (2005) and Ohala (1981) (on the role of acquisition and diachrony in producing phonological patterns) and Bybee (2001) and Wedel (2007) (on the role of frequency and inductive learning) can be applied.

- One final point to emphasize:
  - ☞ Whether the picture painted here is correct or not has no bearing on whether and how we should do OT.
  - OT should stand or fall on its merits in getting all and only the possible patterns right;
  - However, for this enterprise to succeed it is important that OT only try to model what is proper;
  - The key to this is the strict division between categorical, phonologically relevant patterns and those that are language-specific, yet outside of the phonological computation.

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