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Displacement Features in Phonology

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Twenty years after The Sound Pattern of English (SPE) numerous unresolved controversies persist about the set of phonological features. Keating (1988: 7) in a recent survey says "the whole area of back consonant distinctions seems unclear". A number of revisions have been recently proposed, in work on autosegmental phonology and, particularly influentially, by Ladefoged and Halle (1988). The general result of these seems to be an introduction of new features with little emphasis on their replacement of other features. The present paper shows how a thorough revision of the feature-set follows from the extension of [coronal] to characterize front vowels. This suggests revisions of the role of [back] in sorting vowels and consonants. A general feature of backness expressing retraction of any of the three articulators fulfills much of the role of [tense], [ATR], [strident], and [distributed]. A new feature, [fronted], is justified as a result of these revisions, and this feature can fulfill the rest of the role of [strident] and [distributed], and [low] as well. The revised feature-set suggests a somewhat new understanding of phonological structure.

1. Revision of [coronal]

Consider [coronal], a feature said in SPE (304) to characterize only retroflex vowels, even though the articulator involved in it, "the blade of the tongue", can certainly be considered as important in shaping vowels as consonants. In fact, it has been previously proposed to characterize front vowels as [+coronal]. Wood (1982; discussed by Fischer-Jørgensen 1985) groups the front vowels less [æ] as "palatal" on acoustic evidence. Clements (1976), on the evidence of palatalizations, which often involve the coronalization of velars conditioned by front vowels, and, rarely, the similar coronalization of labials, proposed to extend [+coronal] to characterize the non-low front vowels and glides.

Problematic for this argument for a class of front vowels and glides and coronal consonants is that the most common such shift of place of articulation is the raising of already-coronal dentals or alveolars to alveopalatal. Clements notes that this change, when conditioned by only [i], as in Japanese, is to be seen as assimilation of [high]. It appears, indeed, from

the numerous palatalizations surveyed by Bhat (1978), that palatalization of velars by mid-front [e] is quite common but palatalization of dentals and alveolars is typically by [i].

Revised as suggested, [coronal] almost expresses the class of tongue-blade consonants and front vowels which was expressed through the Jakobsonian feature [+grave], neglected by SPE and for which considerable post-SPE evidence exists (Keating 1988: 4, and references there). A difference between [grave] and [coronal] as revised is that the latter excludes the low front vowel [æ]. As Clements (1976: 97) notes, the SPE (304) definition of [+coronal] as "with the blade of the tongue raised from the neutral position" is suitable for all the front vowels except [æ]. [-Grave] phones were said to employ "a smaller and more divided cavity" (Jakobson, Fant and Halle 1952: 30), which seems valid for coronal versus labial and velar consonants, but valid only for non-low front vowels. The evidence from palatalizations for a class of front vowels rarely involves low front [æ] (Bhat 1978).

As a characteristic of all front vowels, [+coronal] would fully duplicate the sorting of vowel-classes of [-back]. Excluding [æ], its comparison with [-back] will be different. As our initial hypothesis, then, let [+coronal] be defined as articulated with simply the front of the tongue in such a way that the feature will be relevant for vowels and will characterize the non-low front vowels as well as the dental, alveolar, and alveo-palatal consonants. See (1), which compares the basic five-vowel set as characterized with [coronal] so employed, versus with [back] as in SPE.

(1) 5-vowel set characterized by [coronal] and [back]

	i	e	a	o	u		i	e	a	o	u
coronal	+	+	-	-	-	back	-	-	+	+	+
high	+	-	-	-	+	high	+	-	-	-	+
round	-	-	-	+	+	round	-	-	-	+	+

Note the symmetry of this prevalent vowel-set as characterized with [coronal], that the pairs of mid, high, front and back vowels are parallel, and that [a] rather than [e] is unmarked in the sense, which could certainly not be insisted on, of lacking plus-values. We will see below that the correlation of markedness in phones with the number of their plus-values for distinctive features is characteristic of the revised feature-set proposed here.

Revising [coronal] for use with vowels leaves [anterior] as the major place-feature only for conso-

nants, and it may be an argument for this revision that it further promotes the replacement of that problematic feature by [labial]. The revised [coronal] provides the ready expression of a class of dental-alveolar consonants and non-low front vowels, for which, frankly, the evidence has never been overwhelming. Also, we have lost the SPE characterization of retroflex vowels, which must be regained below. As revised, [+coronal] characterizes a set of vowels already characterized as [-back, -low]. Perhaps, therefore, the main contribution of the hypothesis of coronal vowels is to raise questions about the role of these features, particularly [back].

2. Reconsideration of [back]

An oddity of the SPE [+back] vowels is the inclusion in this class of the central as well as traditionally recognized "back" vowels. Indeed, the body of the tongue in [ɨ], [ʉ] and [a] only came to be considered retracted in 1968. Extending [+coronal] for use with non-low front vowels makes [back] redundant in characterizing most vowel systems, in which the [+back, -low] vowels are distinct by being [+round]. Stevens (1983: 258) says that, acoustically, roundness rather than backness is what distinguishes the English high vowels [i] and [u]. With [coronal] used as suggested, as well as with SPE's [back], the vowels of the most common three, four and six-vowel sets, as well as of the five-vowel set of (1) above (120 of 173 languages in the corpus of Crothers (1978: 105)), are fully distinct with also [high] and [round]. See (2).

(2)		i	a	u	|	i	ɛ	a	u	|	i	e	ɨ	a	o	u
	coronal	+	-	-	|	+	+	-	-	|	+	+	-	-	-	-
	high	+	-	+	|	+	-	-	+	|	+	-	+	-	-	+
	round				|					|	-	-	-	-	+	+

The ready expression of the common contrast of low vowels, [æ] versus [a] (though not in these common sets), is lost without [back], and must be regained below. However, the basic replaceability of [back] by [coronal] in vowels suggests that we rethink the role of [back] in characterizing consonants also.

In fact, [back] is as unnecessary in the most frequent consonant sets as it is, with [coronal] employed as suggested, in the most frequent vowel sets. Five consonant places of articulation are sorted by [anterior] and [coronal] plus either [high] or [back]. If [labial] is used instead of [anterior], [coronal] and

[back] are inadequate to distinguish [t] and [č], but [coronal] and [high] suffice. [High] is apparently needed in sorting vowels, and, given [high], [back] is redundant in sorting these five places of articulation. See (3).

(3)		p	t	č	k	ʔ		p	t	č	k	ʔ	
	anterior	+	+	-	-	-		anterior	+	+	-	-	-
	coronal	-	+	+	-	-		coronal	-	+	+	-	-
	back	-	-	-	+	-		high	-	-	+	+	-
		p	t	č	k	ʔ		p	t	č	k	ʔ	
	labial	+	-	-	-	-		labial	+	-	-	-	-
	coronal	-	+	+	-	-		coronal	-	+	+	-	-
	back	-	-	-	+	-		high	-	-	+	+	-

There is further evidence that [back] has been misconstrued in phonological-feature theory. Recall the definition of [back] as given in SPE (305): "Back sounds are produced by retracting the body of the tongue from the neutral position". In SPE, velars are [+back], but the briefest consideration of the actual position of the tongue in the articulation of velars raises doubt. If introspection about this isn't enough, see the tongue-position diagrams presented by Ladefoged 1975 (50, 138), who says (208) of velarization that this "involves raising the back of the tongue," but not that it involves retraction. Ohala (1983: 199) mentions research by Houde (1968) that velar stops in English actually "...have a forward-moving component to them". Retraction of the tongue-body certainly occurs in uvulars and pharyngeals, but not in velars.

As reasonable as the [-back] value of velars is the [+high] value of uvulars, also contrary to the sorting of back consonants by SPE features (p. 305), shown in (4):

(4)		velars	uvulars	pharyngeals	laryngeals
	high	+	-	-	-
	back	+	+	+	-
	low	-	-	+	-

Ladefoged (1975: 305) says that "uvular sounds are made by raising the back of the tongue toward the uvula". Keating (1988: 8) says that "phonetically, it would seem that velars and uvulars are really on a diagonal, not a vertical line, with uvulars being both lower and

backer than velars". She mentions Kirghiz, in which "uvulars are said to alternate with velars as a function of vowel backness, not vowel height". If uvulars are, indeed, both [+back] and [+high], the four "back" places of articulation can be fully sorted by using just [high] and the revised [back], without need for [low], as in (5).

(5)		velar	uvular	pharyngeal	laryngeal
	high	+	+	-	-
	"back"	-	+	+	-

A problem with (5) is that the [+high, -back] characterization of velars makes them identical to palatals, and this contrast will have to be regained below. An argument for the identical backness of velars and uvulars, the claimed neutralization of vowel-height in favor of [-high] before putative [-high] uvulars in Eskimo (Kenstowicz and Kisseberth 1979: 250) could be seen as [-high] before [+back], which is not unreasonable.

3. Further revision of [back]

Two other features characterizing tongue displacements are [+tense], which in vowels has been employed to characterize the relatively fronted members of the pairs [i/I], [e/ɛ], [o/ɔ] and [u/U], and [+ATR], which characterizes similar pairs. With [coronal] employed in characterizing vowels as suggested, a revised "[back]" can reasonably and usefully be employed to characterize such pairs as in (6). The specific phon-

(6)		i	I	e	ɛ	a	ɔ	o	U	u
	coronal	+	+	+	+	-	-	-	-	-
	high	+	+	-	-	-	-	-	+	+
	round	-	-	-	-	-	+	+	+	+
	"back"	-	+	-	+	-	+	-	+	-

etic nature of these vowels certainly varies from language to language, but it is uncontroversial that relative tongue-body retraction is partly involved. Lindau (1978: 558) has argued that the [+tense] vowels of English and German are "peripheral" rather than "advanced", and if this is so, backness would correlate with laxness in the front vowels but with tenseness in the round back vowels, as in (7), below.

Now if retraction of the back of the tongue plays any such role in speech, it would be odd if similar re-

(7)		i	I	e	ɛ	a	ɔ	o	U	u
"back"		-	+	-	+	-	-	+	-	+

traction played no role in connection with the other two articulators, the lips and front of the tongue. [Anterior], besides creating a controversial class of labials and dental-alveolars, has played such a role in relation to the tongue blade, but relatively redundantly, since [-anterior] coronals differ from [+anterior] coronals by [+high] also. [Distributed] also distinguishes coronal consonants with different degrees of retraction. Furthermore, [strident] and/or [distributed] have played such a role in relation to the lower lip which, retracted, creates a [+strident] and [-distributed] phone. Since these retractions of the tongue body, tongue blade, and lower lip appear to be mutually exclusive, it is reasonable to let the retraction feature characterize all three articulators, as [strident] and [distributed] characterize articulatory differences in all three.

In labials, retraction describes the labiodentals, which involve backing of the lower lip. In coronals, retraction describes the retroflexed phones, which Ladefoged (1975: 139) says "are made by curling the tip of the tongue up and back". Retroflexion of [+coronal] consonants before retroflex vowels may be neatly seen as assimilation of [+back]. Further evidence for [back] in this role, when it has already been employed in the distinction of pairs such [i/I], [u/U], is the (apparent) absence of contrast of the latter sort between retroflex vowels. In American English, for example, the tense/lax distinction is merged before /r/. Some retroflex vowels are apparently not produced by retraction of the blade of the tongue; but these have tongue-root retraction (Lindau 1978: 55).

These distinctions of relative retraction in the lower lip and tongue blade are collected in (8), but in order to avoid confusion with the traditional use of [back], which was for retraction of just the tongue root, the revised, extended, retraction feature will be termed "[backed]".

(8)		m	ɱ	n	ɳ	|	ə	ɤ
	coronal	-	-	+	+	|	-	-
	backed	-	+	-	+	|	-	+

[Backed] also seems appropriate for capturing the distinction between the four high vowels of Swedish and

Norwegian. Swedish [ɥ] is described as "inrounded" by Lass (1984: 88), and by Lindau (1978: 548) as lacking the lip protrusion which characterizes [u]. Norwegian according to Lindau (1978: 547) "differs from Swedish ...in that the vowels /y ɥ u/ have the same lip position, as well as the same value of the feature High"; see (9). Language specific phonetic interpretation would have to relate [backed] in Norwegian [u] to the tongue-body (9a) and in Swedish [ɥ] (9b) to the lips.

(9)	a.	i	y	ɥ	u	b.	i	y	ɥ	u
	coronal	+	+	-	-		+	+	+	-
	high	+	+	+	+		+	+	+	+
	backed	-	-	-	+		-	-	+	-
	round	-	+	+	+		-	+	+	+

[Backed] also appropriately distinguishes the retroflex from the other [+coronal] liquid, the lateral, (whose velar(ized) allophone like the other velars, would not be [-backed]). Thus it is unnecessary to employ [lateral] to distinguish the two liquids, nor is [continuant] needed to make the distinction, defining [-continuant] as having "blockage of air flow past the primary stricture", as suggested in SPE (318). In fact, given the potential for syllabicity of the liquids, it seems reasonable that both [r] and [l] be considered to share continuantness with the glides. With [backed], the liquids and glides can be fully sorted by place of articulation as in (10).

(10)		l	r	y	w
	coronal	+	+	+	-
	high	-	-	+	+
	backed	-	+	-	-

4. Proposal of [fronted]

Our initial hypothesis to extend the use of [coronal] led to a revision of [back], and this feature, as revised, replaced some of the roles of [tense], [ATR], [strident] and/or [distributed], with no necessity for additional features, and with coverage of some previously problematic contrasts. In fact, it would be odd, given the flexibility of the articulators, if corresponding to [+backed] there was no [+fronted], a feature defined as expressing the relative fronting of any of the three articulators; cf. [+ATR], with fronted tongue root. The cost of adding this new feature will be more than offset by its fulfilment of the rest of the role

of [strident] in distinguishing such fricative pairs as [θ/s] (in which the former has relative fronting of the blade of the tongue), in distinguishing palatals and velars (in which the former has relative fronting of the body of the tongue, and whose SPE sorting is prevented if velars are [-backed], as was suggested above), and in distinguishing [æ] from central [a] (in which also the former has relative fronting of the body of the tongue). These distinctions are shown in (11).

(11)	θ	s	|	c	k	|	æ	a	
	fronted	+	-	|	+	-	|	+	-

Here the palatals are seen as non-coronal, fronted velars, consistent with the SPE analysis, and inconsistent with their grouping with coronals, as by Jakobsonian [grave]. In the distinction of [æ] vs. [a] (the latter a back rather than central vowel), [+backed] may distinctively characterize the latter, rather than [+fronted] the former.

Palatalization of velars by front vowels, as in Turkish, is in SPE features assimilation of [-back]. This characterization is lost in the present proposal, in which instead this would be assimilation of [+fronted], redundant with [+coronal] in the front vowels. Palatalization of velars by [æ] would also be characterizable as assimilation of [+fronted].

With [fronted], English epenthesis with the sibilant suffixes (in *kisses*, *catches* etc.) is in the environment (12)a rather than (12)b. Four features have to

(12) a.	[	-sonorant	]	[	-sonorant]
	[	+continuant	]	[	+continuant]
	[	+coronal	]	[	+coronal]
	[	-fronted	]	[	-fronted]
			]	[	+strident]
				[	+strident]

be mentioned rather than one, but the efficiency of a feature like [strident] in such a rule is entirely owed to its lack of generality, and is offset by its relative uselessness elsewhere in the grammar of English and in other languages. Though it is of questionable significance, notice that since the English coronal stops are redundantly [-fronted], rule (12)a unlike (12)b can be generalized to handle the epenthesis with the past tense suffix (in *waited*, *waded* etc.) just by changing the value of [continuant] to α . The hypothetical role of articulator backness in the phonology of such cases in no way denies acoustic stri-

dency a primary role in phonetic distinctness.

Since [strident] is only relevant for fricatives, the four-way contrast among coronal stops, nasals and laterals in Dravidian and some Australian languages (Keating 1988: 5) requires [distributed] in the SPE feature-set in addition to [strident]. These four stop contrasts are fully sorted as in (13) by the combination of [backed] and [fronted] with [high], which for parallelism with the other two displacement features I will term "[raised]". The characterizations of (13), however, unlike those with [distributed], provide no understanding of why, if Keating (1988: 5) is right, alveolars and retroflexes (apical, [+distributed]) and dentals and palatals (laminal, [-distributed]) should "often pattern together".

(13)		t̥	t	ṭ	č
	coronal	+	+	+	+
	raised	-	-	-	+
	backed	-	-	+	-
	fronted	+	-	-	-

The feature [low] turns out to be largely unnecessary in the resulting system. In sorting basic consonant places, [low] is redundant with backness playing the role we saw in (5). In vowels, [low] has always been redundant in sets with only [a] of the low vowels where the other "back" or [-coronal] vowels are [+round]. When two low vowels must be distinguished, either [fronted] or [backed] will suffice, depending on which is the more restricted. In languages where these two must be distinguished from non-low [ə], both [fronted] and [backed] will be needed but will suffice. These possibilities are shown in (14).

(14)		e	æ	a	o	|	e	æ	a	o	|	æ	ə	a
	coronal	+	-	-	-	|	+	-	-	-	|	-	-	-
	backed	-	-	-	-	|	-	-	+	-	|	-	-	+
	fronted	-	+	-	-	|	-	-	-	-	|	+	-	-
	round	-	-	-	+	|	-	-	-	+	|			

5. The resulting system

The resulting system of two articulator features and three displacement features is considerably more efficient than the SPE features, as seen in the matrix (15) of eleven places of articulation of consonants and the eleven vowels of English. Seven or eight SPE features would be needed to express the same contrasts.

(15) Eleven consonant places and eleven vowels sorted by two articulator & three displacement features

	p	f	θ	t	t̚	č	c	k	q	ħ	ʔ	|	i	I	e	ɛ	æ	ə	a	ɔ	o	U	u
labial	+	+	-	-	-	-	-	-	-	-	-	|	-	-	-	-	-	-	-	+	+	+	+
coronal	-	-	+	+	+	+	-	-	-	-	-	|	+	+	+	+	-	-	-	-	-	-	-
raised	-	-	-	-	+	+	+	+	-	-	-	|	+	+	-	-	-	-	-	-	-	-	+
backed	-	+	-	-	+	-	-	-	+	+	-	|	-	+	-	+	-	-	+	+	-	+	-
fronted	-	-	+	-	-	+	-	-	-	-	-	|	-	-	-	-	+	-	-	-	-	-	-

Place of articulation is unexpressed directly. The five features express the employment of three articulators ([+labial], [+coronal], and [-labial, -coronal]) and their possible displacements ([raised], [backed], and [fronted]). [Backed] and [fronted] are mutually exclusive. [Raised] is irrelevant for labials. One of the three displacements is required in conjunction with the tongue-body articulator; [+raised, -backed] (velar) would be unmarked. Negative values for [labial], [coronal], and for the three displacement features defines laryngeal articulation.

In addition to these and the major-class features, other features will certainly be required for some languages (tenseness, laryngeal features, etc.). But these five features express a natural logic of articulation: languages *do* employ three articulators, plus in their absence laryngeal articulation, and these *do* have the three possibilities of displacement described. It seems reasonable and, I hope to have shown, useful for the feature system to express these.

Though they appear to reduce the number of features, the displacement features nevertheless allow many possibilities of analysis. It was mentioned that [+backed] [u] might be interpreted as having backed lips in Swedish but a backed tongue-body in Norwegian. It was suggested that of /æ/ and /a/ the former might be considered [+fronted] in some languages, but the latter [+backed] in others. Retraction in retroflexes may be of the blade or back of the tongue. Vowel pairs like [i]/[I] could reflect either backing or fronting, depending on markedness.

The three displacement features have characteristics of the neglected Jakobsonian features [flat] and [sharp], which, as described by Ohala (1985: 224), each have "discontinuous articulatory correlates", and generally are not used distinctively until near-maximal use is made of the primary features. As seen in (15), phones assumed to be more marked generally have more plus-values --those of the three displacement features.

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