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What ambivalent segments can tell us about the universality of distinctive features¹

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1. Introduction

Speech sounds which are crosslinguistically variable with respect to feature specification are problematic for the claim that the phonetic properties and phonological patterning of speech sounds are predicted by a universal set of distinctive features, because the phonological patterning must be known before the feature specifications can even be determined. One of the segments that seems to exhibit ambivalent behavior is /l/, and this paper looks at the phonological patterning of /l/ in a database of 561 languages.

(1) The continuancy specification of /l/ and other lateral consonants has varied over the years. For example:

- Jakobson, Fant, and Halle (1954) group laterals with [continuant] sounds (as opposed to [interrupted]).
- Chomsky and Halle (1968:318) group /l/ with [+continuant] sounds, but note the difficulty in categorizing /l/ on the basis of a definition (emphasis C&H):

The characterization of the liquid [l] in terms of the continuant-noncontinuant scale is even more complicated [than the characterization of other liquids]. If the defining characteristic of the stop is taken (as above) as total blockage of air flow, then [l] must be viewed as a continuant and must be distinguished from [r] by the feature of “laterality.” If, on the other hand, the defining characteristic of stops is taken to be the blockage of air flow *past the primary stricture*, then [l] must be included among the stops. The phonological behavior of [l] in some languages supports somewhat the latter interpretation.

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- Halle and Clements (1983) group laterals with [–continuant] sounds, and accordingly adopt a definition that refers specifically to the *mid-sagittal* region of the vocal tract, which is obstructed in the production of laterals.
- Kaisse’s (ms) informal survey of eleven phonology texts from 1968 to present finds that six of them treat /l/ as [+continuant], three treat it as [–continuant], and two treat it as variable from language to language. Two of the most recent texts disagree on the [continuant] specification of /l/.

(2) Kaisse (2000) summarizes the debate as follows:

- The status of laterals hinges on whether [continuant] is defined in terms of occlusion in the oral tract or occlusion in the *mid-sagittal* region of the oral tract.
- The proper definition can only be determined by examining the *phonological patterning* of laterals.
- Kaisse examines 17 languages and concludes that sonorant laterals are [–continuant], because they pattern as [–continuant] in the great majority of these languages, and she suggests the apparent counterexamples should be reanalyzed.

(3) The debate over whether /l/ is [+continuant] or [–continuant] presupposes that it has to be one or the other.

(4) This presupposition follows from the claim that distinctive features are universal, innate, and explanatory (Chomsky 1968, Chomsky and Halle 1968, Clements 1985, etc.). This claim is stated very clearly by Clements and Hume (1995:245):

[S]ince features are universal, feature theory explains the fact that all languages draw on a similar, small set of speech properties in constructing their phonological systems... Feature theory... has provided strong confirmation for the view that languages do not vary without limit, but reflect a single general pattern which is rooted in the physical and cognitive capacities of the human species.

(5) A possible answer to the question of proper feature specifications is that /l/ and other segments which seem to exhibit ambivalent behavior truly *are* ambivalent, i.e., **their features are *not* universally or innately determined.**

- (6) **Ambivalent segments are problematic** for the claim that distinctive features are universal, innate, and explanatory, and they raise questions about the explanatory value of features in general. No large-scale survey of natural classes has been available to test claims about distinctive features and their universality.

2. Survey

- (7) Phonologically active classes² of sounds were drawn from all available language grammars (written in English) in the Ohio State University and Michigan State University library systems (Library of Congress subclasses PA, PB, PC, PD, PE, PF, PG, PH, PJ, PK, PL, and PM), a total of 561 languages (about 9000 classes).
- (8) A *phonologically active class* is defined as a group of sounds which, to the exclusion of all other sounds, do at least one of the following:
1. undergo a phonological process
 2. trigger a phonological process³

3. Results

- (9) 838 classes include /l/ (i.e., an alveolar or dental lateral approximant).
- At least 487 of these /l/ classes can be described using widely accepted distinctive features.
 - Many are large, general classes (e.g., /l/ appears in “the class of consonants” 146 times).
 - Of the classes that can be described with widely-accepted distinctive features, 77 involve the feature [continuant].
 - Among these 77 classes, /l/ patterns with uncontroversial continuants (e.g., vowels, glides, and fricatives) to the exclusion of all others 16 times and with uncontroversial non-continuants (e.g., oral stops, clicks, and nasals) 61 times.

² “Phonologically active class” is a term equivalent to “natural class”, but without the assumption that the class in question is “natural” either phonetically or according to any particular feature theory.

³ Classes which exemplify a static distributional restriction were also recorded, but classes which satisfy only this criterion were omitted from this paper. These classes seem to be far more irregular than classes which satisfy either the 1st or 2nd criteria, both from a traditional feature standpoint and from a phonetic standpoint. This is likely due at least in part to accidental gaps, but may also indicate a more fundamental difference between distributional patterns and phonological alternations.

(10) There are **16** cases where /l/ is [+**continuant**]. /l/ patterns with...

- coronal fricatives and other liquids (3 cases: Doyayo, Finnish, Greek)⁴
- fricatives and glides (2 cases: Mising, Temne)
- fricatives, glides, and other liquids (2 cases: Bearlake Slave, Temne)
- glides and flap but not nasals or /r/ (2 cases: Edo, Okpe)
- coronal fricative (1 case: Selepet)
- fricatives (1 case: Ecuador Quichua)
- lateral fricative (1 case: Navajo)
- palatal glide (but not /r/) (1 case: Itzaj Maya)
- palatal glide, and lateral flap (but not trills) (1 case: Edo)
- voiced alveolar fricative, palatal glide, and other liquids (1 case: Doyayo)
- vowels, glides, fricatives, and other liquids (1 case: Catalan)

(11) There are **61** cases where /l/ is [-**continuant**]. /l/ patterns with...

- a coronal nasal but not /r/ (or /r/) (18 cases: Acehnese, Adilabad Gondi, Anywa, Catalan, Dhaasanac (Daasanach), Faroese, Ganggulida, Harar Oromo (Eastern Oromo), Kalenjin, Kharia, Kilivila/Kiriwina, Kuvi, Libyan Arabic, Maasai, Slovene, Sri Lanka Creole Portuguese, Yiddish)
- all nasals but not /r/ (or /r/) (9 cases: Alyawarra, Basque, Gooniyandi, Gunin/Kwini, Kinande/Nandi, Lele, Spanish (European), Yir-Yoront, Yucatan Maya)
- an alveolar nasal (4 cases: Dieri (Diyari), Ecuador Quichua, Martuthunira, Yir-Yoront)
- alveolar stops and nasal (2 cases: Toba and Yir-Yoront)
- coronal plosives, and nasal if present in the language (2 cases: Bata, Boko/Busa)
- coronal stop, nasal, and /r/ (but not /r/) (2 cases: Agn Armenian, North Puebla Nahuatl)
- coronal stops (and affricates or other liquids if present), but not nasal (2 cases: West Greenlandic, Mishmi)
- voiced stops (2 cases: Dholuo (Luo), Koromfé)
- 22 others: 1 case each (Arabana-Wangkangurru, Biri, Dieri (Diyari), Guatuso, Haitian Creole, Hungarian, Irish Gaelic, Jordanian Arabic, Koromfé, Melayu Betawi, Nangikurrunggurr/Ngankikuringkurr, Ngura, Slovak, Supyire Senoufo, Urhobo)⁵

(12) Many of the classes in (10) and (11) are characterizable this way only if /r/ or /r/ is arbitrarily assigned the opposite [continuant] value.

⁴ References for languages referred to in these examples are listed in the reference section.

⁵ Fewer than 22 languages are listed because some languages have more than one class in which /l/ behaves as [-continuant].

- (13) Some of the “**unnatural**” classes which cannot be described with traditional distinctive features include only [+**continuant**] segments. /l/ patterns with...
- /h/ (4 cases: Cherokee, Manipuri, Sekani, Venda, Yecuatla Totonac)
 - /h/ and other liquids (3 cases: Arapesh, Finnish, Runyoro-Rutooro)
 - voiced bilabial fricative (3 cases: Ehueun, Lumasaaba (Masaba), Ukue)
 - vowels and liquids (but not glides) (3 cases: Catalan, Kanuri, Klamath)
 - voiced bilabial fricative and glides (2 cases: Ehueun, Lumasaaba (Masaba))
 - many others: 1 case each
- (14) Some of the “**unnatural**” classes include only [–**continuant**] segments. /l/ patterns with...
- labial and coronal (but not velar) nasal and other liquids (4 cases: Doyayo, Estonian, Finnish, Lower Grand Valley Dani)
 - glottal stop and other liquids (3 cases: Lower Grand Valley Dani, Madurese, Supyire Senoufo)
 - many others: 1 case each
- (15) There are also “**unnatural**” classes where /l/ simultaneously patterns with [+**continuant**] *and* [–**continuant**] segments. /l/ patterns with...
- fricatives, nasals, and other liquids (2 cases: Amele, Balangao)
 - fricatives, nasals, glides, and other liquids (2 cases: Aymara, Samish (Straits Salish))
 - many others: 1 case each
- (16) A variety of theoretical devices could be used to make the classes in (13-15) “natural”, e.g.:
- underspecification for /h/ or /ʔ/ and liquids (which in many of these cases are transparent to spreading) for (13, 14)
 - introducing new features like “[+/-glide]” for (13), or “[+/-sonorant-like]” (to cover /β/ and /y/) for (13)
 - changing feature definitions, e.g. letting [+anterior] refer to labials (as it did in SPE) in some cases (14) and letting [+continuant] refer to nasals in some cases (15).

- (17) There are also “**really unnatural**” classes that defy all but the most ad hoc attempts to make them seem natural. Unlike many of the “unnatural” classes listed above, the vast majority of these do not occur more than once in the survey, but there are hundreds of individual examples, just among the classes that contain /l/. For example, /l/ patterns with...
- a. /s/, /ʎ/, /n/, and /r/ (but not /r/ or other fricatives or nasals) (Lusi: segments which trigger final V dropping in CVCV reduplicants (Counts 1969))
 - b. /i/, /u/, /s/, /n/, /ɲ/, /ŋ/, /r/, and glides (but not any other fricatives, vowels, or labial consonants) (Maasai: segments which condition deletion of a preceding verb-initial /i/. The same segments block the deletion of a following verb-final /k/ (Hollis 1971))
 - c. /v/, /ɲ/, and /g/ (but not /r/, /j/, or any other stops or nasals) (Central South Saami: segments which usually cause a preceding initial /s/ to change to [ʃ] (Hasselbrink 1965))

4. How could this happen?

- (18) While it is true that phonetically similar segments often pattern together in the phonologies of the world’s languages, the survey shows no evidence that a set of innate features sets any limit on what is a possible phonologically active class.
- (19) A theory of phonology which places more emphasis on **inductive phonetically-based generalizations** may be better able to explain these observations. Data from groups of related languages indicate that phonological processes **generalize** in ways that do not necessarily correspond to distinctive features...
- (20) Data on the following pages illustrate three processes which affect slightly different segments in related languages:
- Pre-stopping in Pama-Nyungan
 - Consonant nasalization in Edoid
 - Postnasal hardening in Bantu

Pre-stopping in Pama-Nyungan: In many Pama-Nyungan languages spoken in and south of the Lake Eyre Basin, nasals and/or liquids are pre-stopped (e.g., /l/ → [dl]) either syllable-finally or after a stressed syllable (Hercus 1994).

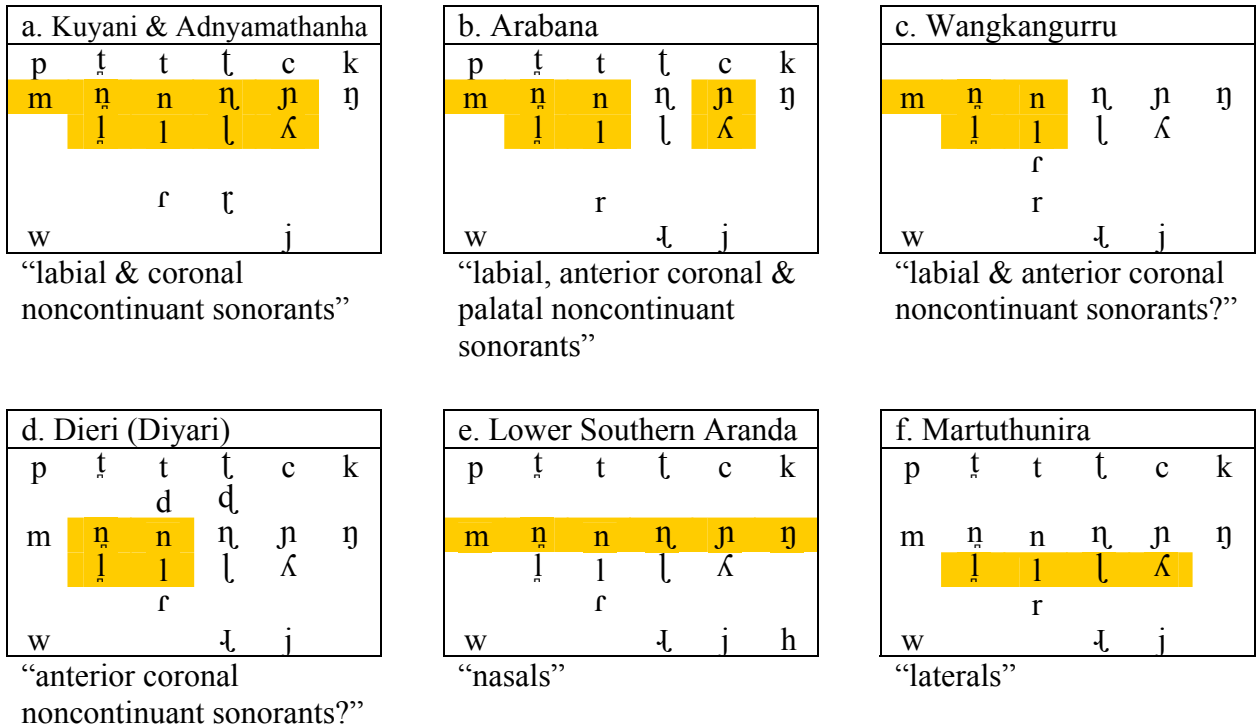


Figure 1. Pre-stopping consonants in some Pama-Nyungan languages (Austin 1981, Breen 2001, Dench 1995, Dixon 2002, Hercus 1994)

- (21) The identity of the class of sounds targeted by this inherited process appears to have been interpreted differently in each language:
- /l/ and other lateral liquids pattern with (traditionally noncontinuant) nasals in five of the languages (fig. 1a-d), while pre-stopping is limited just to nasals (fig. 1e) or laterals (fig. 1f) in one language each.
 - The class of pre-stopping consonants is further limited by place in four different ways in (fig. 1a-d), only one of which (fig. 1d) is readily expressible in traditional features.
- (22) While these processes in related languages are obviously related to one another, there is no way to unify them in terms of distinctive features. It appears that new generalizations are being formed about what consonants are involved, rather than simply being provided by a universal feature set.

Consonant nasalization in Edoid: In many Edoid languages (Elugbe 1989), certain consonants are nasalized when they precede nasal vowels.

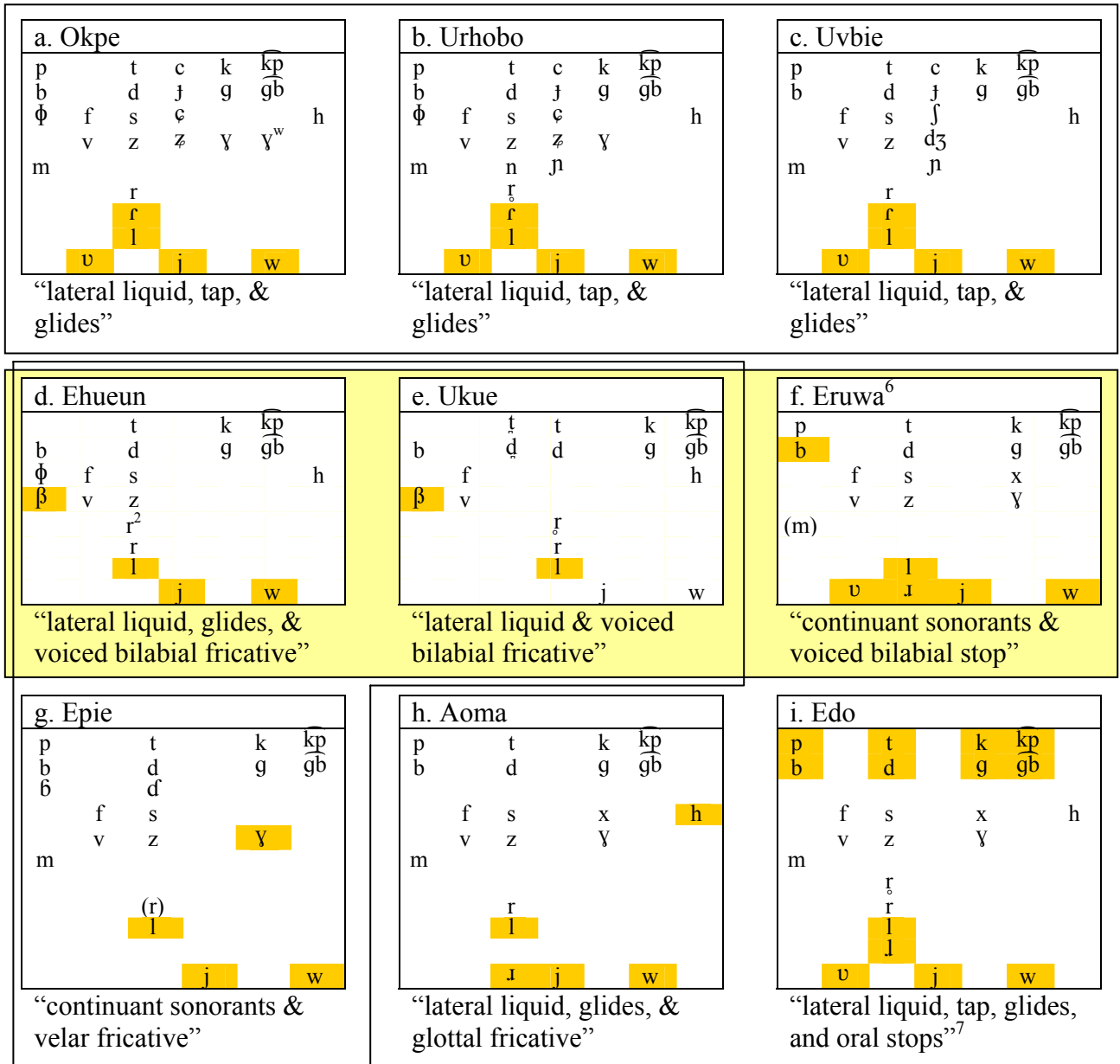


Figure 2. Allophonically nasalizing consonants in Edoid languages (Elugbe 1989)

⁶ Elugbe (1989:61) reports that [b] and [m] appear to be in complementary distribution, with [b] never occurring before nasal vowels, and he hypothesizes that [m] is the allophone of /b/ which occurs there.

⁷ Edo oral stops acquire nasal release before nasal vowels.

- (23) Elugbe (1989) reconstructs Proto-Edoid with *phonemically nasalized consonants* and *allophonically nasalized vowels*, as in several modern Edoid languages.⁸ The nasalization patterns in the languages in fig. 2 result from restructuring.
- (24) This restructuring appears to have occurred differently in different languages and without the guidance of an innate feature set:
- In addition to /l/, (traditionally continuant) glides nasalize in all but one language (fig. 2e), and a nonlateral flap nasalizes in three languages (fig. 2a-c).
 - A single bilabial fricative or stop nasalizes in three languages (fig. 2d-f), while a velar fricative nasalizes in one (fig. 2g)
 - /h/, a lateral flap, or the set of all oral stops are each affected in one language each (fig. 2h-i)
- (25) The segments involved in these processes cannot be formally related within or between languages if their feature specifications are universally determined.
- A universal feature set predicts that fricatives such as /h/, /β/, and /ɣ/ should be systematically included or excluded depending on what features are targeted by the nasalization process.
 - What appears actually to be the case is that the restructuring process in each language caused the pattern to be generalized to a set of phonetically similar segments which is different in different languages.

Postnasal hardening in Bantu: Fig. 3 shows a similar example in related Bantu languages. Liquids and glides are strengthened to stops after nasals in these languages, but as in the Edoid example, /β/, /ɣ/, /h/, and other fricatives exhibit ambivalent behavior, and the patterning of glides and /r/ is not completely consistent from language to language either.

⁸ Edoid languages with this pattern include Auchi, Egene, Emhalhe, Ghotuo, Ibilu, Isoko, Oloma, Uhami, and Uneme (Elugbe 1989).

Ambivalent segments

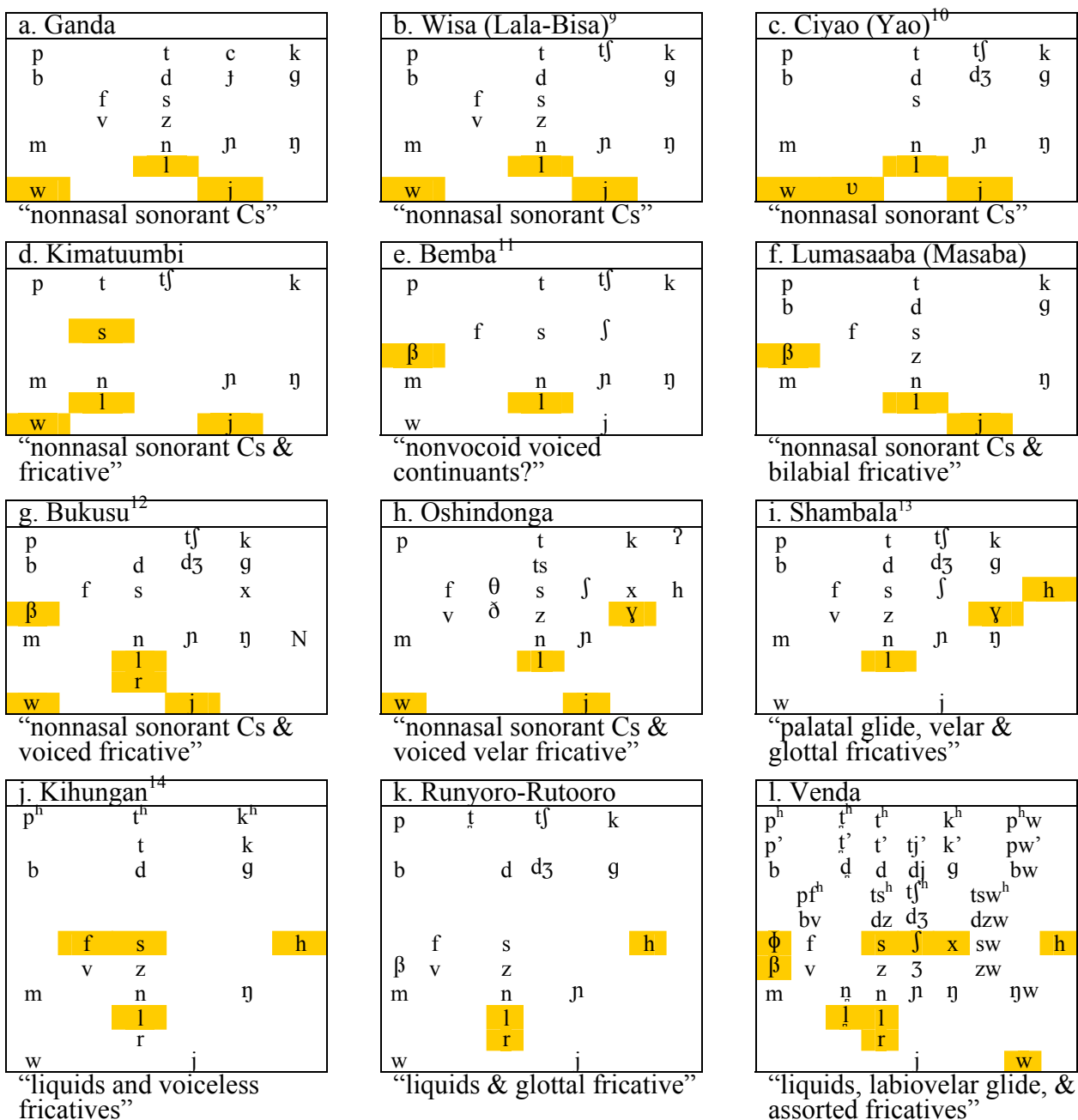


Figure 3. Consonants that undergo postnasal strengthening in some Bantu languages (Austen 1974, Besha 1989, Brown 1972, Cole 1967, Fivaz 1986, Madan 1906, Mutonyi 2000, Ngunga 2000, Odden 1996, p.c., Poulos 1990, Rubongoya 1999, Takizala 1974, van Sambeek 1966)

⁹ /w/ only strengthens after prefix /n/.

¹⁰ /l/ & /j/ become nasal stops.

¹¹ Nonlabial oral stops also turn into voiced stops after nasals.

¹² Austen (1974) treats [β] as an intervocalic allophone of /b/, whereas Mutonyi (2000) treats [b] as a postnasal allophone of /β/ (and posits no voiced stop phonemes). In either case, the distributional pattern for β/b matches w/b, j/ dʒ, l/d, and r/d.

¹³ /h/ strengthens to [p] in Shambala, Runyoro-Rutooro, and Venda.

¹⁴ /t/, /s/, & /h/ become voiceless affricates. Additionally, /t/ & /k/ become aspirated after nasals.

5. Discussion

- (26) Ambivalent segments are only puzzling if we maintain the assumption that each segment must have the same feature values in every language where it occurs.
- Abandoning this assumption does not automatically lead to a nihilistic “anything goes” theory of phonology.
 - Many interesting questions remain, such as **“Which segments can be ambivalent and why?”**
- (27) While sounds seem to stray from what have been argued to be their universal feature specifications, when they pattern in ways not predicted by universal distinctive feature theory, they nevertheless seem to pattern with sounds that share an acoustic or articulatory property, often one that is characteristic of the feature they appear to be sharing.
- (28) /l/ has clear articulatory similarities with continuants and with noncontinuants, and so inductive generalizations involving phonetic properties may take it in either direction.

	like [-continuant] sounds...	like [+continuant] sounds...
/l/	has a “blockage of airflow past the primary stricture” (Chomsky and Halle 1968)	lacks a total blockage of airflow (Chomsky and Halle 1968)

(29) The same is true of other segments and other features:

	like [-continuant] sounds...	like [+continuant] sounds...
/r, r/	involve “interruption of the air stream during at least part of the duration of the sound” (Chomsky and Halle 1968:318)	airflow is not actually blocked – the trill/flap itself is a secondary result of narrowing, caused by the Bernoulli effect (Chomsky and Halle 1968:318)
/m/, /n/	have a total blockage of airflow in the oral cavity	lack a total blockage of airflow

	like [-sonorant] sounds...	like [+sonorant] sounds...
/h/	does not allow spontaneous voicing	does not have a supralaryngeal constriction that causes increased intraoral pressure
/β/, /ɣ/	have a supralaryngeal constriction that causes intraoral pressure increase	may often be realized without a supralaryngeal constriction that causes increased intraoral pressure

(30) This talk has shown that the segments which most frequently exhibit ambivalent behavior are those which are non-prototypical examples of either pole of the relevant opposition (e.g., /l/ is neither a prototypical continuant nor a prototypical noncontinuant).

(31) If phonologically active classes result from inductive generalizations, segments which share phonetic properties with segments at either pole of an opposition would be expected to be able to pattern phonologically with segments on either end.

(32) If likely generalizations predict likely phonologically active classes, then distinctive features may be epiphenomenal.

- Features are defined in phonetic terms, so the natural classes predicted by universal feature theory involve segments that share phonetic properties.
- As shown here, the classes that are *not* predicted by universal feature theory *also* involve segments which share phonetic properties.
- Thus, the apparent predictive power of universal features may be an illusion that results from the fact that universal features are phonetically grounded and the fact that phonologically active classes tend to share phonetic properties (regardless of whether they are predicted by universal feature theory).
- The classes predicted by universal feature theory are a proper subset of the classes predicted on the basis of phonetic similarity, *and* a proper subset of the classes which are observed, which include recurrent classes of phonetically similar sounds and a wide array of non- or seldom-recurrent classes of dissimilar sounds.
- The classes which recur with greater than chance frequency are the ones which result from phonetically-based sound change or from phonetically-based generalizations.
- Phonetically-based generalizations are readily explained if language learners are armed with a general assumption that phonetically similar sounds pattern together (based on the prevalence of such patterns resulting from regular sound change). This assumption results in correct acquisition of “natural” phenomena, and may lead to overgeneralization in other cases, leading to even more “natural” phenomena (see Mielke 2003).¹⁵
- A theory of universal features may then be superfluous.
- Based on this and other mounting evidence (e.g., Pulleyblank 2003), a theory of emergent distinctive features is needed (Mielke 2003, in prep; for related discussion, see Lindau & Ladefoged 1996, Steels 1997, Lindblom 1999, de Boer 2000, Beckman & Pierrehumbert, to appear).

¹⁵ There is experimental evidence that phonetically unnatural classes are learnable (Onishi et al. 2002) but that phonetically natural classes are easier to learn (Wilson 2003).

6. Conclusion

- (33) This paper has provided evidence that the long-standing indecision over the continuancy of /l/ is well-founded.
- /l/ patterns with continuants as well as noncontinuants, and also participates in numerous phonetically natural and unnatural classes.
 - The recurrent classes involve phonetically similar segments, even when they cannot be characterized with traditional distinctive features, and the segments that tend to be ambivalent are the ones that are not prototypical examples of the + or – value of a relevant feature.
- (34) Universal distinctive features are most reliable for predicting the behavior of phonetically unambiguous segments.
- This is precisely the domain in which universal features are least necessary, because natural classes can be predicted on the basis of phonetic similarities.
 - In the phonetic gray areas, where universal features would be expected to define clear boundaries between two values of a feature, the phonological patterning of sounds is as varied as the phonetic cues are ambiguous.
 - Instead of universal features, this study supports a theory of emergent distinctive features which is rooted in sound change and in generalizations based on phonetic properties and phonological patterning.

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