

Revisiting ‘The role of features in phonological inventories’

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Summary of Clements (2009)

- “The role of features in phonological inventories”. In Raimy & Cairns (eds.) *Contemporary views on architecture and representations*.
 - Feature bounding
 - Marked feature values
 - Feature economy
 - Robustness
 - Phonological enhancement

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- Clements's findings

- Results from PHOIBLE

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About PHOIBLE

- ~1600 phonological inventories (1298 unique)
 - Stanford Phonology Archive (SPA)⁴
 - UCLA Phonological Segment Inventory Database (UPSID)¹³
 - *Systèmes alphabétiques des langues africaines* (AA)⁸
 - Published phonological descriptions / grammars

- Entries include:
 - Symbolic representations of phonemes (superset of IPA)
 - Genealogical, geographic, & demographic data (Ethnologue,¹¹ WALS⁹)
 - Vector of feature values for each phoneme

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Guiding principles of PHOIBLE development (1 of 2)

- As true to original description as possible (required several additions to IPA)

D	tap	distinguished from flap ɾ following Maddieson ¹²
a _ɹ	fortis	
a _ɻ	lenis	
a _ɸ	frictionalized	approximant ⇒ fricative; clicks with fricated anterior release
a _̥	non-strident	
a [•]	half-long	
a ^H	epiglottalized	
a ^ʔ	glottalized	used with voiceless consonants, or wherever source implies something other than “creaky”

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- Unique feature-value vector for each phoneme as described in source (regardless of within-language contrasts)
- Example: feature-value vectors should distinguish
 - S (English)
 - \mathfrak{S} (Spanish)
 - \mathfrak{S} (Basque¹⁵)
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Features in PHOIBLE

- Currently 37 features
 - Mostly follows Hayes¹⁰ and Moisik & Esling¹⁴
- Hierarchical organization: parent node [-value] \Rightarrow child node [0value]
 - All [-coronal] segments are [0anterior, 0distributed, 0strident]
 - All [-dorsal] segments are [0high, 0low, 0front, 0back]
 - All [-labial] segments are [0round, 0labiodental]
 - 0 values treated as not contrasting with either + or -
- Contour segments: ordered tuple values for certain features
 - Example: kL'_{g} (velar ejective with lateral release)
 - has feature values [-sonorant], [-,+continuant], [-nasal], [-,+lateral], etc.
 - found in Zulu (Bantoid, Niger-Congo)

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Phonemes in PHOIBLE

- ~2000 distinct segments (~1000 occur in only one language)
 - $\underset{=}{\underset{=}{\text{ɕ}}}$ (non-strident voiceless retroflex fricative)
 - found in Sa'ban (Malayo-Polynesian, Austronesian)²
 - $\tilde{\text{ɯ}}$ (nasalized creaky high back round vowel)
 - found in Mambay (Adamawa, Niger-Congo)¹
 - $\text{t}^{\text{ʔ}}$ (glottalized voiceless retroflex stop)
 - found in Siona (Tucanoan)¹⁸
 - $\text{ɬ}_{\text{ɮ}}$ (simultaneous alveolar/velar voiceless lateral fricative)
 - found in Akluslay/Nivaclé (Matacoan)¹⁷

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Feature bounding: Definition

- Mathematical relationship between segments & features
 - minimum $\lceil \log_2(n) \rceil$ binary features needed to distinguish n phonemes
 - Linguistic features rarely orthogonal; actual number of features needed often much higher

Feature bounding: Clements's findings from UPSID

- Observation: coronals in UPSID restricted to 4-way place contrasts at most
- Prediction: $[\pm\text{anterior}] \times [\pm\text{distributed}]$ might be enough to capture all (within-language) contrasts
 - Cf. “phonetic approach”: interdental / apico-dental / lamino-dental / apico-alveolar / lamino-alveolar / retroflex / (lamino)postalveolar / alveolo-palatal / (dorso)palatal
- Finding: phonological approach accounts for all coronal contrasts in UPSID
 - Exceptions (Albanian & !Xóõ) rely on secondary features (velarization/pharyngealization & affrication, respectively)

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Feature bounding: Results from PHOIBLE

Four-way coronal stop contrasts

Contrast	Language	Genus, Root	Features needed
$t \quad t \quad t \quad t$	Eastern Arrernte Western Arrarnta Yanyuwa	Pama-Nyungan, Australian	
$t \quad t \quad t \quad c$	Alyawarra Diyari Yolngu Kalkatungu	Pama-Nyungan, Australian	anterior, distributed
$t \quad t \quad t \quad \text{ɕ}$	Tira	Heiban, Niger-Congo	
$t \quad t \quad t \quad \text{ɕ}$	Nunggubuyu	Nunggubuyu, Australian	
$t \quad t \quad t \quad c$	Garawa	Garawan, Australian	anterior, distributed, dorsal
$t \quad t \quad \text{ɕ} \quad c$	Quechan	Yuman, Hokan	ɕ & c both [-ant +dist +dors]

Feature bounding: Results from PHOIBLE

Attested coronal stop contrast types (1 of 2)

Contrast type (à la Clements 2009 ³)	Contrast	Sample language	#lx.
{apical / nonapical} anterior	$\text{t} \quad \text{t̪}$	Nez Perce (Sahaptian, Penutian)	58
	$\text{t} \quad \text{t̥}$	Maung (Iwaidjan, Australian)	5
	$\text{t̪} \quad \text{t̪̥}$	Didinga (Surmic, Nilo-Saharan)	1
{apical / nonapical} posterior	$\text{t̠} \quad \text{C}$	Siraiki (Iranian, Indo-European)	20
	$\text{t̠} \quad \text{t̠̥}$	Bardi (Nyulnyulan, Australian)	5
	$\text{t̠} \quad \text{C̥}$	Alawa (Maran, Australian)	3
apical {anterior / posterior}	$\text{t} \quad \text{t̠}$	Iai (Oceanic, Austronesian)	38
nonapical {anterior / posterior}	$\text{t̪} \quad \text{C}$	Chrau (Bahnaric, Austro-Asiatic)	42
	$\text{t̪} \quad \text{t̪̥}$	Ngiyambaa (Pama-Nyungan, Australian)	5
	$\text{t̪} \quad \text{C̥}$	Nunggubuyu (Nunggubuyu, Australian)	2
	$\text{t̪} \quad \text{C}$	Kunjen (Pama-Nyungan, Australian)	1

Feature bounding: Results from PHOIBLE

Attested coronal stop contrast types (2 of 2)

Contrast type (à la Clements 2009 ³)	Contrast	Sample language	#lx.
	t C	Shekgalagari (Bantoid, Niger-Congo)	183
apical anterior / nonapical posterior	t t̥	Amuzgo (Amuzgoan, Oto-Manguean)	12
	t ç̥	Campa (Arawakan)	4
nonapical anterior / apical posterior	t̥ t̄	Bagirmi (Bongo-Bagirmi, Nilo-Saharan)	48
	t̥ t̄	Punjabi (Indic, Indo-European)	6
nonapical {anterior / posterior}? (t̥ vs C according to Furby ⁶)	t̥ C	Garawa (Garawan, Australian)	1
“palatal” vs “pre-palatal” according to Halpern ⁷	ç̥ C	Quechan (Yuman, Hokan)	1

Feature bounding: Results from PHOIBLE

Three- and four-way coronal fricative contrasts

Contrast	Language	Genus, Root	Features needed
θ s \int	26 languages		
s \int ξ	20 languages	various	
ξ \int ξ	3 languages		anterior, distributed
ξ \int ξ	Basque	Basque	
ξ s ξ	Chimborazo Quichua	Quechuan	
ξ s \int	Serrano	Takic, Uto-Aztecán	
θ ξ \int	Galician	Romance, Indo-European	
θ ξ s \int	Berta	Berta, Nilo-Saharan	anterior, distributed, strident
θ ξ s \int	Libyan Arabic	Semitic, Afro-Asiatic	

Feature bounding: Summary

- Clements's generalization about coronals holds across >99% of languages
- Most violations resolved with other common features (dorsal, strident)
- Only remaining violation (Quechan ç vs c) possibly reanalyzable as t̤ vs c , which [dorsal] serves to distinguish

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Marked feature values: Definition

- Marked feature value: fails to occur in some languages, and complementary value never fails to occur
 - Example: [+nasal] consonants are missing from some languages (21 in PHOIBLE)
 - All languages have [-nasal] consonants
 - Therefore [+nasal] is marked (for consonants)

- Marked segment: segment that exhibits a marked feature

- Clements's predictions:
 - Languages w/ marked segments will have larger inventories
 - Within a language, marked segments < unmarked segments (constrained to segments for which the marked feature matters)

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Marked feature values: Clements's findings from UPSID

- [+sonorant]
- [+continuant]
- [+nasal]
- [+strident]
- [+posterior]
- [+lateral]
- [+spread glottis]
- [+constricted glottis]
- [+round]
- [+high]
- [+low]
- [+front]
- [+labial]
- [+dorsal]

Marked feature values: Results from PHOIBLE

Marked feature values for vowels (1 of 2)

Marked feat.	What is rare?	Langs. w/o marked feat.		% langs. w/ unmarked segs. > marked segs.
		Pct.	Count	
[-voice]	Voicing contrast	>99%	1293	100%
[+coronal]	Rhotic vowels	>99%	1293	100%
[+atr]/[+rtr]	Pharyngeal/ATR contrast	>99%	1287	100%
[+short]	Length contrast	99%	1279	100%
★ [+nasal]	Nasal contrast	77%	1002	93%
[+long]	Length contrast	66%	852	80%

★ denotes findings mentioned in Clements 2009³

3 of the 19 languages requiring [short] also require [long], constituting a three-way length contrast. The languages are South Central Dinka (Nilotic, Nilo-Saharan), Ndut-Falor (Northern Atlantic, Niger-Congo), and Hopi (Hopi, Uto-Aztecan).

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Marked feature values for vowels (2 of 2)

Marked feat.	What is rare?	Langs. w/o marked feat.		% langs. w/ unmarked segs. > marked segs.	
		Pct.	Count		
★ [+labial]	Lack of rounded vowels	1.2%	15	90%	
★ [+high]	Lack of high vowels	<1%	11	81%	
★ [+front]	Lack of front vowels	<1%	6	87%	
	[+back]	Lack of back vowels	<1%	6	88%
★ [+low]	Lack of low vowels	<1%	4	99%	

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Marked feature values: Results from PHOIBLE

Marked feature values for consonants (1 of 2)

Marked feat.	What is rare?	Langs. w/o marked feat.		% langs. w/ unmarked segs. > marked segs.
		Pct.	Count	
[+epiConstr]	epiglottal consonants /H ʕ/	>99%	1297	100%
[+fortis]	plain/fortis contrast	>99%	1294	100%
[+click]	clicks	99%	1280	100%
[+syllabic]	syllabic/nonsyllabic contrast	98%	1276	100%
[+low]	pharyngeal consonants /ħ ʕ/	96%	1248	100%
[+long]	length contrast	94%	1213	100%
[+rLrx] (ejct)	ejective consonants	89%	1158	100%
[-high]	uvular/pharyngeal(ized) cons.	84%	1093	99%
[+lLrx] (impl)	implosive consonants	81%	1052	100%
[+tap]	tap/flap consonants	72%	931	100%
★ [+constrGlott]	glottalized/creaky/ejective cons.	54%	697	100%
[+trill]	trilled consonants	52%	668	100%

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Marked feature values: Results from PHOIBLE

Marked feature values for consonants (2 of 2)

Marked feat.	What is rare?	Langs. w/o marked feat.		% langs. w/ unmarked segs. > marked segs.	
		Pct.	Count		
	[+labiodent]	lack of labiodentals	38%	487	99%
★	[+spreadGlott]	lack of aspirated cons. or /h/	31%	400	100%
★	[-anterior]	lack of retroflex & palatal cons.	14%	177	94%
	[+lateral]	lack of laterals	13%	166	100%
	[+back]	lack of velar/uvular(ized) cons.	11%	137	93%
★	[+strident]	lack of coronal fricatives/affricates	5.6%	73	82%
	[+front]	lack of palatals & fronted velars	5.2%	67	85%
	[+delayedRel]	lack of fricatives	3.2%	42	70%
★	[+nasal]	lack of nasal cons.	1.6%	21	99%
★	[-voice]	lack of voiceless cons.	<1%	6	76%
★	[+sonorant]	lack of approximants & nasals	<1%	1	87%
★	[+labial]	lack of labial & rounded cons.	<1%	1	97%
★	[+dorsal]	lack of dorsals	<1%	1	95%

★ denotes findings mentioned in Clements 2009³

Marked feature values: Summary

- Many more marked feature values than discussed by Clements
- [+round] not marked in PHOIBLE
 - 164 langs. lack [+round] consonants, but 2 langs. lack [-round] consonants (lack /p b m f v/, but have rounded/unrounded dorsals)
- Feature geometry/hierarchy has important implications for markedness results

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- Feature Economy
 - Feature set expansion to close remaining gaps
 - By-language dimensionality reduction to discover “optimal” feature sets
- Markedness
 - Alternative calculation based on cross-linguistic occurrence of features in economy-optimized, language-specific feature subsets
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- PHOIBLE development
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 - Allow alternative feature systems to be swapped in easily
 - Interface with lexical data (cognate identification, feature weighting)

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