

The Life Cycle of Voiceless Sonorants: A Study in Differential Phonologization

Juliette Blevins
CUNY Graduate Center, jblevins@gc.cuny.edu

I. VOICELESS SONORANTS: FOUR KINDS, ONE PROBLEM

(1) Four kinds of voiceless sonorants

DESCRIPTION	COVER SYMBOL	SAMPLE SEGMENTS	FEATURE MAKE-UP*	σ -POS
Voiceless laryngeal glide	h	/h/	[+SG,-vd] [+son,-cons] no PL	free
Other voiceless glides	W̥	/w̥, j/	[+SG,-vd], [+son,-cons], PL	non-Nuc
Voiceless sonorant consonants	R̥	/l̥, m̥/	[+SG,-vd], [+son,+cons], PL	non-Nuc
Voiceless vowels	V̥	/i̥, u̥/	[+SG,-vd], [+son,-cons] ,PL	Nuc

*[+SG] = [+spread glottis]; PL = Place. Other feature specifications are possible, but a minimal system of three laryngeal features is necessary to distinguish phonological contrasts between plain modal voice, breathy voice, creaky voice and voiceless sonorants.

(2) Frequency, distribution and contrastive status of voiceless sonorants

As *phonetic* segment types, voiceless sonorants are extremely common, though often overlooked. For example in many languages with /sR/ clusters, R a sonorant, R is phonetically voiceless (e.g. English [sɲæk], [s̥ɲæk], [sm̥æk]). However, as contrastive segments, there is an interesting typological asymmetry:

TYPE	FREQUENCY (MADDIESON 1984)	GENETIC/AREAL DISTRIBUTION	CONTRASTIVE STATUS	IMPLICATIONS FOR SEGMENT INVENTORY?
h	279/317 63.6%	all major language families	very common	none
W̥	11/317 .035%	South-East Asia; Northwest NA; Meso-America	uncommon	if W̥ then W; /h/
R̥				if R̥ then R; /h/
V̥	2/317 .006	(Nilo-Saharan) (Sino-Tibetan)	rare/unattested*	If V̥ then V; /h/

*Maddieson (1984) lists Ik (Nilo-Saharan) and Dafla (Sino-Tibetan) as having contrastive voiceless vowels. See below for details.

(3) Some phonetic properties of voiceless sonorants

Chomsky and Halle (1968:302) define *sonorant* sounds ([+sonorant]) as those produced with a vocal tract cavity configuration in which spontaneous voicing is possible, while obstruents ([-sonorant]) have cavity configurations which make spontaneous voicing impossible. Stevens (1983:254) enhances these definitions by referring directly to the aerodynamic pressure increase in obstruents and associated turbulent noise (during closure or release), and the absence of this intraoral air pressure and associated noise in sonorants. In later work inhibition of vocal fold vibration is noted as a mechanical effect of air pressure increase in obstruents (Stevens 1997:490).

The articulation of *voiceless sonorants*, like modal voiced sonorants, involves approximately equal air pressure above and below the glottis, with no significant increase of intra-oral air pressure. However, since vocal folds are not in their neutral position, there is no modal voicing. Instead, vocal folds are widely spread at the arytenoid cartilages, or there some other glottal devoicing gesture, while in modally voiced sonorants there is none. In general, no vocal cord vibration is present and longitudinal tension, medial compression and adductive tension are minimal, though, in some cases, vocal cords vibrate at low amplitude despite glottal aperture. Depending on glottal area and transglottal airstream turbulence, frication can arise. (Ladefoged 1971; Gordon and Ladefoged 2001; Bombien 2006; Tucker and Warner 2010).

Acoustic properties associated with voiceless sonorants include: greater duration of voiceless sonorants than voiced sonorants; increased spectral noise at higher frequencies; decrease in overall acoustic intensity; fall off of energy at higher frequencies (negative spectral tilt, in contrast to modal voice with intermediate values, and positive values for creaky voice); possible raising of fundamental frequency; possible shifts in formant frequencies (Maddieson & Anderson 1994; Gordon and Ladefoged 2001; Turnbull et al. 2011).

(4) Non-contrastive status of voiceless vowels

A. Ik (Kuliak), Karamojong, Teso, Turkana (Eastern Nilotic) and other Nilo-Saharan

Though Heine (1975) and Dimmendale (1982, 1983) suggest that Turkana has a contrast between word-final voiced and voiceless vowels, this analysis is dubious, for the following reasons, as suggested by Schrock (2011:7-8) for Ik and other languages of the NE Uganda, NW Kenya region:

- i. Voiceless vowels are limited to word-final position and are voiceless only in phrase-finally before pause.
- ii. Voiceless vowels are voiced when non-final in the phrase.
- iii. In some languages, like Ik, the phrase-final reduced vowel variant can be voiceless or a short (voiced) schwa.
- iv. In some languages, like Teso and Turkana, the vowels are not pronounced at all in phrase-final position.
- v. In some languages, like Turkana, a phrase-final sequence of $R\check{V}//$ is pronounced ... $R\check{ɔ}$] with a final voiceless sonorant consonant allophone.
- vi. In Ik and Toposo, nominal case-endings are often, but not always, voiceless when phrase-final.
- vii. There are no minimal or near-minimal pairs distinguished only by voiced/voiceless vowel pairs.

(5) General explanations for synchronic distribution of linguistic features

The State-Process Model (Greenberg 1966, 1969, 1978): For any state of a natural human language there must be (i) at least one process leading to that state; and (ii) at least one process leading from it to a different state. If this is the case, then synchronic distribution of linguistic features offers insight into their rates of diachronic innovation and transmission. High frequency features may be frequently innovated, robustly transmitted or both. Rare features may be rarely innovated, poorly transmitted, or both. Genetic and areal distribution of linguistic features can be highly suggestive of innovation and transmission rates. If a feature clusters within related languages or in language areas, especially where there is thought to be significant time depth, the feature shows diachronic fitness, persisting over time, and (in cases of areal features) spreading to unrelated languages. If, on the other hand, there is random distribution of a feature within a language or area, this suggests poor transmission, genetically and/or laterally.

Evolutionary Phonology (Blevins 2004, 2006, 2008): A sound or sound pattern S may be rare because (i) there is no sound change $XZY > XS\mathbf{Y}$, or this sound change itself is rare; or because (ii) there is a common sound change $X\mathbf{S}\mathbf{Y} > XZY$. Clicks appear to be rare because they rarely originate via natural phonetically-based sound change from non-click sounds; however, once evolved, they are relatively stable. Three-way contrasts in nasality or vowel length appear to be rare because they commonly morph into (or phonologize as) two-way contrasts.

(6) The Problem

i. Phonetic vowel devoicing is extremely common among unrelated languages with predictable voiceless vowels occurring in two common contexts:

- a. phrase-final, pre-pausal
- b. adjacent to voiceless consonants (especially /h/ and /s/)

50 languages with voiceless vowels (Gordon 1998): Acoma, Ainu, Alabama, Apinaye, Awadhi, Azerbaijani, Bagirmi, Big Smokey Valley Shoshoni, Boraana Oromo, Bulu, Campa, Cheyenne, Chontal, Cocama, Comanche, Dafla, French (Montreal), Gadsup, Galla, Goajiro, Greek, Hupa, Ik, Inuit, Island Carib, Japanese, Kawaiisu, Ket, Korean, Malagasy, Mandarin, Mbay, Mixtec, Mokilese, Nyangumarta, Oneida, Papago, Portuguese (Brazilian), Quechua, Saami, Sara, Shina, Southern Paiute, Tarascan, Ticuna, Tongan, Totonac, Tubu, Tunica, Turkana, Turkish, Tzeltal, Washkuk, Woleaian, Zuni.

ii. Phonetic sonorant glide/consonant devoicing is extremely common among unrelated languages with predictable voiceless sonorants in occurring in two common contexts:

- a. phrase-final, pre-pausal
- b. adjacent to voiceless consonants (especially /h/ and /s/)

Angas, Camuno, English, Icelandic, Kishambaa Lenakel, Romanian, Tohono O'odham, etc.

iii. Nevertheless, voiceless vowels rarely if ever phonologize, while voiceless sonorant consonants do (Table 2). Under the general models just sketched, this might be attributed to the fact that voiceless vowels delete more frequently than other voiceless sonorants, and do so before they can phonologize. However, the genetic and areal distribution of voiceless vowels in, e.g. Numic, Micronesian and the northern Uganda/Kenya region suggests some degree of diachronic persistence. *How, then, do we explain this asymmetry in phonologization?*

(7) Differential deletion?

The most common sound change that applies to voiceless vowels is deletion (Blevins 2004:199). However, the fact that voiceless vowels often delete does not explain why those that do not fail to phonologize. (It is unclear whether word-final voiceless vowels are any more or less likely to delete than word-final voiceless nasals or glides. Data in Dafla, reported in (4b), shows (voiceless) final vowel loss in one dialect; the same dialect shows loss of final (voiceless) /ŋ/.)

(8) Perceptual markedness?

Gordon (1998:93) suggests that “non-modal vowels are perceptually less robust than modal vowels and are therefore eschewed by many languages.” A universal constraint *NON-MOD V is proposed, but can be ranked above or below constraints demanding vowel devoicing on the basis of articulatory/aerodynamic ease. The same reasoning would lead to a similar constraint for other sonorants (*NON-MOD R). This synchronic analysis highlights a weakness of constraint-based grammars: since most are geared to generate surface allophones from underlying forms, or relate surface phones to phones, they are at a loss to explain why a particular phone should resist phonologization. In contrast, an evolutionary approach allows us to ask: what are the stages of phonologization, and how might differences in the phonetics of sonorant devoicing result in states that are incompatible with reanalysis of \bar{V} as something distinct from V?

II. THE EVOLUTION OF VOICELESS SONORANTS

(9) Prelude: Stages of phonologization in splits

Stage 1	XaY	VaW	
Stage 2	XaY	Va'W	a' is a phonetic variant of a
Stage 3	XaY	Va'W	a' is a predictable variant of a in context V_W
Stage 4	XaY	Qa'R	conditioning of a' is opaque in Q_R

(10) Phrase-final, pre-pausal devoicing

Most likely due to decline in subglottal pressure across the utterance; in some languages, enhanced by phrase-final laryngeal spreading gestures (Blevins 2006)

- i. $V > \bar{V} // (> \bar{V} \# > \emptyset)$ ii. $R > \bar{R} // (> \bar{R} \# > \emptyset)$

Ainu vs. Woleaian vs. Trukese Icelandic vs. Angas vs. Galambu (WChadic)

May progress from word-final to phrase-final, but, significantly, there is no evidence of phonologization of voiceless sonorants (R, W or V) in this context.

Why? Because (i) word-final conditioning remains transparent and (ii) in languages like Woleaian, suffixation shows alternation between non-final voiced and final voiceless vowels:

meja	meja-fi	‘feel’/trans.
fire	fire-xi	‘weave’/trans.

(11) Gestural spreading, segmental fusion

A great deal of work explores the hypothesis that in HR clusters, H an aspirate (/h/, /s/, aspirated stops), and R a sonorant, sonorant devoicing is a consequence of gestural overlap or sharing of a single laryngeal aspirating gesture (e.g. Gordon 1998; Tsuchida et al. 2000, Bombien 2006, Tucker and Warner 2010).

- i. $V > \check{V} / H$
- ii. $R > \check{R} / H$ ($\check{R}H, HR > \check{R}$)

Voiceless vowels can arise in this way, as in the organic vowels of Comanche (4c), where, historically, there is evidence of (i), with vowel devoicing before {h,s}.

Voiceless sonorants also commonly evolve this way, but interestingly, with a twist: unlike vowels where a VC or CV sequence is maintained, a simultaneous or subsequent sound change *merges* the sonorant + aspirate into a single segment, as in Kokota, an Oceanic language of the Solomons (Palmer 1999, 2009):

	<u>Zabana</u>	Kokota	
*namaha	namaha	naṃa	‘love’
*komuhu	komuhu	koṃu	‘season/year’
*naroho	naroho	naṛo	‘rope’

This segmental merger explains certain phonetic properties of voiceless sonorants:
 a) voiceless-voiced (Tibeto-Berman) or voiced-voiceless (Kokota) contours
 b) longer segment durations

The answer to why voiceless vowels rarely phonologize seems directly related to a simple difference between (11i) and (11ii) above: gestural overlap between a vowel and /h/ is less likely to be interpreted as a single V segment because of phonotactic constraints of a given language, and the fact that, given that all languages have /h/, there is always the possibility of the /hV/ or /Vh/ interpretation. In contrast, in all languages where CC clusters occur, a single C can occur as well, so overlapped gestures can always be interpreted as single Cs.

- i. kohno ‘cradle’ haβi-kɔno ‘night cradle’
- ii. tosa ‘white’ to-tɔsa ‘white’ (RED)’

(12) Obstruent weakening (not relevant to vowels)

- i. ʈ > ɭ
Tahltan (Shaw 1991) Maori ??
- ii. ɸ > w
- iii. ɣ̥ > ɣ

Selected References

- Abraham, P. T. 2005. *A Grammar of Nyishi language*. Delhi: Farsight Publishers and Distributors.
- Arden, Michelle. 2010. A phonetic, phonological, and morphosyntactic analysis of the Mara language. M.A. Thesis, San Jose State University.
- Armogost, James L. and Wick R. Miller. 2000. Are voiceless vowels phonemic in Comanche? In Eugene H. Casad and Thomas L. Willet (eds.) *Uto-Aztecan structural, temporal, and geographic perspectives*. Hermosillo: Universidad de Sonora. 57-82.
- Aumann, Greg and Paul Sidwell. 2004. Subgrouping of Mienic Languages: Some Observations. *Papers from the Eleventh Annual Meeting of the Southeast Asian Linguistics Society: SEALS XI*. Tempe, Arizona State University. South East Asian Studies Program, Monograph Series Press.
- Bartholomew, Doris. 1960. Revisions of Proto-Otomi Consonants. *IJAL* 26:317-29.
- Bhaskararao, Peri and Peter Ladefoged. 1991. Two types of voiceless nasals. *Journal of the International Phonetic Association* 21. 80-88.
- Blankenship, Barbara, Peter Ladefoged, Peri Bhaskararao, Nichumeno Chase (1993). "Phonetic structures of Khonama Angami". *Fieldwork Studies of Targeted Languages, UCLA Working Papers in Phonetics* 84: 127-141.
- Blevins, Juliette. 2004. *Evolutionary phonology: The emergence of sound patterns*. Cambridge: CUP.
- Blevins, Juliette. 2006. A Theoretical Synopsis of Evolutionary Phonology, *Theoretical Linguistics* 32:117-65.
- Blevins, Juliette. 2008. Natural and unnatural sound patterns: A pocket field guide. In Klaas Willems and Ludovic De Cuypere (eds.), *Naturalness and Iconicity in Language*. Amsterdam: John Benjamins. 121-48.
- Blevins, Juliette. 2009. Structure-preserving sound change: A look at unstressed vowel syncope in Austronesian. In A. Adelaar and A. Pawley (eds.). *Austronesian historical linguistics and culture history: A festschrift for Bob Blust*. Canberra: Pacific Linguistics. 33-49.
- Blust, Robert. 2009. *The Austronesian Languages*. Canberra: Pacific Linguistics.
- Bombien, Lasse. 2006. Voicing alternations in Icelandic sonorants - a photoglottographic and acoustic investigation. *AIPUK, Working Papers of the Institute for Phonetics*, University of Kiel 37: 63-82.
- Buckley, Eugene. 1990. Glottalized and aspirated sonorants in Kashaya. In M. Langdon (Ed.), *Papers from the 1990 Hokan-Penutian Workshop*, pp. 75-91. Carbondale, IL: Southern Illinois University.
- Buckley, Eugene. 1992. *Theoretical aspects of Kashaya phonology and morphology*. University of California, Berkeley Ph.D. dissertation. [Published by CSLI 1994].
- Catford, J. 1964. Phonation types: the classification of some laryngeal components of speech production. In D. Abercrombie, D.B. Fry, P.A.D. MacCarthy, N.C. Scott and J.L.M. Trim (Eds.), *In honour of Daniel Jones*, pp. 26-37. London: Longmans.
- Catford, J. 1977. *Fundamental problems in phonetics*. Edinburgh: Edinburgh University Press.
- Chomsky, Noam and Morris Halle. 1968. *The Sound Pattern of English*. New York: Harper & Row.
- Clayton, Ian D. 2010. *On the Natural History of Preaspirated Stops*. PhD Dissertation, University of North Carolina at Chapel Hill.
- Dantsuji, M. 1986. Some acoustic observations on the distinction of place of articulation for voiceless nasals in Burmese. *Studia Phonologica* 20. 1-11.
- Das Gupta, K. 1969. *Dafla language guide*. Shillong: Research Department, North-East Frontier Agency. Accessed via STEDT database <<http://stedt.berkeley.edu/search/>> on 2012-01-09.
- Greenberg, Joseph. 1966. Synchronic and diachronic universals in phonology. *Language* 42, 508-517.
- Greenberg, Joseph. 1969. Some methods of dynamic comparison in linguistics. In Jan Puhvel (ed.). *Substance and structure of language*. Berkeley and Los Angeles: University of California Press.

- Greenberg, Joseph. 1978. Diachrony, synchrony, and language universals. In Joseph Greenberg, Charles Ferguson, & Edith Moravcsik (eds.), *Universals of Human Language*, vol. 1: Method and Theory. Stanford: Stanford University Press. 61-91.
- Greenhill, S.J., Blust, R., & Gray, R.D. (2008). The Austronesian Basic Vocabulary Database: From Bioinformatics to Lexomics. *Evolutionary Bioinformatics*, 4:271-283. (Data accessed November 2011)
- Gordon, Matthew. 1998. The phonetics and phonology of non-modal vowels: a cross-linguistic perspective. *Berkeley Linguistics Society* 24, 93-105.
- Gordon, Matthew and Peter Ladefoged. 2001. Phonation types: a cross-linguistic overview. *Journal of Phonetics* 29, 383-406.
- Heine, B. 1975. Ik – eine ostafrikanische Restsprache. *Africa und Ubersee* 59:31-56.
- Huffman, M.K. 1987. Measures of phonation type in Hmong, *Journal of the Acoustical Society of America* 81: 495-504.
- Jaques, Guillaume and Alexis Michaud. 2011. Approaching the historical phonology of three highly eroded Sino-Tibetan languages: Naxi, Na and Lazi. *Diachronica* 28: 468-98.
- Jessen, M. and M. Pétursson. 1998. Voiceless Nasal Phonemes in Icelandic. *Journal of the International Phonetic Association* 28. 43-53.
- Karlsson, Anastasia Mukhanova and Jan-Olof Svantesson. 2011. Preaspiration in Mongolian Dialects: acoustic properties of contrastive stops.
- Ladefoged, Peter. 1971. *Preliminaries to linguistic phonetics*. Chicago: University of Chicago.
- Ladefoged, Peter and Ian Maddieson. 1996. *The sounds of the world's languages*. Oxford: Blackwell.
- Maddieson, Ian. 1984. *Patterns of sounds*. Cambridge: Cambridge University Press.
- Maddieson, Ian and Victoria Anderson. 1994. Phonetic Structures of Iaa. *UCLA Working Papers in Phonetics 87: Fieldwork Studies of Targeted Languages II*: 87:163-182.
- Maddieson, Ian and Karen Emmory. 1984. Is there a valid distinction between voiceless lateral approximants and fricatives? *UCLA Working Papers in Phonetics* 59.
- Myers, Scott and Benjamin Hansen. 2007. The origin of vowel length neutralization in final position: Evidence from Finnish speakers. *Natural Language and Linguistic Theory* 25:157-93.
- Palmer, Bill. 1999. Voiceless Sonorants – Phonemes or Underlying Clusters? *Australian Journal of Linguistics* 19: 77-88.
- Ray, P. S. 1967. Dafla phonology and morphology. *Anthropological linguistics* 9. 8: 9-14.
- Schrock, Terrill. 2011. *The phonological segments and syllabic structure of Ik*. *Electronic Working Paper 2011-004*. SIL International.
- Shorto, Harry L. 2006. edited by Sidwell, Paul, Cooper, Doug and Bauer, Christian. *A Mon-Khmer comparative dictionary*. Canberra: Australian National University. Pacific Linguistics.
- Smith, Norval. 2005. Final sonorant devoicing in early Yokuts field records. In *Organizing Grammar: Studies in Honor of Henk van Riemsdijk*. Hans Broekhuis et al. (eds.), Berlin: Mouton. 592-98.
- STEDT lexical database. <http://stedt.berkeley.edu>
- Stevens, Kenneth N.. 1983. Design features of speech sound systems. In P. F. MacNeilage (ed.) *The Production of Speech*, New York: Springer. 247-61.
- Stevens, Kenneth N. 1997. Articulatory-acoustic-auditory relationships. In W. J. Hardcastle and J. Laver (eds.), *The Handbook of Phonetic Sciences*, Oxford: Blackwell. 462-506.
- Tayeng, Aduk. 1990. *Nishi Phrase book*. The Director of Information and Public Relations, Arunachal Pradesh, Shillong.
- Thongkum, T. 1988. Phonation types in Mon-Khmer languages. In O. Fujimura (Ed.), *Vocal fold physiology: voice production, mechanisms and functions*, pp. 319-334. New York: Raven Press.
- Thurgood, Graham. 1999. *From Ancient Cham to Modern Dialects: Two Thousand Years of Language Contact and Change*. Honolulu: University of Hawaii Press.
- Tsuchida, A., Abigail Cohn and M. Kumada. 2000. Sonorant devoicing and the phonetic realization of [spread glottis] in English. *Working Papers of the Cornell Phonetics Laboratory* 13. 167-181.
- Tucker, Benjamin V. and Natasha Warner. 2010. What it means to be phonetic or phonological: The case of Romanian devoiced nasals. *Phonology* 27: 289-324.
- Turnbull, Rory, Magnus Pharo Hansen and Ditte Boeg Thomsen. 2011. How a moribund dialect can contribute to the bigger picture: Insights from Acazolco Otomi. Paper presented at CUNY Phonology Forum, January 2011.