On the Typology of Final Laryngeal Neutralization: Evolutionary Phonology and Laryngeal Realism*

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1. Introduction. This commentary outlines a typology of final laryngeal neutralization under the assumptions of ‘laryngeal realism’, an approach to feature representation which distinguishes structurally the two-way contrasts of ‘voice’ languages (Dutch, Polish, Spanish) from those of ‘aspiration’ languages (German, Somali, Washo). The typology in turn opens the door to a fresh test for what has emerged as a central debate about Evolutionary Phonology (EP), namely, the status of ‘unnatural’ developments, in particular, the possible occurrence of ‘final voicing’ patterns. While EP allows for the existence of such systems, Kiparsky (this volume) argues vigorously that the proposed cases should all be reanalyzed, and that final voicing is actually unattested because it is impossible in human language.

EP, in short, accommodates ‘crazy rules’ like final voicing as possible albeit rare products of intertwining historical processes (rare because the changes that lead to them are uncommon), whereas a more traditional generative perspective implies that final voicing not only does not but cannot occur, given the structure of universal grammar. Final aspiration, however, a direct parallel to final voicing in structural terms (involving addition of a marked feature), is similarly predicted to be impossible under universal markedness, yet is robustly and securely attested (Vaux & Samuels 2006). The reasons for this, we will suggest, are that final aspiration, despite neutralizing to a marked feature ex nihilo, enjoys structural motivation from two areas of the grammar that Blevins regards as ‘pure phonology’ (2004:251-258): phonological features and prosodic structure. In the following, we first sketch the theoretical stakes here in greater detail (§2), then lay out the typology of final laryngeal neutralization as it affects voicing and aspiration contrasts (§3), and the consequences of that typology (§4), followed by a concluding summary (§5).

2. The stakes. Blevins (this volume) expands on her 2004 description of the natural forces which lead to the emergence of the common final devoicing pattern and the historical coincidences which give rise to the rare final voicing pattern. She presents several familiar motivations for the rise of final devoicing, from the difficulty for speakers to maintain modal voice in obstruents to the challenge for hearers to perceive a voicing distinction in word-final position, where stops are often not released. With these physiological and perceptual factors...
favoring voicelessness, and disfavoring voicing, the emergence of final obstruent devoicing is the hallmark of a ‘natural’ phonological development, and the basis for its widespread occurrence across languages (Russian, Dutch, Catalan, etc.).

Moreover, some languages mark the boundaries of phonological phrases by either spreading or constricting the glottis: in the former case, phrase-final stops are aspirated, in the latter they are glottalized, but in both cases voicing is inhibited because vocal fold vibration in obstruents, aerodynamically difficult to begin with (Ohala 1999), is facilitated by a neutral glottis with neutral or slack vocal folds rather than a spread or constricted glottis in which the vocal folds are commonly stiffened (Halle & Stevens 1971, Avery & Idsardi 2001, Iverson & Salmons 2003a). The resulting frequent tokens of voiceless phrase-final obstruents then serve as the basis for learners of the language to overgeneralize to word-final position as well, yielding an edge-marking pattern of final aspiration (Kashmiri, Klamath, cf. Vaux & Samuels 2006) or final glottalization (which, Blevins reports, may be emergent in English, especially among alveolars).

But other sound changes, she argues, can give rise to a pattern in which final stops are regularly voiced. This is very rare, apparently because, as Blevins emphasizes, there is no natural phonetic or aerodynamic reason to make stops voiced in final position. But one case that has been widely reviewed is Lezgian (Yu 2004), whose plain voiceless series emerges as voiced in word-final position. Blevins (2004, this volume) has endorsed this analysis of final voicing, and interprets final neutralization in Somali and certain other languages along similar lines. While admittedly rare, a pattern of final voicing is learnable, on the assumptions of EP, but results in a rule or constraint of nonassimilatory neutralization which adds rather than removes the feature of [voice] from final position.1

EP thus sanctions nonassimilatory neutralizations not only to the structurally unmarked member of an opposition, per commonly applied models of autosegmental phonology (e.g., Goldsmith 1990), but also to the phonologically specified member. Even though less often implemented, this generalization of the theory allows, as we will argue momentarily, for the more accurate characterization of obstruent neutralization in some languages as final fortition rather than final devoicing. Moreover, it makes a novel connection, for EP, between commonly learned patterns of neutralization that involve structural reductions and those (some phonetically motivated, others not) which are less frequent, yet still learnable, involving feature additions. The match-up in nonassimilatory neutralization patterns between structural reductions, which are commonplace, and structural additions, which are rather rare, thus

1 That unnatural phonological patterns are as learnable as natural ones has been driven home in recent psycholinguistic experimental work. Pycha et al. (2003), in particular, show that naïve adult subjects can just as easily make generalizations over data that reflect a pattern of vowel disharmony, an unnatural process, as they can vowel harmony, an archetypically natural pattern. Parallel to final voicing, then, the fact that general vowel disharmony is rare (if not unknown) among languages is due to the absence of natural phonetic factors that would give rise to it, whereas the coarticulatory conditions underlying vowel harmony, like the phonetic factors inducing final devoicing, are familiar and commonplace, i.e., natural.
reflects (if imperfectly) the familiar natural versus unnatural divide, a distinction whose formal expression fits well into the historical/functional paradigm of EP.

The stakes for our understanding of the nature of sound systems in human language are high in this debate, as Kiparsky summarizes (this volume):

(1) Phonologists have postulated as a universal that marked features may be suppressed in such “weak” positions in favor of unmarked features, but not conversely. In OT [Optimality Theory], this putative universal is formally reflected by the existence of constraints that prohibit marked features in weak positions, and the absence of constraints that prohibit unmarked features in them. A markedness constraint may be defeated by a higher-ranked constraint (either by another markedness constraint, for instance one that enforces assimilation, or by faithfulness constraints). But it may not be reversed.

In privative terms, feature addition in codas is prohibited because it is neutralization to a marked feature in a weak position; [voice] can be deleted in codas, in other words, but cannot be inserted there. Final voicing then is not simply unattested — a position for which Kiparsky presents detailed arguments — but is rendered impossible because of the way that markedness relations are encoded in our capacity for language. We return to this point in §4 below.

3. Laryngeal Realism. Let us first draw attention to the basic differences in phonation between what are now often contrasted as ‘voice languages’ versus ‘aspiration languages’. On the one hand are languages like Dutch (and the Romance and Slavic languages) with early voice onset time (VOT) in initial, thoroughly voiced stops but with short lag VOT in voiceless, unaspirated stops; on the other hand are languages like German, as well as English and most of the other Germanic languages, with short lag VOT in initial voiced stops (which are thus phonetically really not voiced) but with long lag VOT in voiceless, heavily aspirated stops (Lisker & Abramson 1964). Following Kim’s (1970) groundbreaking work on aspiration, Iverson & Salmons (1995, 2003a, b) develop what has come to be called the ‘multiple feature hypothesis’ (Kager et al. 2005) or simply ‘laryngeal realism’ (Honeybone 2005), a proposition which structurally distinguishes glottal phonation types according to basic feature representation.\(^2\) Specifically, laryngeal realism holds that the thoroughly voiced stops of Dutch will be represented phonologically with the privative feature [voice], leaving the voiceless unaspirated stops laryngeally neutral, whereas the voiceless, typically aspirated stops of German are marked with the feature [spread glottis], rendering the so-called voiced stops in this language as neutral or unspecified. Importantly, this contrast in basic representation is arrived at through

\(^2\) Laryngeal realism, in our work and closely parallel work by Jessen 1998, has been expanded and developed by many, including Jessen & Ringen (2003), and applied to language change by Honeybone (2005, forthcoming) and Calabrese & Halle (1998), to language typology by Kehrein & Golston (2004), to psycholinguistics by Brown (2004), and to language acquisition by Kager et al. (2005); cf. also earlier work anticipating these findings by Anderson & Ewen (1987), Harris (1994), Spencer (1996).
examination of the phonetic properties of the languages themselves as well as their ambient phonological phenomena, including biases in the directionality of laryngeal assimilation (toward segments marked for [spread glottis] in aspiration languages, toward [voice] in voice languages; cf. Iverson & Salmons 1995, 1999, 2003b). The choice of laryngeal marking in a given language is not based on typological considerations under this approach, then, nor on cross-linguistic naturalness. Instead, linguistic generalizations about the internal workings of a language are determined by analysis of the same kind of phonetic input and phonological patterns that learners of it are exposed to, i.e., on the basis of data rather than putatively universal predilections.

Central to our present concerns is the fact that, in both Dutch and German, laryngeal oppositions are neutralized in final environments — but in Dutch this is final devoicing (loss of [voice]) (cf. Iverson & Salmons 2003b), while in German it is final fortition (addition of [spread glottis]) (cf. Iverson 1997 and Iverson & Salmons forthcoming). In the context of EP, as described above, other languages neutralize final laryngeal distinctions in other ways: rarely, as appears to be the case in Lezgian, there is final voicing, i.e., the addition of [voice]; more commonly, there is also final lenition, i.e., the removal of [spread glottis], as in Korean (which neutralizes final manner distinctions as well as the language’s lax–tense–aspirated contrast: all stops, fricatives and affricates reduce to unreleased laryngeally neutral stops; Iverson 1989). Southern Icelandic (Hansson 2003) and some modern German dialects (Iverson & Salmons forthcoming), to cite other examples, also show final lenition.

Structurally, these four types of final laryngeal neutralization are reflected in four kinds of rules that may be learned on the basis of the input data, as laid out in (1), in which the ‘final’ environment is taken to be the right edge of the syllable.3

3 For the sake of simplicity, we leave aside glottalics here (marked by the feature [constricted glottis]), focusing instead on neutralizations involving [voice] and [spread glottis].
(2) a. Final devoicing: /d, t/ → [t] (Dutch, Polish, Catalan)

\[ \begin{array}{c|c|c}
\sigma & /d/ & /t/ \\
\hline
\dagger & | & | \\
\text{[voice]} & \text{[voice]} & [ ] \\
\end{array} \]

b. Final voicing: /d, t/ → [d] (Lezgian, perhaps others)

\[ \begin{array}{c|c|c}
\sigma & /d/ & /t/ \\
\hline
\dagger & | & | \\
\text{[voice]} & \text{[voice]} & [ ] \\
\end{array} \]

c. Final lenition: /tʰ, t̥/ → [t] (Korean; with final devoicing as well in Sanskrit, Thai)

\[ \begin{array}{c|c|c}
\sigma & /t^h/ & /t/ (or /d̥/) \\
\hline
\dagger & | & | \\
\text{[spread]} & \text{[spread]} & [ ] \\
\end{array} \]

d. Final fortition: /tʰ, t̥/ → [tʰ] (German, Kashmiri, Washo)

\[ \begin{array}{c|c|c}
\sigma & /t^h/ & /t/ (or /d̥/) \\
\hline
\dagger & | & | \\
\text{[spread]} & \text{[spread]} & [ ] \\
\end{array} \]

Formally, these rules appear to be identical in structure and complexity, although final devoicing (2a) and final lenition (2c) are feature delinkings whereas final voicing (2b) and final fortition (2d) are feature additions. Theories of autosegmental phonology, especially those embellished by feature underspecification, generally explain assimilations as the spreading of a specified feature from one segment into a position that is unspecified in another (or which becomes so through delinking of a feature that is already there), as in, for example, the assimilation of unspecified coronals to the place of articulation of specified labials and velars (Iverson & Kim 1987, Rice 1994). Nonassimilatory neutralizations, conversely, are described in terms of the removal or delinking of a specified feature, the result then ‘defaulting’ to the segment which is unspecified for that feature. This is the case with both final devoicing and final lenition as presented in (2a, c), and represents the formal means by which the theory seeks to capture the Trubetzkoyan insight that the direction of nonassimilatory neutralization is to the unmarked member of an opposition — hence final devoicing in Dutch, final lenition in Korean.

The neutralizations in (2b, d), however, involve the addition of a feature ex nihilo, placing final voicing and final fortition in a category quite different from final devoicing and final lenition. It is noteworthy, then, that the rarity of final voicing correlates with the oddity of its phonological characterization as a nonassimilatory neutralization, viz., the addition of a feature ([voice]) from no apparent source, and with no apparent motivation. Final voicing thus joins the class of ‘crazy rules’ identified by Bach & Harms (1972) — rules which exist in a grammar,
and which of course can be learned, but which are without apparent synchronic motivation, having arisen through sound changes whose initial impetus has been obscured by the development of other changes.

4. The consequences of laryngeal realism for EP. Kiparsky (this volume) maintains that final voicing does not occur in any general way, and proposes counteranalyses for all the examples of final voicing that Blevins raises. In the celebrated case of Lezgian, a proposed alternative treatment of the laryngeal phonology aims to bring it closer in line with how related languages are described, each without final voicing. For Somali, the reanalysis rests on the fact that ‘voiceless’ stops are cued by aspiration, hence are better represented as ‘tense’ or ‘fortis’, while the ‘voiced’ stops are phonemically voiceless and unaspirated, being voiced only passively (Iverson & Salmons 2003a, b) and so should be taken as underlyingly ‘lax’ or ‘lenis’, i.e., laryngeally neutral. Somali final neutralization, accordingly, is lenition in the manner of (2c) rather than voicing in the manner of (2b). But while the bona fide existence of general final voicing patterns would vitiate the contention “… that marked features may be suppressed in such “weak” positions in favor of unmarked features, but not conversely,” the nonexistence of these patterns does not prove the contention, either, absence of evidence not being evidence of absence. The point thus is not so much that final voicing DOES exist in some language, a curious consequence of coincidental historical developments, but that it COULD exist, i.e., that it is learnable in principle — just as unnatural vowel disharmony patterns are learnable if they are regular (cf. footnote 1). The cross-linguistic dearth of final voicing is readily explained by the fact that the event is ungrounded in phonetic naturalness (indeed, conflicts with the physics of articulation), so attention should be focused on other final neutralization phenomena which are incompatible with the view expressed in (1), namely, fortition. Here, too, the views advanced by Blevins and Kiparsky make quite different predictions.

The synchronic motivation for final fortition is the marking of phrase boundaries, which may generalize to word and syllable boundaries. Though this is feature addition without assimilatory source, and thus runs against the grain of traditional expectations, its demarcative function of signaling a prosodic edge gives it further force and enhances the likelihood of its occurrence. In phonetic terms, as Blevins notes, Ohala (1983) suggests that a spread glottis can be understood as anticipatory coarticulation to an approaching pause. Structurally, as a single, perceptually salient and acoustically prominent gesture (as opposed to the sharply diminishing effect of obstruent vocal fold vibration), aspiration lends itself to demarcative and prosodic functions. Addition of [voice] constituent-finally has none of these characteristics and thus is not a plausible demarcative signal, diachronically or synchronically. In short, final voicing lacks any motivation or support, and should therefore be quite rare, though still possible to learn.

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4 This characterization is eerily reminiscent of the evidence brought by the present authors (1995) for a ‘laryngeally real’ treatment of German and English, with marked underlying fortis or aspirated stops standing in contrast to phonemically unmarked lenis, passively voiced ones.
Under the view laid out in (1), final devoicing and final lenition are both possible and should be expected, while both final voicing and final fortition are claimed to be impossible. Yet final fortition is well attested, as reviewed recently by Vaux & Samuels (2006) over an array of disparate languages for which they interpret the aspirated stops as unmarked precisely because these are the product of final neutralization, not unaspirated ones. In the typology laid out in (2), however, and from the evolutionary perspective on synchronic phonological patterns, aspirated stops in positions of nonassimilatory neutralization can still be regarded as marked relative to unaspirated ones; but the exclusive occurrence of aspirates there (if not due to a synchronically ‘crazy’ rule) should serve some grammatical function — in the present examples, the marking of prosodic edges. To cite a parallel case, Yu (2006, p.c.) confirms earlier reports that Washo neutralizes its three-way laryngeal contrast consistently to the aspirate, with mandatory release in all contexts, i.e., applying a feature addition rule of the form in (2d). [confirm this with Alan!] The naturalness of final fortition thus lies in its extraphonological motivation as a prosodic edge marker; service of this grammatical function appears to override the autosegmental or theoretical peculiarity of nonassimilatory feature addition. Lacking such grammatical utility, however, the similarly baseless feature addition involved in final voicing is neither morphologically functional nor phonetically purposeful. Hence, final voicing falls somewhere between rare and nonexistent, albeit not impossible.

5. Summary and conclusions. We have filled out the typology of final neutralization as it affects voicing and aspiration contrasts under the assumption of ‘laryngeal realism’. Final devoicing (Dutch) is joined by final lenition (Korean, perhaps Somali) as an anticipated process of final laryngeal neutralization via weakening. The other possibilities, final voicing and final fortition, qua feature addition, are both less common than feature loss. Nonetheless, final fortition is widely attested. It is prosodically motivated, as a constituent edge marker, so does not represent the typological oddity that final voicing appears to. (Final glottalization would present another parallel to final voicing and final fortition.) Such patterns fall out naturally and expectedly from EP, but run counter to the position on markedness and neutralization that is articulated in (1).

Early work in EP has emphasized the historical processes which lead to and underlie synchronic phonological behavior, but has had less to say about the role of the abstract phonological structures that Blevins recognizes, features and prosody. The present commentary has focused on how prosodic structures interrelate with the historical phonetic mechanism of laryngeal neutralization, already well described in EP. Word-final laryngeal neutralization apparently has origins in phonetically-motivated phrase- or clause-final neutralization, leading often to loss of features (devoicing, lenition) but sometimes instead to addition, as a means of prosodic edge marking (fortition), or, rarely, as a consequence of coinciding independent changes (voicing). EP recognizes the full, if restricted, range of final neutralization possibilities listed in (2), and more generally invites the suggestion that sound patterns are shaped by the forces of history and acquisition on the one hand, and abstract structural considerations on the other. The markedness bias identified in (1) is thus not absolute, but is tempered by natural
historical forces as well as by the internal phonological predisposition to favor, *ceteris paribus*, feature deletion over feature addition in nonassimilatory neutralizations — but neither of these, it turns out, is ruled out.

References


Blevins, Juliette. This volume. “A theoretical synopsis of Evolutionary Phonology,” *Theoretical Linguistics*.


