

Some Observations Regarding The Synchrony and Diachrony of External Sandhi Processes

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I. Overview

- (A) Coarticulation seems like the ultimate foundation for many sound change events. We adopt a modified definition of coarticulation from Manuel (1999) – “...patterns of coordination, between the articulatory gestures of neighbouring segments, which result in the vocal tract responding at any one time to commands for more than one segment.” Specifically, for us, the notion ‘commands’ refers to ‘commands for implementing the phonological features of the segment.’ In this sense, coarticulation is epiphenomenal.
- (B) Phoneticians have noted cross-linguistic variation in coarticulation patterns. We take this to be an observational description which, when made explicit, entails language-specific prosodic and suprasegmental features combining with universal, physiological gestural overlap.
- (C) One recent example of language-specific coarticulation is found in a study by Dutta, Irfan and Harsha (2016). They found that Telugu appears to have significantly stronger carryover, rather than anticipatory, vowel co-articulation in adjacent syllables. Their study focussed particularly on the unexpected nature of certain so-called vowel harmony cases, which appeared to be anticipatory (regressive) rather than carryover (progressive) as predicted from the coarticulation patterns. Rather than examine a case that is questionable in terms of whether or not it involves assimilation (see Kissock 2014, 2010 for arguments against vowel harmony in Telugu), we turn to several other processes where coarticulation may have been influential in their appearance.¹
- (D) While we might not expect *all* phonological processes to follow from carryover co-articulation, since other factors may be at play, we might predict, a priori, that external sandhi effects – a fairly coherent subgroup – would group together with respect to the directionality of co-articulation. In addition, we suppose that such sandhi processes (like all phonological processes) are assumed to have arisen from sound change. To the extent that any sandhi process is assimilatory or dissimilatory, we assume that coarticulation is instrumental in such change.

II. Some Aspects of Telugu Sandhi

- (E) We take as our case study a set of Telugu external sandhi processes, beginning with one which results in final vowel deletion before a following vowel-initial word.

¹Although the Dutta et al study focuses exclusively on V-V coarticulation, the general claim of carryover coarticulation has consequences for sequences of VC as well as V-V.

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|-----|--|---|------------------|---|--|---|-------------------|
| (1) | <i>me:ka undi</i>
goat be-IIIsgMasc | → | <i>me:k undi</i> | → | <i>qabbu ante:</i>
money say-CONDIT | → | <i>qabb ante:</i> |
| | “There’s a goat there.” | | | | “If you’re talking about money...” | | |

The vowel deletion is an across-the-board effect, triggered solely by adjacency (lack of intervening pause).

- (F) A second external sandhi process consists of voicing assimilation where a voiceless initial consonant is voiced when the preceding word ends in a vowel. This process is sensitive to syntactic structure/phonological phrasing and therefore does not occur across-the-board. Lisker (1963) describes this process; recent fieldwork confirms that it remains productive.

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|-----|---------------------------------------|---|--|
| (2) | <i>ka:du</i> → <i>ka:du</i>
be-NEG | → | <i>adi ka:du</i> → <i>adi ga:du</i>
that be-NEG |
| | “No (it’s not).” | | “That’s not right.” |

Both the vowel deletion and the initial voicing processes are well documented (see Lisker 1962 *inter alia*) and remain productive.

- (G) A reasonable initial assumption is that vowel deletion processes of the type listed above arise from regressive/anticipatory assimilation of the first V to the second V, resulting in a misanalysis. (Poor or no evidence of the UR V of the first word, reduction and ultimately an analysis of complete deletion.) The initial consonant voicing process appears to be a clear case where progressive/carryover coarticulation caused a misparse of the cues for voicelessness. (A discussion of how this could arise in the context of no general intervocalic voicing follows later in the paper.)
- (H) It seems, then that we have both regressive and progressive external sandhi processes in Telugu. If sound change is largely predicated on coarticulation, and if, as some have maintained, coarticulation can be said to generally show directionality, this is a surprising result.
- (I) The aberrant pattern of the two processes, given Dutta et al., is the vowel deletion process. If, diachronically ‘other factors’ than mere coarticulation could be responsible for the rise of vowel deletion, the aberrancy will be abated.

III. Epenthesis and Deletion

- (J) We propose that the vowel deletion process arose, not through misanalysis of coarticulation effects, but rather through the interaction of the ambiguity introduced by u-epenthesis in certain environments.
- (K) As we have discussed elsewhere (Hale and Kissonck ms, 2012 and Kissonck 2010, 2014), Telugu has an extremely productive word-level epenthesis of [u] to any consonant-final word when that word occurs *in pausa*, whether sentence internally, sentence finally, or in citation forms. In addition, evidence from plural formation suggests there are also underlying final /u/’s, though these are massively less frequent than final *u* arising from epenthesis.

(3) /CVC/ → [CVCu] (Telugu word-level epenthesis)

(L) For historical reasons, words which lexically contain final vowels are much fewer in number compared to those that end in consonants. Surface forms, therefore, show a preponderance of final [u]'s (a limited number of which may be lexical) relative to other vowels (*i*, *a*, and in an extremely limited distribution, *e* and *o*).

(M) We can outline the possible sandhi environments that the acquirer was faced with at some earlier point as well as their potential analyses as follows:

(4) a. CVCu # CVC → CVCu CVC (pre-consonantal epenthesis)

b. CVCu # VC → CVC VC (pre-vocalic lack of epenthesis)

(5) a. Analysis 1 of the 4ab contrast: no epenthesis before following vowel-initial words

b. Analysis 2 of the 4ab contrast: word-level epenthesis followed by deletion of the epenthesized [u] before following vowels

(N) In the pre-vocalic environment, the acquirer could assume an environment for epenthesis that was greater than the word-level, resulting in failure of epenthesis in just those cases in which the final C could be resyllabified with the following initial V (Analysis 1). On the other hand, the acquirer might assume epenthesis had, in fact, occurred across-the-board at the word level, but that there was in addition a deletion process which deleted the epenthesized [u] before a following initial V (Analysis 2) in some higher prosodic domain (e.g., the intonation group—recall that there is no deletion before a pause).

(O) We propose that the synchronic vowel deletion process arose from the acquirer's choice of Analysis 2. Note that as soon as such an analysis was in place, the rare underlying word-final /u/ would be affected (since, once epenthesized in one prosodic domain, subsequent domain-level processes could not distinguish between underlying and epenthetic [u]). The probability of overgeneralization to other final vowels (also quite rare) seems to us high, with the result that a general vowel-deletion process in sandhi environments which were prevocalic came into being.

(P) Thus the apparent directionality issue can be resolved by removing coarticulation as the trigger for the vowel deletion process, should that be a desirable outcome.

IV. Progressive VC Voicing Assimilation in Telugu

(Q) The second issue we would like to address today concerns the diachrony of the 'initial stop voicing' process presented above in (2). It, too, appears to involve coarticulation, but there are interesting complications.

(R) You will recall from that example that Telugu has a process whereby, in close external sandhi contexts, initial voiceless stops get voiced. Interestingly, word-internal sequences of the same type do not show this voicing. That is, given the three strings below (where '=' indicates a close prosodic connection between the words on either side of the boundary, a # a word boundary without such a close prosodic connection), we get the following results:

/aka/ → [aka]
 /a = ka/ → [aga]
 /a # ka/ → [aka]

- (S) This looks a lot like a post-lexical version of a ‘derived environment effect’—sequences of /ka/ following /a/ which are composed at some prosodic level (let’s say, the phonological phrase) show the effects of a phonological process (voicing of the /k/) distinct from those sequences that either already existed before the construction of that level (word-internal /aka/) or had not yet been composed (a # ka).
- (T) Derived environment effects are of course well-known in the phonological literature, but, particularly in the case of phonology-syntax interface induced external sandhi effects of the type seen here, they give rise to an interesting conceptual challenge for theories which seek to explicate sound change, and the phonological processes which result from such changes, in misparsing during acquisition.
- (U) While it is easy to see that the ‘distant’ /a/ in the /a # ka/ case will not trigger any strong voicing effect on the following /k/, how can the /a/ in the /a=ka/ case trigger a *stronger* voicing coarticulation effect on the following /k/ than does the obviously more tightly connected /a/ in the word-internal /aka/ case? That is, how could a ‘more distant’ preceding /a/ trigger greater coarticulatory effects (to mask voicelessness) on a following /k/ than a ‘closer’ preceding /a/ does?
- (V) There is, we think, a helpful if also not entirely clear parallel from Sanskrit which can be invoked here. As you all, in your role as professional phonologists, know, Sanskrit shows a well-known (if also not entirely understood) process of the retroflexion of /s/ in the so-called RUKI environment (i.e., after high vowels and their glide counterparts, /r/ and velars). A typical example is /sádənt-/ ‘sitting’ next to /nisádənt-/ → *niṣádənt-* ‘sitting down’:

$$\begin{array}{cccccccc}
 & & \text{RUKI} & & & & & \\
 & & \curvearrowright & & & & & \\
 \text{n} & \text{i} & \text{ś} & \text{á} & \text{d} & \text{ə} & \text{n} & \text{t-}
 \end{array}$$

- (W) Less well-known in the general phonological literature is a restriction on RUKI known as the *tisra*-rule. As you can see from *tisrə-* (‘three-FEM’), although the /s/ meets the conditions for RUKI, it is nevertheless not RUKIed. The relevant conditioning factor is the following /r/ (which may follow at some minimal distance, e.g., *viṣərgə-* not **viṣərgə-*—see Hale, forthcoming).
- (X) /r/ itself is a well-known trigger of retroflexion (even at a distance), not only in the RUKI rule, but also in the *ṇati*-rule: /r/ triggers retroflexion of /n/ rightward as long as no coronals intervene (roughly, again see Hale, forthcoming, for a discussion). The other RUKI triggers do not do this.

- (6) a. *soma-* makes the instrumental *somenə* ‘with Soma’
 b. *indra-* makes the instrumental *indreṇə* ‘with Indra’

$$\begin{array}{ccccccc}
 & & & \text{ṇati} & & & \\
 & & & \curvearrowright & & & \\
 \text{i} & \text{n} & \text{d} & \text{r} & \text{e} & \text{ṇ} & \text{ə}
 \end{array}$$

- (Y) Given the strongly retroflexed nature of Sanskrit /r/, we would expect some coarticulation between it and an immediately preceding /s/, but the sequence /sr/ does not show retroflexion of its /s/. Whatever coarticulatory effect was present, it was apparently ‘corrected for’ by acquirers, who (correctly) attributed it not to an inherent feature on the /s/, but rather to coarticulation with the following /r/. [This contrasts with the RUKI case, obviously.]
- (Z) So, in an intensive like /sarsre/ ‘he extends himself’ (RV 6.18.7b), how are we to understand, diachronically, the *tisra*-exception—i.e., the fact that the RUKIification of the inter-*r* /s/ which we expect to be triggered by a preceding /r/ is blocked by a following /r/?

s
a
r

 $\xrightarrow{\text{RUKI}}$
s
r
e

- (a) Obviously, to get RUKI to come into being, some acquirer (mistakenly) decided that the coarticulation effect on /s/ from a preceding RUKI-trigger was too great to be attributed to coarticulation alone, leading to the positing of the RUKI rule to account for the (mis)perceived output.
- (b) To cross the threshold for reanalysis of coarticulation as being due instead to a phonological rule, we believe that it can be relevant that *another trigger* for the perceived retroflexion is present in the string. In essence, the coarticulatory effect of the following /r/ on the realization of /s/ is such that it *masks* some of the RUKI-effect—enough of the RUKI effect that the realization of /s/ can be attributed to simple coarticulation from the segments on either side, with no ‘rule’ required.
- (c) Note that under this scenario the [s] in *sarsre* may well be **more** retroflexed than the [ʂ] in [niʂádənt-], but in the former case we have multiple triggers for coarticulatory realization of [s], in the latter only the RUKI-inducing segment is available.
- (d) Let us return, then, to the Telugu case. We know from the existence of intervocalic voicing of voiceless stops that both preceding and following vowels induce some coarticulatory effects on such stops. If such coarticulation was only triggered by preceding (voiced) vowels, we would find more frequently post-vocalic (rather than intervocalic) voicing, which is not the case. If such coarticulation was only triggered by following (voiced) vowels, we would find more frequently prevocalic (rather than intervocalic) voicing, which, again, is not the case.
- (e) So having a vowel on both sides of you induces a stronger coarticulatory voicing effect than either having only a vowel to your left or only a vowel to your right. However, as we saw with *sarsre*, strong coarticulatory effects from both sides may allow for relatively trivial *correct* analysis as mere coarticulation, and thus *disfavor* a coarticulation-triggered sound change.
- (f) So we would propose that in the word-internal /aka/ cases in Telugu, the coarticulatory voicing effect of the vowels on /k/ was so clear, that there was no ambiguity as to what the learner should attribute it to: coarticulation.
- (g) In the post-pausal (a # ka) and phrase-initial (## ka) cases, the effect of only a following /a/ was so minimal, that no voicing was triggered (as expected).
- (h) It is precisely in the case of phrasally-close preceding /a/, i.e., the /a = ka/ cases, that there was *some* voicing spillover, but not enough for it to be *unambiguously* attributed to coarticulation. Since the effect is weaker than in the clearly coarticulatory /aka/ case, and stronger than in the ‘no voicing spill-over’ /a # ka/ case, the acquirer posits a rule-driven effect—the now synchronically active voicing rule.

- (i) The parallel with RUKI is telling: RUKI segments trigger some retroflexion effect on following /s/, more than we would see in a simple /sre/ case, but surely less than in the /rsr/ case. The case with the strongest effect (/rsr/) is treated as ‘mere’ coarticulation, the case with an intermediate effect (a preceding, but not a following, retroflexion trigger) is treated as rule-driven.

V. Conclusions

- (j) The origin of vowel deletion in external sandhi can involve the reanalysis of the context of non-epenthesis as a context of deletion, rather than being due to coarticulation. We believe that such reanalyses are common.
- (k) What the initial consonant voicing case suggests is that the trigger for coarticulation-induced sound change is not the coarticulation *per se*, but the absence of unambiguous coarticulation cues.
- (l) Both of these cases suggest that assessing the role of directionality of coarticulation in the diachronic development of phonological rules can be more complex than it first appears.

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