EPENTHETIC NASALS IN THE HISTORICAL PHONOLOGY OF HINDI

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ABSTRACT

We demonstrate the plausibility of a posited historical process whereby an epenthetic nasal consonant appeared between a sequence of nasal vowel + voiced stop (but not if the stop was voiceless) by showing that the same process occurs phonetically in present-day Hindi and French pronunciation.

1. INTRODUCTION

Modern Hindi (MH) words such as [dãt] "tooth vs [tʃãnd] "moon" present an interesting asymmetry in their phonological history: in their development from Middle Indo-Aryan (MIA) to Old Hindi (OH) and then to New IA both were subject to cluster simplification with compensatory lengthening and nasalization of the preceding vowel [1, 4]. Thus: Skt danta > MIA danta > OH dãta > MH [dãt]; Skt čandra > MIA čanda > OH čãda > MH [tʃãnd].[6] (Historical forms are given in conventional transliteration; modern forms in IPA where [ɑ] is inherently long.) In the latter example the nasal consonant, present in MIA but then subsequently lost, re-appears in MH. Is it plausible that a nasal be re-introduced only before a voiced stop or should we rethink the historical derivation of such words? The primary evidence that the nasal was indeed lost by the time of OH is the fact of compensatory lengthening of the vowel which in numerous other instances correlates with simplification of medial consonant clusters or geminates, e.g., Skt hasti "elephant" > Prakrit hatthi > MH [hɑtʰi]. We present phonetic evidence in support of the scenario that a nasal consonant (N) could have been re-introduced preferentially between a nasalized vowel (Ṽ) and a following voiced stop (D) but not a following voiceless stop (T).

In an earlier exploratory study of Hindi we found that in the transition between a word final distinctively nasal vowel and a following word initial voiced stop, the initial part of the voiced stop became a nasal consonant. For example, the Hindi utterance /ek mɛ̃ do / (literally) "one 'I' give" was phonetically [ek mɛ̃ ⁿdo]. Here it seemed clear that the nasal consonant formed out of the first part of the voiced stop was not lexical and was purely a product of low-level phonetic interaction between cross-word boundary segments. If verified, shown not to occur with Ṽ + T sequences, and found in other languages too, then this epenthetic nasal would constitute a plausible parallel to the posited diachronic scenario which requires the creation of a N out of a sequence of Ṽ + D.

2. AN INSTRUMENTAL STUDY

2.1. Methods

To obtain an indication of velic movement in speech in a non-invasive way we used a nasal olive [10] which gives a rough measure of nasal air flow, itself an approximate measure of velic opening. The nasal olive records air pressure behind one blocked nostril, the other nostril remaining open. This technique also permits a high-quality audio recording of the speech to be made simultaneously. Our subjects were two native speakers each, of Hindi and French; for both languages there was one male and one female speaker. The first author was the female Hindi speaker. The subjects read a list of sentences in their respective languages which included sequences of word-final Ṽ followed immediately by word-initial D or T, as well as control utterances.

2.2. Results

The nasal olive was quite sensitive and picked up nasal microphonics in addition to the DC pressure variations that would be more directly indicative of velic opening. Some nasal microphonics may be present even when the velic valve is closed; the acoustic transparency of the velum to low frequencies is well-known [2, 3]. This happens particularly with high vowels (which have low F1) and voiced obstruents. Such microphonics are less evident in sounds with the higher F1 characteristic of low vowels. Thus the evidence of velic opening is to be seen in a DC pressure change or a disproportionate increase in nasal microphonics, vis-a-vis other comparable oral utterances.

Fig. 1. presents records of simultaneous audio (bottom) and the output of the nasal olive (top) for portions of two utterances spoken by the female French speaker. Fig. 1a gives a portion of the utterance dit 'saint' pour moi ("say 'saint' for me") /di sɛ̃ puʁ mwɑ / and Fig. 1b, a portion of the utterance dit 'saint' bel enfant ("say 'saint' beautiful baby") /di sɛ̃ bɛl ɑ̃fɑ̃/. Here the initial parts of the word-initial stops (following the nasalized vowel [ɑ̃]) are nasalized through perseveratory assimilation, i.e., they are prenasalized stops. However, in the case of the word initial voiceless stop [p] the nasalization is very brief, on the order of 30 msec, whereas in the case of the voiced stop it is much longer, about 70 msec.

Fig. 2. presents two similar records spoken by the male Hindi speaker: Fig. 2a, a portion of the utterance / ɑp jəhɑ̃ tɑko/ "you glance here" and Fig. 2b, a portion of the utterance / ɑp jəhɑ̃ dekʰo / "you see here". In Fig. 2a the signal from the nasal olive shows the word-initial /t/ to have about 30 msec of pre-nasalization. In comparison, Fig. 2b shows about 60 msec of pre-nasalization.

Comparable results were obtained for the other speakers and other places of articulation.

3. DISCUSSION

It is essential for our argument that none of the words which provided the cross-word boundary sequences of V + D would actually exhibit a N when these words are spoken in isolation. This is certainly true of the Hindi examples. In the case of French one might recall that the liaison form of words with final nasal vowels would have a supposedly "underlying" nasal consonant appear, e.g., bon ,"good", [bɔ̃] but bon ami, "good friend", [bɔn ami]. Could the nasal element found in the French examples be this underlying nasal? We think not: such liaison consonants appear when the next word starts with a vowel, not a consonant. Second, the fact that the appearance of the intrusive nasal is influenced by the voicing of the stop suggests that it is a purely transitional phonetic event created by the nasalization of the vowel invading the initial portions of the following stops.

The nasal epenthesis parallels and thus supports the historical scenario posited above for words like MH [tʃãnd]. The

"phonetic" nasal can become phonologized (to use Jakobson's term) if listeners reinterpret this as an intended part of the pronunciation and not a predictable and thus discountable feature [5].

The phonetic and phonological literature on other languages reveals that voiced stops (but not voiceless ones) may tolerate nasal onsets when in contact with a preceding nasal segment (or occasionally even when there is no preceding nasal environment)[7, 8, 9, 11, 12]. We speculate that a possible phonetic basis for this phenomenon comes from perceptual evidence that some of the essential perceptual cues for voiced stop include an amplitude and spectral discontinuity with respect to adjacent sonorants, presence of voicing during the closure, and the stop burst at the release. It seems, then, that a perceptually adequate fully voiced stop may be made by allowing the initial portion to be nasal as long as the final portion has velic closure and concomitant oral pressure impulse in order to create the requisite stop burst on release. There is no motivation to the speaker to time velic closure precisely with the onset of the stop closure. On the other hand, in the case of voiceless stops there is motivation to achieve velic closure near the onset of the stop closure: to maintain voicelessness for a substantial portion of the stop closure to avoid the frication at the nostrils, i.e., a voiceless nasal, that would occur if velic closure were delayed.

It should be mentioned that the reason for selecting Hindi and French for this study is simply the fact that both their phonologies permit $\tilde{V}$ + D sequences spanning a word boundary. It is just a coincidence that it is also the history of Hindi which exemplifies the puzzle we were trying solve. If one accepts that there are universal and timeless phonetic factors which cause variation and change in pronunciation (which may lead to sound change through phonologization), then the parallels to phonetically-based sound changes should be evident, potentially, in any spoken language which exhibits the appropriate conditions.

4. REFERENCES

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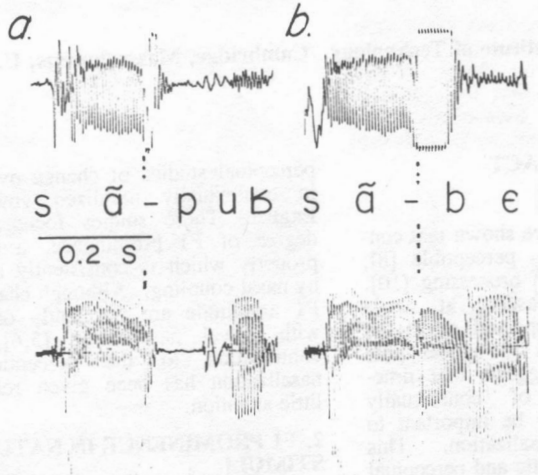

FIGURE 1. Records from the female French speaker: top: nasal olive; bottom: audio signal; a: portion of "dit 'saint' pour moi"; b: portion of "dit 'saint' bel enfant". Hyphen marks word boundary in phonetic transcription; vertical dotted line marks it in the graphic signals.

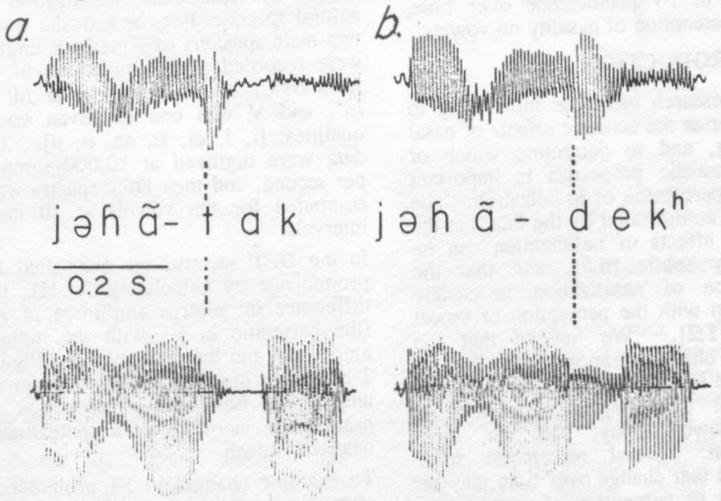

FIGURE 2. Records from the male Hindi speaker: top: nasal olive; bottom: audio signal; a: portion of /ap jəhã tako/; b: portion of /ap jəhã dekho/. Hyphen marks word boundary in the phonetic transcription; vertical dotted line marks it in the graphic signals.