Some patterns of unscripted speech in Hindi

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This paper presents data from a small corpus of unscripted speech gathered from one male and one female adult native speaker of Hindi. An acoustic analysis of the data demonstrated changes such as lenition and assimilation. The cases of assimilation included stop plus stop sequences yielding geminates. The results of a perceptual test showed that such 'pseudogeminates' are generally perceived as true geminates. Parallels between these phenomena and historical sound changes in Indo-Aryan are also discussed.

1 Introduction

This paper aims to do the following:

- Show parallels between variation in sounds in unscripted speech and universal phonological tendencies arising through sound change such as spirantization and assimilation. (Examples of other processes such as epenthetic nasals and stops were given in M. Ohala 1997, 1999.)
- To use the analysis of unscripted speech to examine the processes of variation to see what gets into sound change in spite of normalization by the listener. For example, J. Ohala (1993) claims that most sound changes arise from listeners' misinterpretations of some inherent ambiguities in the speech signal produced by the speaker. Some of the ambiguities are due to 'shortcuts' taken by the speaker or due to inherent physiological constraints of the speech mechanism. Though not intended by the speaker as a change in the pronunciation norm, these may lead to sound change if the listener takes them at face value (e.g. the epenthetic stop [p] in English *glimpse*, from Middle English *glimsen*, which arose when the terminal portion of the [m] became denasalized and devoiced due to anticipatory assimilation of those features of the following [s]). Other sound changes arise due to impoverished or ambiguous acoustic cues (which can give rise to shifts in place of articulation such as that exemplified in PIE **gwiyo* 'living', Cl. Greek *bios*) or due to a kind of perceptual hypercorrection on the part of listeners when they erroneously attempt to normalize what they think is a contextually distorted signal; this, according to J. Ohala, is the origin of dissimilation where, given a feature distinctive in two sites within a word, listeners discount its presence in one site

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thinking it had spread from the other. Only the 'seeds' of the first type of sound change (speakers' shortcuts, physiological constraints) should be found in speech production, not those due to ambiguous acoustic cues or listeners' hypercorrection.
- Extend the empirical base for claims about universals, e.g. those of Kohler (1991, 1995), on unscripted speech by providing evidence from yet another language, namely, Hindi.

In sections 3 and 4, I present data from assimilation and in section 5, data from obstruent weakening/spirantization. Each section also includes data on diachronic parallels.

2 Method

The data to be presented is from a small corpus of spontaneous, unscripted speech, which was gathered from a male and a female adult native speaker of Standard Hindi. The speech was taped in the speakers' residence using high quality portable recording equipment. The tape was digitized and select portions were analyzed via waveform, spectrograms and close auditory study, using Kay Elemetrics' Multispeech (but the spectrograms below were generated using SpeechAnalyzer). Thus this data does not represent automatic analysis of large corpora but detailed case analysis on a word-by-word, segment-by-segment basis.

The following procedures were used to help validate claims regarding variation between CANONICAL (i.e. citation) and REALIZED forms:

- I conducted listening tests on the variant forms – with controls – to verify claims that the variant of /A/ sounds like /B/.
- When examining the acoustic form of the variant, I compared it with canonical examples of the same sound. These canonical tokens were taken from elsewhere in the unscripted speech corpus of the same speaker. I am aware of the possibility that some variants might be lexicalized, e.g., English [gɪmi] for *give me*. However, at this stage, it is impossible to determine which of the variants in the Hindi data might represent such calcification. Therefore I give the citation form as one possible pronunciation in hyper-articulated speech.

3 Voicing assimilation in clusters

Examples. (/. . ./ marks the CANONICAL form, not 'phonemic' or 'abstract underlying form'.) The frequently observed assimilation of voicing was found in clusters as shown in table 1. Incidentally, the phonological literature on Hindi does not discuss processes such as assimilation in detail and thus does not address the incidence of anticipatory vs. perseveratory assimilation. In the data to be presented, both types were found. Moreover, in some cases it is possible to analyze the data as involving a cause other than assimilation (cf. the discussion below of the first word in table 2).

A more interesting case can be seen in the spectrogram in figure 1, which shows mutual assimilation of the two consonants in question. Here, the canonical /kʊ̀t͡ʃʰ + d̪ɪn/ 'some, few + days' was rendered with something like an intervocalic sequence of a voiced fricative plus a voiceless stop. This is also what it sounded like under 'micro-listening' (listening to the target sound or sequence with minimal surrounding context).

Based on data from German, Kohler (1991) addresses the issue of reduction processes in unscripted speech. He proposes that such processes are not only motivated

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Table 1 Assimilation of voicing in clusters.

CANONICAL	REALIZED AS
/bʱagn̪i/ 'runs' (fem. 'run' + participial marker)	[bʱakn̪i]
/ek bag/ 'one garden'	[egbag]

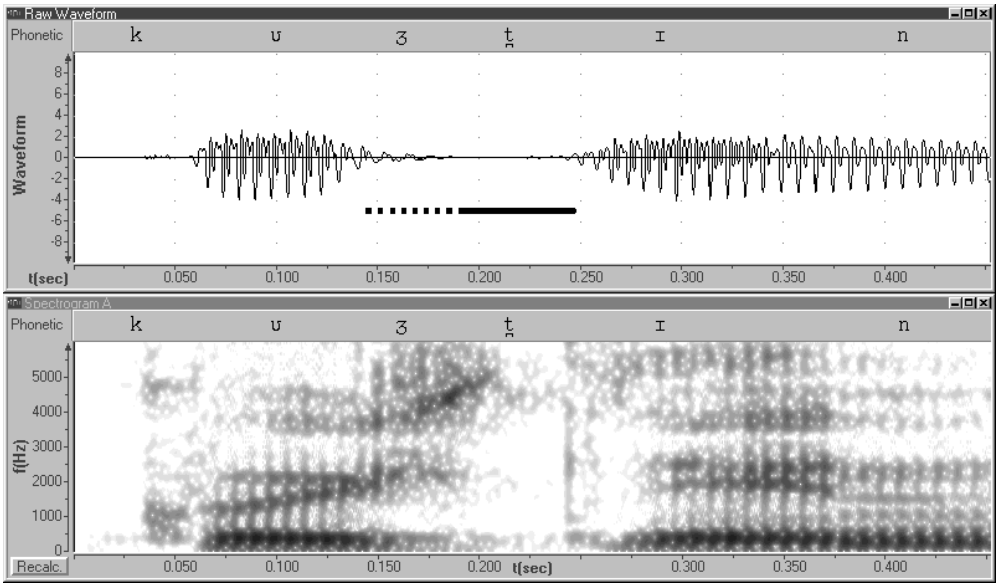


Figure 1 /kʊ̂tʃʰ + d̪ɪn/ 'some days' realized as [kʊʒt̪ɪn]. Dashed line marks voicing and the solid line, voicelessness.

by physiological considerations but also by the needs of the listener, i.e. perceptual salience. He goes on to claim that the word initial position has a higher signaling value for listeners than the word final position and thus initial contrasts are better preserved than final ones.

The example given in figure 1 and the first example in table 2 would seem to constitute counterexamples to the claim that initial contrasts are better preserved than final. (Additional counterexamples were given in M. Ohala 1997.)

4 Clusters across word boundaries become geminates

Another interesting case of assimilation is that of complete assimilation of the segments involved leading to the development of long consonants whose durations were similar to or greater than that of true geminates, e.g. 187–200 ms or so. (Ohala & Ohala (1992) reported that the average duration of geminates in Hindi was 146 ms.) Table 2 lists some examples. It should be noted that instead of involving assimilation, the first example given in this table could be analyzed as having the [d̪] devoiced due to aerodynamic factors involved in maintaining voicing during a long stop closure (J. Ohala 1983).

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Table 2 Examples of the formation of pseudogeminates across word boundaries.

CANONICAL	REALIZED AS
/saṯ + ḏɪsʌmbər/[1] seven + December'	[saṯːɪsʌmbər]
/kʊ̄t͡ʃʰ + t͡ʃoṯ / 'some + hurt'	[kʊt͡ʃːoṯ]
/rok + ḏɪja/ 'stop + did' (= 'stopped')	[roḏːɪja]
/bagʱ + ke/ 'lion + genitive postposition'	[bakːe]

Let me call these PSEUDOGEMINATES, as opposed to true geminates, which also exist in Hindi. (Perlmutter (1995) uses the terms 'true' geminates vs. 'apparent' or 'fake' geminates.) Focusing on cases where these pseudogeminates resulted in a sound that has a match in the Hindi phonemic inventory, I gave a listening test to five subjects to see if these pseudogeminates did indeed sound like geminates – or at least did not sound like singletons.

4.1 Method

I extracted the VCV portion of such pseudogeminates from the speech data of one of the speakers and also extracted some examples of the same consonants in VCV environments where they were either clear singletons or true geminates. The preceding and following vowels were kept short (by splicing), such that the constituent words were not identifiable in order to avoid subjects being influenced by any existing words. A total of 16 such tokens, 9 singletons, 6 pseudogeminates and 1 true geminate, were randomized in a tape and were played over earphones to five native speakers of Standard Hindi (all currently in the USA). Each token was heard three times with an inter-stimulus-interval of 2 seconds and with 6 seconds between these triples. Subjects were told that the purpose of the test was to see if they could identify 'single' vs. 'double' consonants just by hearing a small portion of a word. ('Double consonant' refers to the orthographic representation and was a term familiar to the subjects.) They were given a questionnaire in the Devanagari orthography, containing singletons in one column and geminates in a second column. Just the consonant part was included. They were instructed to circle the appropriate consonant. Some examples of the types of tokens used and their durations are given in table 3.

Table 3 Examples of tokens used in the pseudogeminate listening test plus their durations.

Stop type	duration in msec	canonical word/phrase yielding token	translation
pseudogeminate	155	/lʌgṯa/ [lʌgṯa] (in this corpus spoken as [lʌ̤tːɑ])	'seems'
true geminate	131	/mɪṯːʌl/ [mɪṯːʌl]	'proper name'
singleton	53	/pʌṯa/ [pʌṯa]	'address'

[1] /r/ varied phonetically between a trill, a tap, and an approximant. The transcription given for this sound may not always be the most accurate.

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4.2 Results

The results are given in figure 2. As we can see, the pseudogeminates are perceived as 'true' geminates. The results are of interest for phonological theory since phonologists (Lahiri & Hankamer 1988, Perlmutter 1995) have asked whether such geminates are different from true geminates. At least as far as perception is concerned, they seem to be treated as similar.

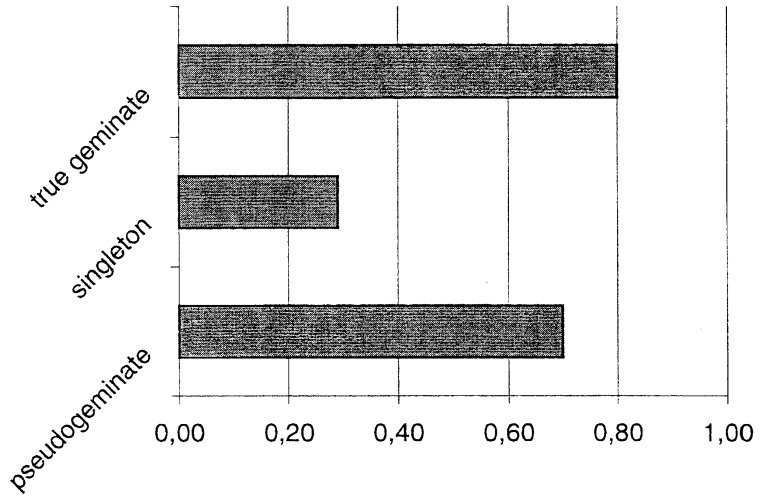


Figure 2 Proportion of 'geminate' responses to the true geminates (N=1), singletons (N=9) and pseudogeminates (N=6).

The almost 30% response of 'geminate' to singletons and about the same percentage of 'singleton' responses to pseudogeminates (in spite of their long closure duration) also calls for some comment. Given the small number of subjects (only five), the most reasonable explanation is 'chance'. Subjects do show some variation, and with the small number of subjects this is a problem. However, there are other possible explanations. It has been noted in the literature (Lahiri & Hankamer 1988, Ohala & Ohala 1992) that vowels are shorter before geminates (Ohala & Ohala report vowels to be 12.4 ms shorter before geminates). As mentioned above, in the experiment reported on here, the preceding vowel (and the following one) was kept short. Could this have influenced subjects' responses? I think not for the following reasons: (a) if this was an influencing factor, the pseudogeminates should all have been reported as geminates, and (b) in a perception experiment reported on in Ohala & Ohala (2000), consonant closure duration and the duration of the preceding and following vowel was systematically varied for both singletons and geminates. Although the consonant closure duration was found to be a significant perceptual cue, vowel duration was not. However, the possibility of other secondary cues (i.e. cues other than consonant closure duration) influencing subjects' judgments cannot be ruled out. For example, in this same paper, Ohala & Ohala reported finding the initial consonant of the syllable containing a geminate to be longer by about 12 ms. (Local & Simpson (1999) found a similar pattern in Malayalam.) Moreover, it is also well known that the rate of speaking affects the duration of consonants and vowels. Thus, definitive answers to questions such as why there were not 100% 'geminate' responses to the pseudogeminates await a more rigorous study with a larger number of subjects.

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4.3 Diachronic data on the development of geminates

That geminates arise out of cluster assimilation is reflected in the history of Indo-Aryan. In Old Indo-Aryan (OIA), two dissimilar stop sequences gave rise to geminate versions of the second stop in Middle Indo-Aryan (MIA), as exemplified in table 4 (data from Masica 1991).

Table 4 Examples of geminate formation in the history of Indo-Aryan.

Sanskrit *bhakta*[2] 'meal, food'	>	Pali/Prakrit *bhatta*
Sanskrit *sapta* 'seven'	>	Pali/Prakrit *satta*

5 Weakening/spirantization of obstruents

Stops (including affricates) showed weakening and were often articulated as fricatives or even as glides. The affricates showed the greatest tendency to vary.

5.1 Affricates

The affricate [t͡ʃ] varied from having no closure to being something like [ʃ] (cf. M. Ohala 1997), to being just a voiceless nasal before a following nasal as shown in the spectrogram in figure 3, which also shows a 'canonical' [t͡ʃ]. The [t͡ʃ] in this spectrogram may not look like an affricate but it did sound like one to my ears. In any case, the crucial point here is the voiceless nasal.

Figure 4 shows a spectrogram of /t͡ʃʰ/ losing aspiration and frication, and simply becoming a geminate. It is a bit short for a geminate but it sounded like a geminate and was so identified by the subjects in the listening experiment reported on above.

The affricate [d͡ʒ] varied from losing its frication and ending up like a palatal stop, as is shown in figure 5, or losing the closure part and ending up like a weak voiced palatal fricative or palatal glide, as shown in the spectrogram in figure 6. Figure 5 also includes a canonical [d͡ʒ]. (See M. Ohala 1997, 1999 for additional examples.)

5.2 Diachronic parallels to the modifications of affricates

There are many examples of affricates becoming fricatives in the history of Indo-Aryan.

Indo-Iranian *č* > Old Indo-Aryan *š*: **dača*- 'ten' > Skt. *daša* (Misra 1967)
Skt. *mariča* 'chili pepper' > Singhalese *miris* (Masica 1991)
Affricates > glides
Skt. *raǰa* 'king' > Shaurseni Prakrit *raya*; Mod. Hindi [raj] 'a title' (Misra 1967)
Affricates > stops
Indo-Iranian *ǰ* > Old Indo-Aryan **ɟ*: *ǰana* 'people' > Skt. *ɟana* (Misra 1967)

(Note that it is disputed whether the stop in this latter Sanskrit form was a palatal stop or an affricate; see M. Ohala 1997 for more details.)

[2] The transcription given for words in Sanskrit and other intermediate historical stages between that and Modern Hindi is given not in IPA but in the traditional transliteration.

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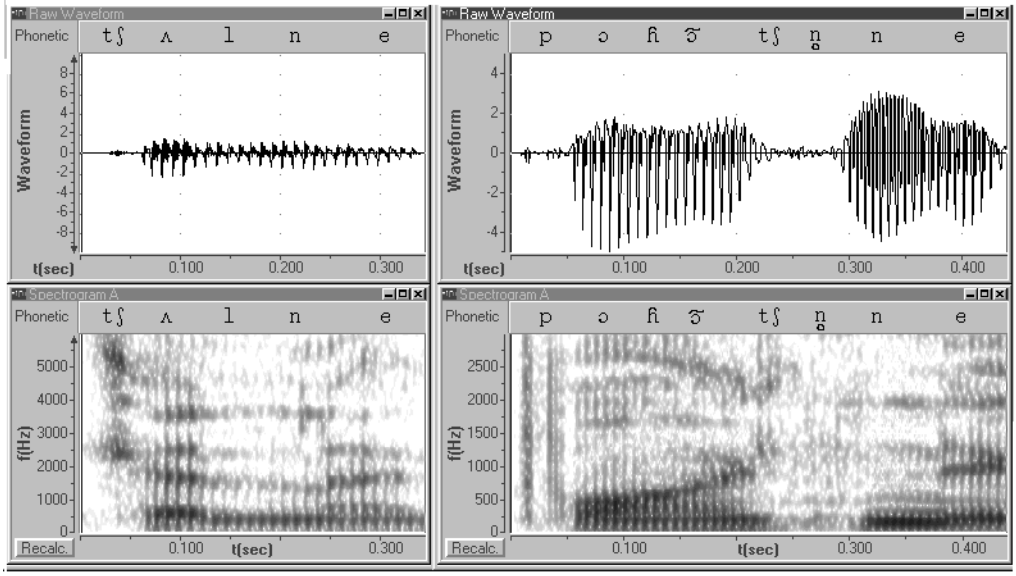


Figure 3 Left: a canonical [t͡ʃ] exemplified by the word [t͡ʃʌlne] 'to go'; right: a [t͡ʃ] transformed into a voiceless nasal in the word [pɔɦɔ̃ t͡ʃn̥ ne] (from /pɔɦɔ̃t͡ʃ ne/) 'to reach'.

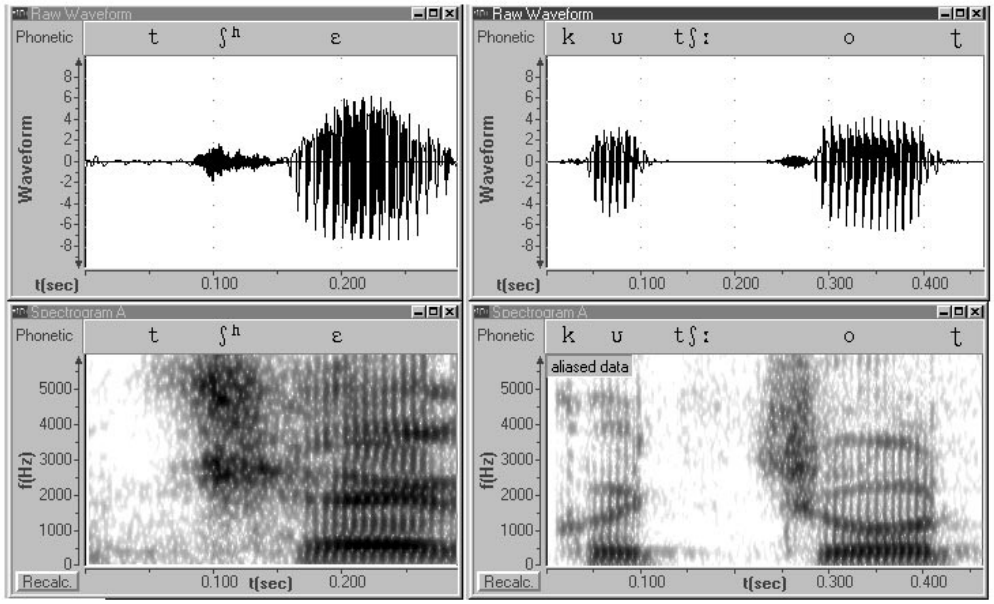


Figure 4 A case of /t͡ʃʰ/ losing its aspiration and forming a geminate. Left: a canonical [t͡ʃʰ] in the word /t͡ʃʰɛ/ 'six'; right: the word final /t͡ʃʰ/ in /kʊt͡ʃʰ/ losing its own fricative release and its aspiration and forming a geminate affricate with the initial /t͡ʃ/ in /t͡ʃoʈ/.

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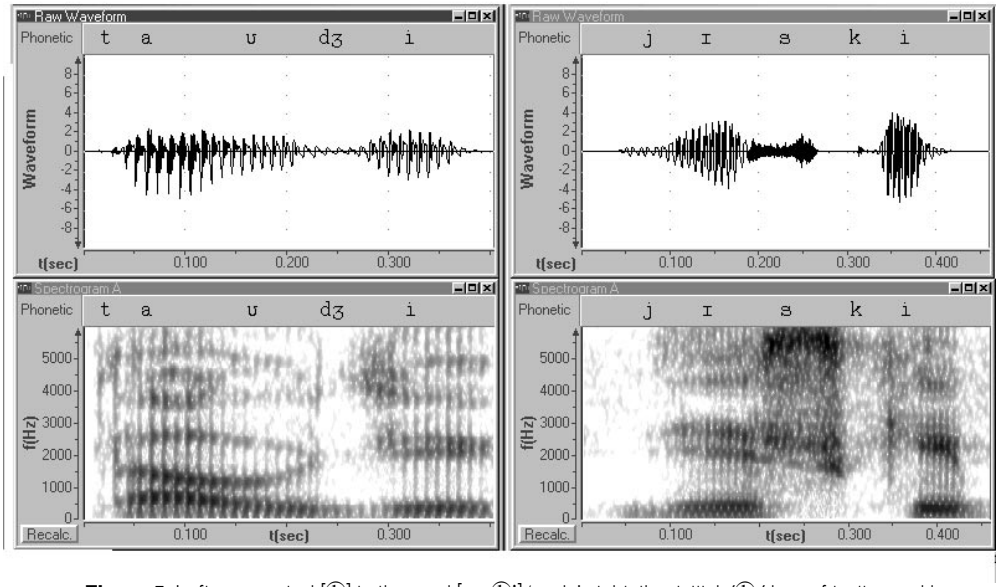


Figure 5 Left: a canonical [d͡ʒ] in the word [t̪aud͡ʒi] 'uncle'; right: the initial /d͡ʒ/ loses frication and becomes [j]-like in the word /d͡ʒɪski/ [jɪski] 'whose'.

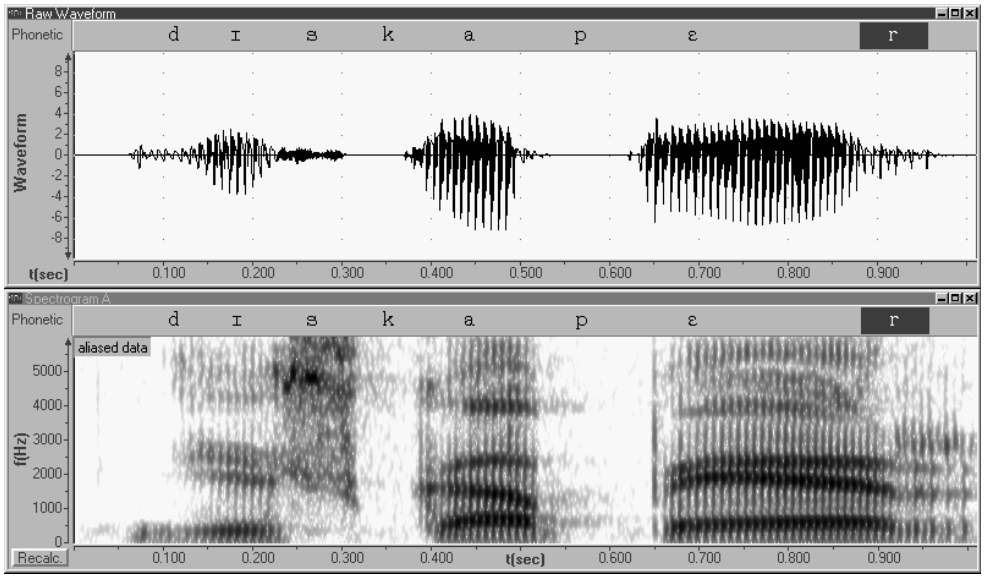


Figure 6 /d͡ʒ/ loses its fricative release; /d͡ʒɪskapɛr/ > [dɪskapɛr] 'whose foot'.

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5.3 Stops

Among stops the velars varied the most and dentals the least. The voiceless bilabial [p] and the retroflex stops did not show much variation. However, it should be noted that there were rather few examples of the voiced retroflex stops in the data collected. Thus, Kohler's (1995) claim that apical gestures show greater instability was not evidenced in Hindi.

5.3.1 Velars

As has just been mentioned, velars varied quite a bit. The spectrogram in figure 7 gives a canonical [gɦ] and also shows the breathy-voice velar losing its stop part although the 'breathy' part is there.

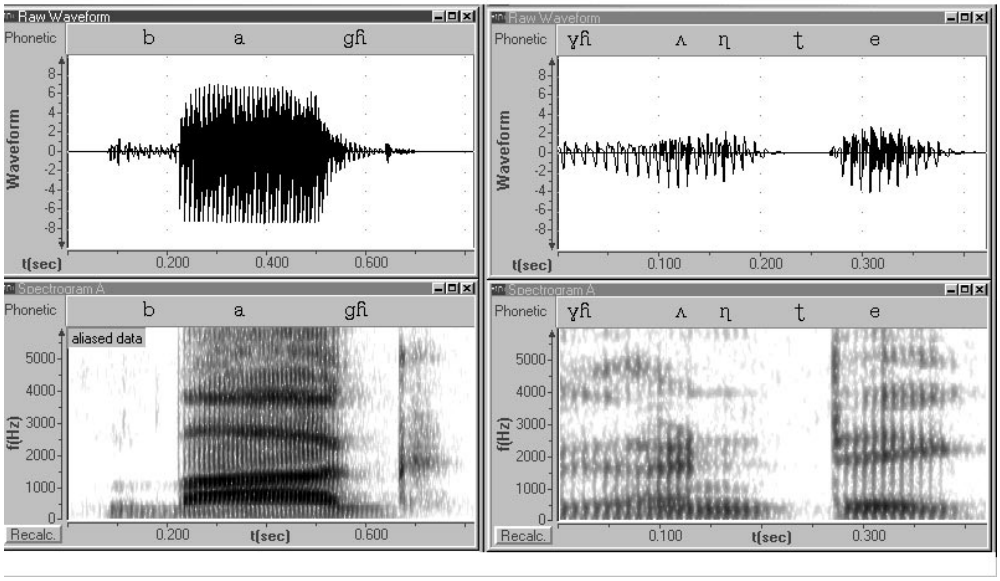


Figure 7 Left: canonical [gɦ] in the word [bagɦ] 'lion'; right: the breathy voiced velar stop loses its stop character, leaving something like a breathy voiced fricative in the word /gɦ ʌɳtə/ 'hours' > [ɣɦ ʌɳtə].

The velar stop [g] varied between becoming a voiced fricative and an approximant. Figure 8 shows it becoming a [ɣ]-like glide and also gives the canonical [g]. (For an example of it becoming a fricative, see M. Ohala 1999.)

The stops [k] and [kʰ] both had velar fricative variants. Figure 9 gives the canonical [kʰ] and the fricative version. [k] was often voiced between vowels, e.g. /lekɪn/ 'but' was rendered as [legɪn]. Examples of [k] becoming a fricative can be found in Ohala (1999).

5.3.2 Bilabials

Along with the usual expected cases of [b] becoming voiceless before voiceless stops, there were a number of unexpected cases of [b] becoming a voiced bilabial fricative/approximant, even in word initial position. The spectrogram in figure 10 gives both the canonical [b] and the fricative version perhaps bordering on an approximant. (Examples of the fricative version in initial position were given in M. Ohala 1997, 1999.)

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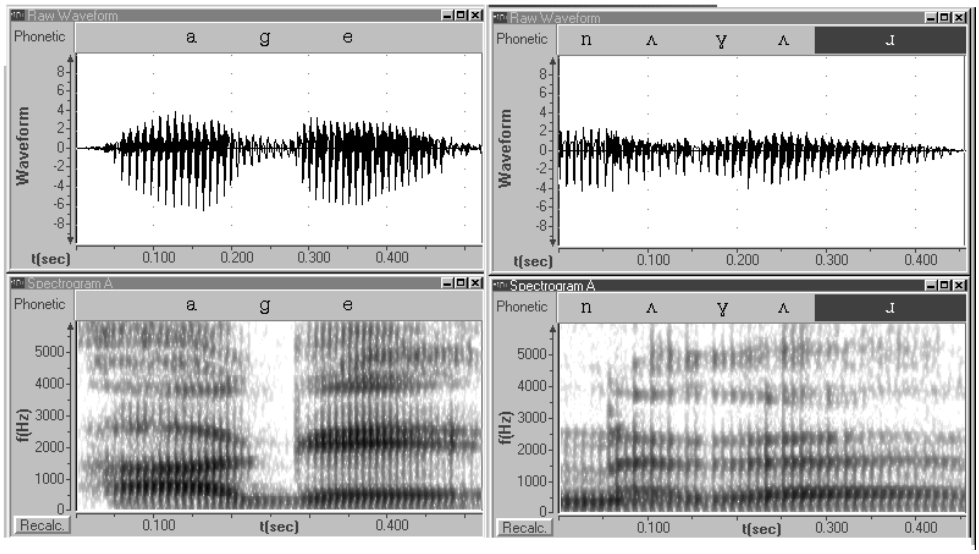


Figure 8 Left: canonical [g] in the word [age] 'ahead'; right: [g] becomes a [ɣ]- like glide in the word /nʌgʌr/ 'town' > [nʌɣʌɹ].

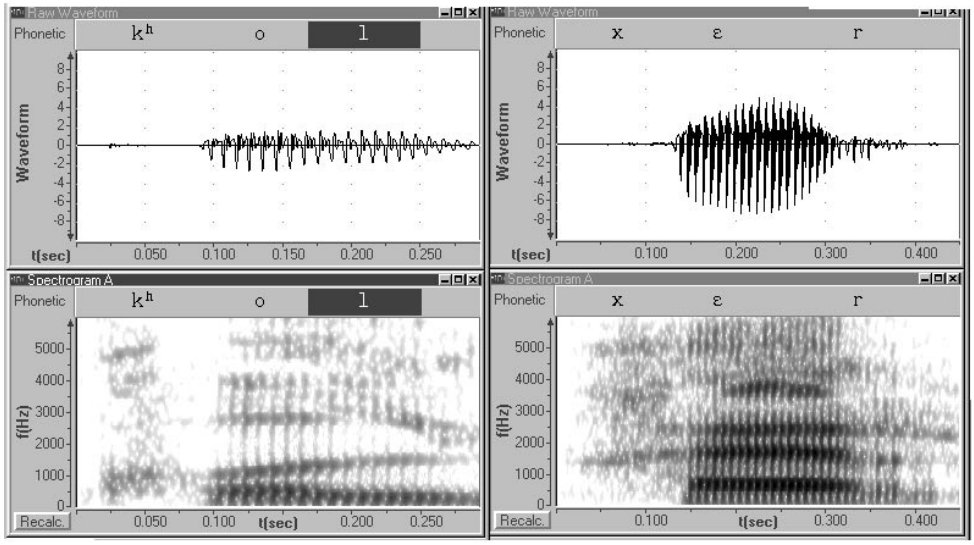


Figure 9 Left: canonical [kʰ] in the word [kʰol] 'open'; left: [kʰ] changes to the voiceless velar fricative [x] in the word /kʰɛr/ 'never mind' > [xɛr].

5.4 Diachronic data

I give below the diachronic data reflecting the patterns just discussed.

Intervocalic stop voicing

Skt. *hita* 'good' > MIA *hida* (Turner 1960: 30)

Intervocalic stop weakening

In the development of MIA from OIA, it was common for intervocalic single stop to undergo the following progressive development:

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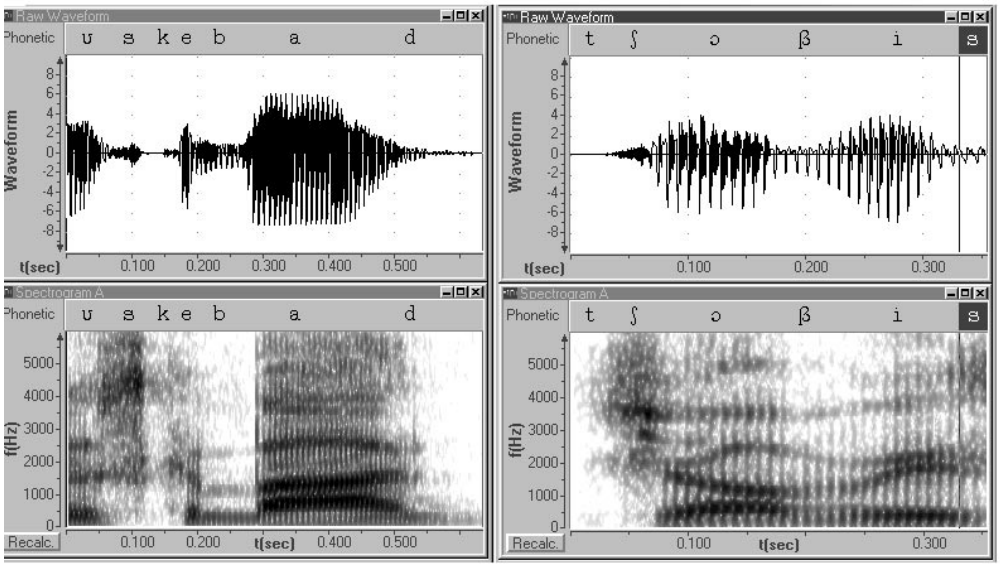


Figure 10 Left: canonical [b] in the word [ʊskebad̪] 'after that'; right: the stop [b] becomes a voiced bilabial fricative [β] in the word /tʃɔbis/ 'twenty four' > [tʃɔβis].

Stop > fricative > glide > Ø
Skt. *śōka* 'sorrow' > *sōga* > *sōɣa* > *soɯa* > *soa*
Skt. *kapha* 'phlegm' > *kabha* > *kaβha* >*kavha* > *kaha*
Skt. *mr̥du* 'soft' > *miðu* > *miðu̯* > *miu*
Skt. *čarmakāra* > *Hindi* [t͡ʃʌmar] 'cobbler' (Masica 1991; transcription modified)

In the case of the voiceless stops, they first became voiced, then voiced fricatives (Masica 1991, Bubenik 1996). Of these stages, spirantization is evidenced either by vacillations in writing or, more explicitly, in the Niya Prakrit of Central Asia. The glide stage is represented in the Jain manuscripts. Masica lists not only [ɣ] and [β] but also [ð]; I did not find any examples of the latter in my data. Interestingly, Masica also notes that velars were the weakest and mentions that retroflexes, though modified, were not lost completely.

6 Conclusion

We see, then, that Hindi does show some of the more common (universal?) phonological processes leading to variation: voicing assimilation, spirantization and other forms of weakening. It also shows some less common assimilations: voiceless nasals and 'pseudo'-geminate formation from intervocalic -CC- clusters across word boundary.

The parallels with sound change are largely those predicted by J. Ohala (1993). There was no dissimilation or changes that could be traced to ambiguous acoustic cues. Those that did occur, neutralizations, weakening of affricates, and various forms of spirantization of stops, the deaspiration and devoicing of /gʱ/ before a following /k/, etc. can be attributed to speaker shortcuts and physiological constraints. Only cases such as /rok + d̪ɪja/ > [roḍ̪ːɪja], i.e., complete assimilation in place of C1 to C2 in C1C2

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clusters, which J. Ohala (1990) attributes to impoverished place cues in VC sequences, goes against his theory.

In contrast to previous claims, modification in word initial position is quite common. Also, apical consonants do not see more variation than non-apicals (in this limited corpus).

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