

The Adaptation of English Alveolar Stops in Telugu and Hindi

Paul Arsenault
University of Toronto

1. Introduction

- Theoretical Background: Is loanword adaptation driven by phonetic/perceptual factors (Peperkamp 2003), phonological factors (Paradis & Lacharité 1997), or some combination of both (Silverman 1992, Rose & Demuth 2005, Herd 2005, etc.)?
- South Asian languages such as Hindi and Telugu share two related properties:
 - a) a phonemic contrast between dental and retroflex stops
 - b) alveolar stops in English loanwords are adapted as retroflex, never as dental
- Question: Assuming adaptation is motivated by similarity, in what way is English alveolar [t] more like retroflex [ɖ] than dental [t̪]? Perceptually? Phonologically?
- Thesis: Adaptation is driven by both perceptual and phonological factors:
 - a) Loanword input is phonetic.
 - b) Segmental adaptations take place in perception under the influence of phonology.
 - c) Phonology influences perception via the distinctive features specifications of the borrowing language (and their correlation with acoustic cues).
- Analysis: Retroflex stops in Telugu & Hindi are contrastively specified as [apical], whereas dentals are underspecified for coronal features and are redundantly laminal. Thus, Telugu and Hindi speakers are sensitive to the apical cues generated by English alveolars and associate these cues with retroflex articulations.

2. English Alveolar Stops in Telugu and Hindi

- Contrastive retroflexion is an areal feature of South Asia (Bhat 1973). I will look at two representative languages: Hindi (Indo-Aryan) and Telugu (Dravidian).
- Both languages have 3-way contrast among coronal stops/affricates:
 - a) Dentals = laminal denti-alveolar
 - b) Retroflex = apical (or sub-apical) post-alveolar
 - c) Palatal = laminal post-alveolar (affricates)

(1) Telugu Coronal Obstruents (Jagannath 1981; Krishnamurti 1998)

DENTAL		ALVEOLAR		RETROFLEX		PALATAL	
t̪	ɖ̪			ɽ	ɖ̠	tʃ	dʒ
(t ^h)	(ɖ ^h)			(ɽ ^h)	(ɖ̠ ^h)	(tʃ ^h)	(dʒ ^h)
		s		(ʂ)		(ʃ)	

(2) Hindi Coronal Obstruents (Ohala 1983, 1994)

DENTAL		ALVEOLAR		RETROFLEX		PALATAL	
t̪	ɖ̪			ɽ	ɖ̠	tʃ	dʒ
t̪ ^h	ɖ̪ ^h			ɽ ^h	ɖ̠ ^h	tʃ ^h	dʒ ^h
		s	(z)			(ʃ)	

- Loanword adaptation: English alveolar stops are always adapted as retroflex; never as dental (Telugu data from Jagannath 1981; Hindi data from Ohala 1983, Koshal 1978).

(3)

	English	Hindi	English	Telugu
t → ɽ	taxi	[t̪æksi]	taxi	[t̪æksi]
	train	[t̪ren]	truck	[t̪rakku]
	hotel	[hoʈəl]	motor	[mo:ʈaru]
	postage	[post̪edʒ]	party	[pa:ɽti]
	hit	[hit̪]	hit	[hit̪tu]
	shirt	[ʃ̪ɛɽt̪]	skirt	[sk̪ɛɽtu]

(4)

	English	Hindi	English	Telugu
d → ɖ̠	doctor	[d̪akʈɛɽ]	doctor	[d̪a:kʈaru]
	drama	[d̪ɽama]	driver	[d̪ɽaivaru]
	soda	[soɖa]	idiom	[ji:ɖijamu]
	holder	[hold̪ɛɽ]	candy	[kæɖ̠ɖi]
	pad	[pɛɖ̠]	wood	[wud̪ɖu]
	guard	[gaɽɖ̠]	gold	[go:l̪ɖu]

3. Phonology and Perception

- Question: In what way is English alveolar [t] more similar to retroflex [ɖ] than to dental [t̪]? Perceptually? Phonologically?
- Werker et. al. (1981), Pruitt et. al. (1990): English speakers have difficulty distinguishing the dental and retroflex stops of Hindi, even with some training.
- Implication: perception is influenced by phonology.
- Ohala (1978): Hindi speakers *perceive* English alveolars as retroflex 91% of the time:

(5)

Sounds Presented:	Sounds Identified as:	
	Dentals	Retroflexes
Hindi dentals	89%	11%
Hindi retroflexes	4%	96%
English alveolars	9%	91%

- What causes Hindi/Telugu speakers perceive English alveolars as retroflex?

4. Phonetic Cues

- Articulatory properties of retroflexion (Hamann 2003):
 - a) Apicality: articulated with the tip or underside of the tongue
 - b) Posteriority: articulated behind the alveolar ridge
 - c) Sublingual Cavity: a cavity beneath the tongue
 - d) Retraction: displacement of the tongue back towards the pharynx
- Primary acoustic property of retroflexion: low F3

Formant Transitions:

- Formant patterns of alveolars are more like dentals than retroflex (Hamann 2003: 63):

(6)

	Dental t̪	Alveolar t	Retroflex ɖ
F3	mid	mid	lowest
F2	high	high	high

- Whatever cues Hindi/Telugu speakers are using to distinguish retroflex and dental stops, these cues must also be present in English alveolars (and its not a low F3!).

Spectral Burst:

- Hamilton (1996: 49-51): Laminal vs. apical contrast is distinguished by the spectral properties of the burst. Lamino-dental articulations have a slower, noisier release, while apico-alveolars are characterized by a clean, rapid release.
- Hamann (2003): The most reliable cue associated with apicals is the shorter duration of their transitions and the shape of the spectral burst.
- Retroflexes have a ‘flapping-out’ gesture, and hence an *apico-alveolar* release.
- Thus alveolars and dentals share formant transition cues (F3), but alveolars and retroflexes share cues associated with ‘apicality’ in the spectral burst/release.
- From a purely acoustic point of view, the adaptation pattern could go either way:

(7)

	Dental ṭ	Alveolar t	Retroflex ʈ
F3 Spec. Burst	mid ‘laminal’	mid ‘apical’	lowest ‘apical’

- Why are the spectral burst cues more relevant than the formant transition cues?

5. Phonological Features:

- Coronal feature specifications for lamino-dental, apico-alveolar, and retroflex stops:

(8)

	Dental ṭ	Alveolar t	Retroflex ʈ
[posterior]	–	–	+
[apical]	–	+	+

- Problem: English alveolar [t] is *equally* similar to retroflex [ɖ] and dental [t̪], since it shares exactly one feature with each. Again, the adaptation could go either way.
- Solution: If retroflexes are contrastively specified as [apical] and underspecified for other features such as [posterior] (cf. Jagannath 1981), then this might explain why the apical cues have priority.
- Need to assume some theory of underspecification: only those features that are lexically contrastive are phonologically active, and relevant for evaluating similarity.

6. Underspecification of Phonological Features

- Indeterminacy Problem: there is more than one way to underspecify a phonemic system.
- Various proposals to constrain the accessibility of features in underspecification:
 - a) Clements (2001), Herd (2005): features are accessed to establish contrasts in an order that is pre-determined by a universal hierarchy.
 - b) Rice & Avery (1989, 1993): the choice of features is constrained by the internal structure of segments themselves (i.e., by feature geometry).
- It is not clear that any universal hierarchy / feature geometry will always make the right predictions without recourse to some degree of parametric variation.
- The active status of fine-grained coronal features such as [apical] and [posterior] must be motivated by language-internal evidence.

7. Evidence for the Feature [apical] in Telugu

- *Phonotactics*: retroflex consonants do not occur word-initially in Telugu, while laminal coronals do (i.e., laminal dentals and laminal post-alveolar affricates).
- Historical support: Proto-Dravidian had a contrast between dental, alveolar, and retroflex. The phonotactic constraint applied to all apicals (alveolar and retroflex).
- *Allophonic Variation (Palatalization)*: coronal affricates have two allophones: lamino-alveolar [ts] before non-front vowels, and lamino-post-alveolar [tʃ] before front vowels.

(9) Complementary distribution of [ts] and [tʃ] in Telugu (Krishnamurti 1998)

[tsali]	‘cold’	[tʃilaka]	‘parrot’
[tsa:pa]	‘mat’	[tʃi:puru]	‘broom’
[tsukka]	‘droplet’	[tʃeʃtu]	‘tree’
[tsu:pu]	‘sight’	[tʃe:ra]	‘open palm’
[tsokka:]	‘shirt’		
[tso:tʃu]	‘place’		

- Dentals can also be palatalized (at least optionally), but retroflexes may not.

(10) Optional palatalization of dentals in Telugu (Jagannath 1981: 8)

[paɖɖ ^h enimiɖi]	~	[paɖɖʒ ^h eniwiɖi]	‘eighteen’
[paɖjemu]	~	[paɖɖʒeʋu]	‘stanza’

- Evidence suggests: retroflexes form a category distinct from other coronals (dentals & affricates); the defining feature of this category is apicality.

8. Conclusion & Directions for Further Research

- Phonological features influence perception by determining: 1) which acoustic cues are linguistically relevant; and 2) how those cues are mapped to articulatory gestures.
- Retroflex stops are contrastively specified as [apical] in languages like Telugu, while dentals are underspecified for coronal features and are redundantly laminal.
- The primary cues associated with [apical] are those of the spectral burst, and these cues are common to both retroflexes and apical alveolars.
- Thus, Telugu speakers relate the “apical” cues of English alveolars to the feature [apical], and through this feature, to retroflex segments and gestures.
- The analysis proposed here predicts that Hindi also specifies retroflex segments with the feature [apical]. It remains to be seen whether language-internal evidence can be found to support (or refute) the active status of [apical] in Hindi.

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