UNIVERSITY OF CALIFORNIA

Los Angeles

Similarity Avoidance

in Bengali Fixed-Segment Reduplication

A thesis submitted in partial satisfaction

of the requirements for the degree Master of Arts

in Linguistics

by

Sameer ud Dowla Khan

2006

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF EQUATIONS

LABEL	DESCRIPTION	PAGE

ABSTRACT OF THE THESIS

Similarity Avoidance

in Bengali Fixed-Segment Reduplication

by

Sameer ud Dowla Khan

Masters of Arts in Linguistics

University of California, Los Angeles, 2006

Professor Kie Ross Zuraw, Chair

language, it was found that the more similar a base's initial consonant is to /t/, the more likely it is that the reduplicant will not begin with the fixed segment /t/; instead, speakers tend to use alternate fixed segments such as /f/ or /m/ to fulfill phonological dissimilarity between base and reduplicant. On what

1

1.1.1 BENGALI ECHO FIXED-SEGMENT REDUPLICATION

The extremely productive echo reduplication construction in Bengali uses a Fixed Segment (fixed segment), normally /t/[4], as shown in the following examples:

(1)	gʱuʃi[5]	'punch'
	gʱuʃi kʰae̯a	'having gotten punched'
	gʱuʃi kʰae̯a kand̪t̪ese.	'Having gotten punched, he's crying.'
	gʱuʃi tuʃi kʰae̯a kand̪t̪ese.	'Having gotten punched and whatnot, he's crying.'
	gʱuʃi kʰae̯a tae̯a kand̪t̪ese.[6]	'Having gotten punched and whatnot, he's crying.'

(2)	boj	'book', 'books'
	uni boj pɔɹen na.	'He doesn't read books.'
	uni boj toj pɔɹen na.	'He doesn't read books or anything.'

1.1.1.1 V

prevalent consonantal fixed segments after /t/ are the labials /m/, /f/, /b/, and /p/, and the breathy affricate /dʒʱ/ (sometimes in variation with the fricative /z/):

(3)	ɹajgga[8]	'having gotten angry'
	ɹajgga majgga	'having gotten angry and all'
(4)	tʃujʃʃa	'having sucked'
	tʃujʃʃa fujʃʃa	'having sucked and whatnot'
(5)	dana	'wing', 'wings'
	dana bana	'wings and other such things'
(6)	silka	'peel', 'peels'
	silka pilka	'peels, et cetera'
(7)	najmma	'having gotten down'
	najmma dʒʱajmma	'having gotten down and everything'

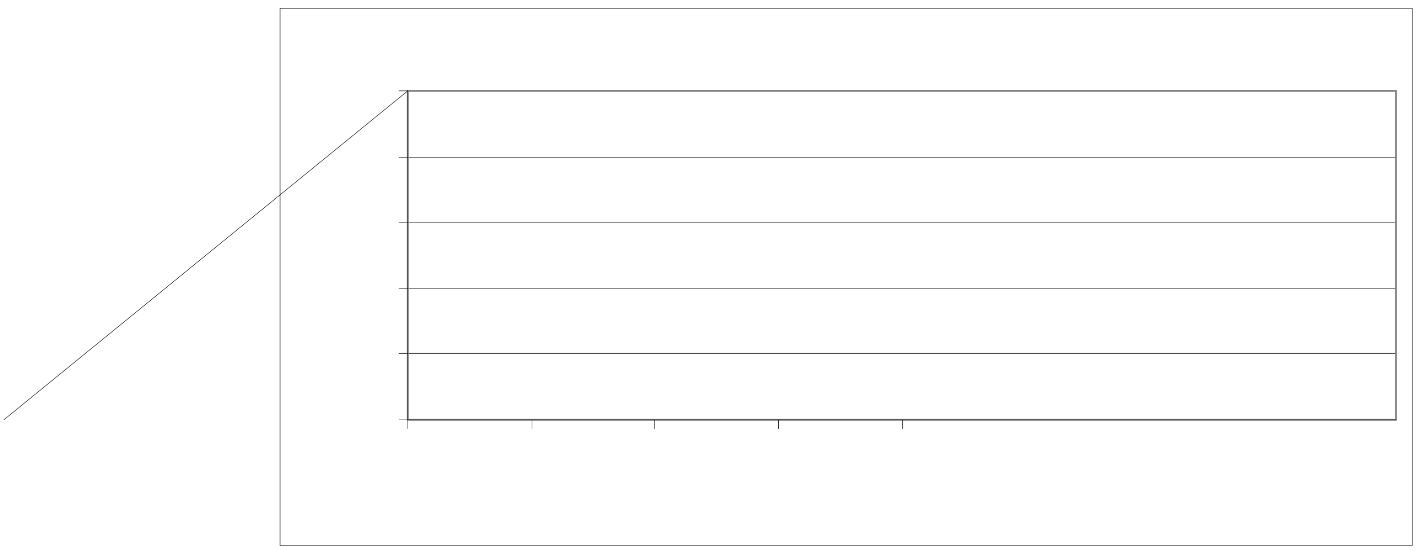
Many speakers prefer to preserve the initial consonant, and instead replace the vowel of the first syllable to /u/ or /a/, serving as a vocalic fixed segment.

(8)	sajɹa	'having let go'
	sajɹa sujɹa	'having let go and such'
(9)	tupi	'hat', 'hats'
	tupi tapi	'hats and all that comes with them'

---

[8] These examples were collected in the experiment described in Section 3.

the base was /t/. In fact, /t^h/-initial words also showed a strong tendency of fixed segment /f/-, /m/-, and /u/-use, while /d/-initial, /t̪/-initial, and /t̪^{h}/-initial words showed less of a tendency. Clearly, these speakers are not just avoiding total identity of base and reduplicant, but extending this to a more gradient **Similarity Avoidance**, where even relatively similar but not identical base-reduplicant pairs such as *[t^{h}ajʃʃa **t**ajʃʃa] are avoided with preference given to pairs such as [t^{h}ajʃʃa **f**ajʃʃa] or [t^{h}ajʃʃa **m**ajʃʃa]. Figure 1 graphs fixed segment /t/-use in the reduplicants of Bengali words presented in pilot survey, with the initial consonant of the base strung along the x-axis:



initial reduplicants), but to similarity avoidance, where bases starting with consonants presumably considered more similar to /t/ (e.g. /tʰ/, /t̪/, etc.) allow fewer fixed segment /t/-reduplicants than bases starting with consonants considered less similar to /t/ (e.g. /k/, /h/, etc.). This current study aims to investigate the following questions:

1. On what basis do Bengali speakers measure consonant similarity?
2. Is this measurement of similarity universal or language-specific?

Before attempting to answer these questions, let's examine other studies on fixed-segment reduplication cross-linguistically (Section 1.2), fixed-segment echo reduplication in Bengali (Section 1.3), and similarity avoidance in non-reduplicative constructions in three languages (Section 1.4).

1.2 Fixed-Segment Reduplication Cross-Linguistically

When a base includes a segment that is homophonous to the fixed segment it is in correspondence with,[10] speakers of different languages react in different

tebil tebil	**'tables and such'**

Language Type B: Turkish (echo) – The default fixed segment is reduplicant-initial /m/;

Language Type E: English – Total base-reduplicant identity is avoided by using one of many possible backups to default fixed-segment /ʃm/. Possible alternatives range widely; for example, 64% of respondents to the survey conducted in Nevins & Vaux (2003) felt no output was possible for the /ʃm/-reduplication of *schmooze*, while 31% preferred some form without initial *schm-* (many forms were attested), and only 5% preferred the non-dissimilated *schmooze-schmooze*.

Although there have been many previous studies on fixed-segment reduplication in Bengali, including Trivedi (1990), Fitzpatrick-Cole (1994) and (1996), Jha et al. (1997), and Nevins & Wagner (2001), among others, no previous study (to my knowledge) has discussed the issue of similarity avoidance or iden

The Ray et al. (1966) study of the Standard Kolkata Bengali dialect briefly mentions the assortment of fixed segments in echo r

Bykova (1981) also describes echo reduplication in Standard Kolkata Bengali as "incompletive reduplication" (p 105), where fixed segments /t/, /b/, /ʃ/, and /a/ are mentioned in four examples copied below.

(28)	**lutʃi**	**'luchi (a flat cake fried in clarified butter)'**
	lutʃi tutʃi	**'luchi etc.'**

adjacent[17] homorganic consonants (i.e. similarity avoidance) has been proposed to describe the relationship between OCP and consonant cooccurrence within roots in the lexicons of many languages.

Although the tendency for homorganic consonants to be underrepresented in Arabic triliteral roots has been noted in many studies, including Greenberg (1950), McCarthy (1988) and (1994), Pierrehumbert (1993), Padgett (1995), and Frisch, Pierrehumbert, and Broe (2004), only this last study, Frisch et al.

similarity with respect to this phenomenon, and can thus freely cooccur. This topic will be addressed again later.

	b	f	m	t	d	tˤ	dˤ	θ	ð	s	z	sˤ	zˤ	ʃ	k
b	1	.38	.5	0	0	0	0	0	0	0	0	0	0	0	0
f	.38	1	.22	0	0	0	0	0	0	0	0	0	0	0	0
m	.5	.22	1	0	0	0	0	0	0	0	0	0	0	0	0
t	0	0	0	1	.42	.26	.17	.21	.14	.32	.19	.12	.08	.12	0
d	0	0	0	.42	1	.16	.3	.13	.21	.17	.32	.08	.13	.07	0
tˤ	0	0	0	.26	.16	1	.4	.24	.14	.14	.09	.41	.21	.13	.21
dˤ	0	0	0	.17	.3	.4	1	.13	.23	.09	.14	.2	.42	.07	.11
θ	0	0	0	.21	.13	.24	.13	1	.45	.4	.24	.45	.24	.37	0
ð	0	0	0	.14	.21	.14	.23	.45	1	.25	.44	.24	.44	.21	0
s	0	0	0	.32	.17	.14	.09	.4	.25	1	.44	.35	.2	.3	0
z	0	0	0	.19	.32	.09	.14	.24	.44	.44	1	.2	.35	.17	0
sˤ	0	0	0	.12	.08	.41	.2	.45	.24	.35	.2	1	.42	.33	.11
zˤ	0	0	0	.08	.13	.21	.42	.24	.44	.2	.35	.42	1	.17	.07
ʃ	0	0	0	.12	.07	.13	.07	.37	.21	.3	.17				

$$\frac{\textbf{Total roots}}{\dfrac{\textbf{Observed } /t^{ʕ}/ \textbf{ Occurrence in roots}}{\textbf{Total roots}} \times \dfrac{\textbf{Observed } /\theta/ \textbf{ Occurrence in roots}}{\textbf{Total roots}}}$$

Figure 4.

Coetzee & Pater (2005) extend the Frisch et al. metric of similarity based on shared natural classes to the consonants of Muna, comparing the similarity scores of consonant pairs to their corresponding cooccurrence rates in roots of the shape (V)CVCVCV. Their findings show that, indeed, pairs of homorganic non-identical consonants are underrepresented in Muna roots, as shown in Figure 6.

	Labial			Dorsal			Coronal		
	Obs	Exp	O/E	Obs	Exp	O/E	Obs	Exp	O/E
Labial	156	477.8	0.33						
	bafu, mopi, mafaka								
Dorsal	875	770.9	1.14	63	210.6	0.30			
	meko, bage, bugi			kangia, kagala, kagu^{n}di					
	2741	2179.0	1.26	1766	1522.5	1.16	1400	1751.5	0.80

Corode 1ZWx3xβχ ʔ W6PP§x0G633x̬ˤ ʈMbD0,6WP3MMiDH63G73,WMnDH6GHZ3x̬ˤ M 1ZGD0,6WP3MMil findings in Coetzee & Pater (2005) point out some important distinctions between the Arabic pattern and the Muna pattern, as Frisch et al. analyze coronal obstruents as one set separate from the coronal sonorants (thus largely disregarding voicing as a factor in OCP-Place), while Coetzee & Pater find voiced coronals acting as one set separate from voiceless coronals, thus reducing the weight of the oral-nasal distinction in OCP-Place.

Coetzee & Pater maintain that only positing one general OCP-Place constraint in an Optimality Theoretic (Prince & Smolensky 1993/2004) approach would require speakers of Muna to accept a rather large number of exceptions to the generalization, when the data actually makes it quite clear that these "exceptions" can be more easily analyzed measuring similarity. Positing both OCP-Dorsal (αVoice) and OCP-Dorsal (αContinuant) instead of individual OCP constraints would predict, for example, that having two adjacent dorsals, two adjacent continuants, two adjacent stops, two adjacent voiced consonants, or two adjacent voiceless stops would be acceptable, but having two voiced dorsals, two voiceless dorsals, two dorsal stops, or two dorsal continuants would be penalized. OCP constraints incorporating even more features are allowed in the Coetzee & Pater framework, with their Muna analysis includi

While both Frisch et al.

1.4.3 MEASURING SIMILARITY AVOIDANCE IN BENGALI ROOTS

Frisch et al. (2004) examines the correlation between consonant cooccurrence within roots and the number of natural classes shared between the cooccurring (or not cooccurring) consonants. If consonant cooccurrence is restricted cross-linguistically by some form of the OCP, then we can predict that speakers' grammars correlate consonant cooccurrence with consonant similarity cross-linguistically. Since Frisch et al. used ins6n tsrrtu§0363G73,WMoDW67G3§W§McD0,GH33GWM D0,§H6W617§GW67G,77MfDH633Z similarity avoidance from fixed segment /t/ in reduplicants of words beginning with that consonant.

2 PREDICTIONS

The theories presented in Section 1.4 make predictions as to what base-initial

Stops and affricates in most dialects of Bengali contrast in a four-way distinction of voiceless unaspirated, voiceless aspirated, voiced unaspirated, and voiced aspirated (breathy). Most fricatives are voiceless and all sonorants are voiced in Bengali.

The phonemic inventory of Common East Bengali is not fixed; any two speakers can have slightly different inventories given their exposure to other dialects, as no speaker of Bengali is truly “monodialectal”. Some consonants, in particular, can have a number of pronunciations depending on the individua

CONSONANTS	Bilabial	Labio-Dental	Lamino-Dental	Apico-Alveolar	Apico-Postalveolar	Lamino-Postalveolar	Velar	Glottal
Stops	p b bʱ		t̪ d̪ t̪ʰ d̪ʱ		t d tʰ dʱ		k g kʰ gʱ	
Affricates						tʃ dʒ tʃʰ dʒʱ		
Fricatives		f		s z		ʃ		h
Approximants				l	ɹ			
Nasals	m			n			ŋ	

Figure 9. Rough sketch of the consonantal inventory of Common East Bengali.

The stops listed as "apico-postalveolar" in

Figure 9 have been described as "retroflex" in Ramaswami (1999) and several other sources, "retroflex alveolar" in Ray et al. (1966:6), "pronounced at a lower position [than retroflex or cerebral], approaching the alveolar region" in Chatterji (1970:xxxiii), "not true retroflex; the tip of the tongue is slightly curbed back at the point of articulation, which is a little further back than for that of the usual English sounds of 't' and 'd'," in Haldar (1986:22), and "simply alveolar as they are articulated in the alveolar region and not in the retroflex or cucuminal [sic] region" in Tunga (1995:139), adding that "true retroflex stops are found only in Dravidian and Munda languages". Palatographic evidence presented in Hai (1960) indicates that these stops are "alveolo-retroflex", as they are realized "with the tip of the tongue curled back against the point of contact at the alveolar ridge (Hai 1960:186)."

What are labeled in

other languages." The status of the aspirated nasals /mʱ/ and /nʱ/ is considered in Esposito et al. (2005) to be intermediate between phonemic singletons and clusters of consonants.

There is a small number of significant differences between the inventory in Figure 9 and the phonemic inventory of Standard Kolkata Bengali. Many of the differences are one-to-one correspondences across the dialects; Common East Bengali /f/, for example, corresponds to Standard Kolkata Bengali /pʰ/. Other differences, however, involve collapses in phonemic distinction across dialects; Standard Kolkata Bengali phonemes /ɹ/ and /ɾ/, for example, are collapsed in Common East Bengali as two allophones of /ɹ/. These cross-dialectal differences can be very salient for some speakers, and depending on the situation, a speaker may be very conscious of his or her particular pronunciation. For the purposes of this study, audio recordings and written materials were provided in both Common East Bengali and Standard Kolkata Bengali.

Both Standard Kolkata Bengali and Common East Bengali have seven contrastive vowels, distinguished by four levels of tongue height and three positions of tongue backness. Vowel qualities are less disparate than consonantal realizations across the dialects, although western dialects such as Standard Kolkata Bengali tend to make use of more vowel harmony processes than eastern dialects such as Common East Bengali. This does not increase or decrease the size of the vocalic phonemic inventory, but it does mean that vowels in certain words may not be consistent across dialects. Standard Kolkata Bengali has twice as many vowels as Common East Bengali when nasalization is factored in, as nasalization can be a phonemically distinguishing feature for all seven vowel qualities. Nasalized vowels in western dialects are most often the result of historically oral vowels followed by nasal consonants, a sequence type that is still preserved in eastern dialects.

2.2 APPLYING THE NATURAL CLASSES METRIC TO BENGALI FIXED SEGMENT ECHO REDUPLICATION

As seen in example (10) in Section 1.1.1.1, Bengali echo fixed segment reduplication typically involves replacing the initial consonant in the reduplicant with the fixed segment, which is most often /t/. This default fixed segment /t/ is replaced by backup fixed segments in circumstances where the base already begins with /t/, a situation that would otherwise create a homophonous base-reduplicant pair.

According to the Frisch et al. (2004) theory, the consonants that share the largest number of natural classes are to be considered the most similar to each other. If the Bengali speakers that participated in the pilot survey are choosing fixed segments based on this measure of similarity, we can make a prediction as to what consonants will be considered more similar to /t/. Using the programs FeaturePad and Similarity[23] to apply the natural classes metric (Frisch, Pierrehumbert, and Broe – or Frisch et al. – metric) to the Bengali phoneme inventory[24], consonant similarity to /t/ is predicted to follow as shown in Figure 11.

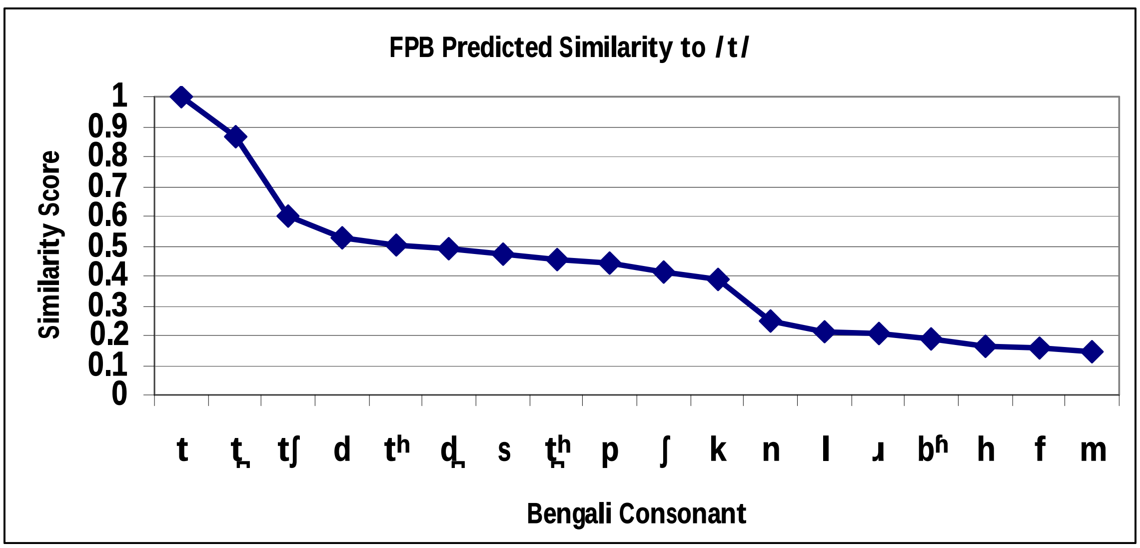


Figure 11. Similarity values of selected Common East Bengali consonants to the voiceless unaspirated alveolar stop /t/, as measured by the Frisch et al. shared natural classes metric, and as calculated by FeaturePad and Similarity.

---

[23] Zuraw (1998) and (n.d.), respectively.

[24] The feature specifications of each Bengali phoneme can be found in Appendix C (Section 5.3).

claiming that they belong to two very distinct groups when examining the cooccurrence data; thus, Figure 13 graphs similarity to /t/ within Common East Bengali coronal obstruents, thus removing /n/, /l/, and /ɹ/ from the set.

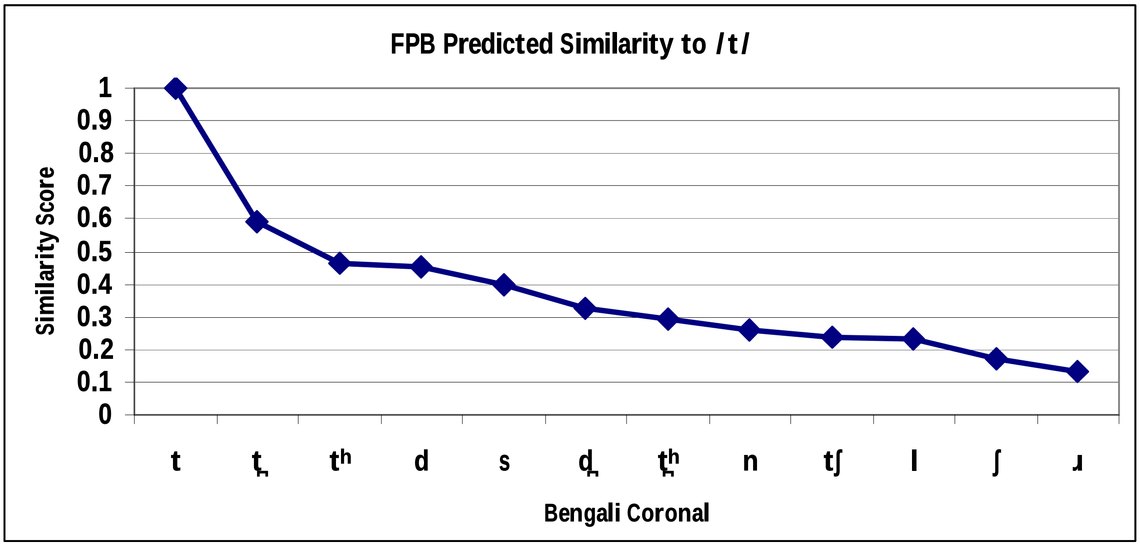


Figure 12. Similarity values of selected Common East Bengali coronals to the voiceless unaspirated alveolar stop /t/, as measured by the Frisch et al. shared natural classes metric, and as calculated by FeaturePad and Similarity.

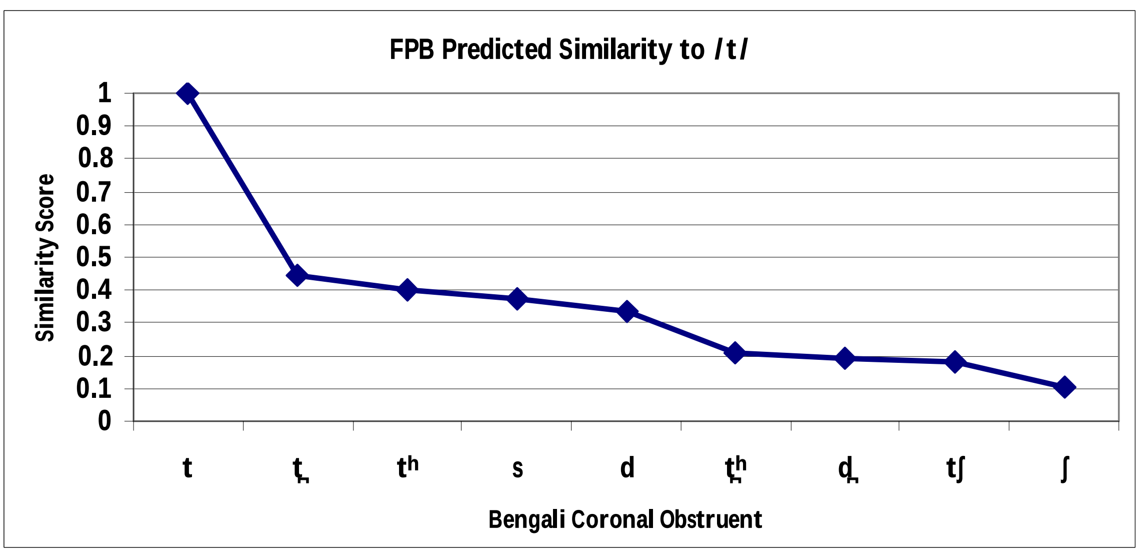
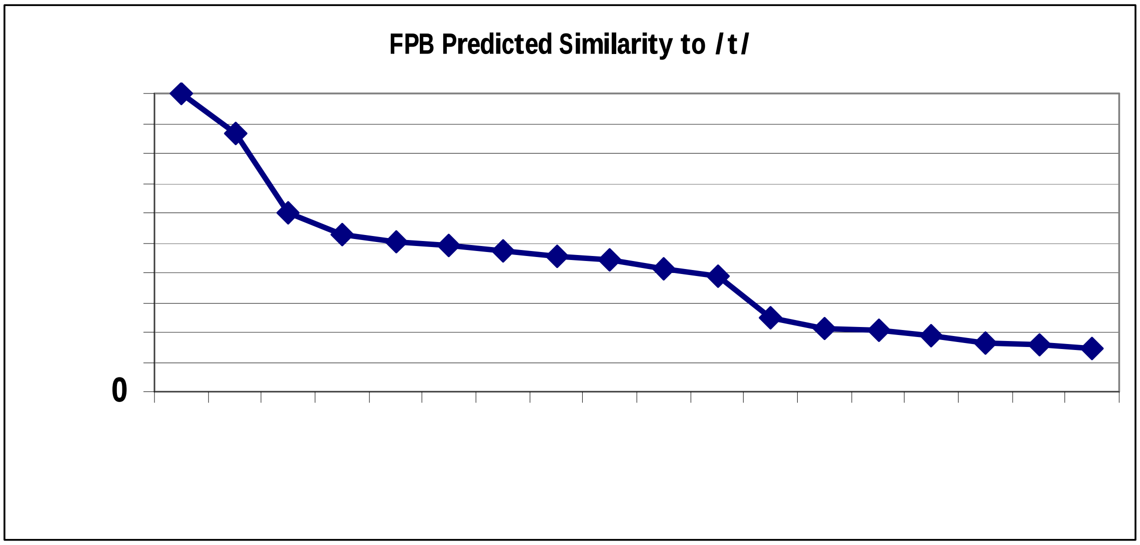


Figure 13. Similarity values of selected Common East Bengali coronal obstruents to the voiceless unaspirated alveolar stop /t/, as measured by the Frisch et al. shared natural classes metric, and

class less than in the larger set. When restricting similarity measurements to coronal obstruents, the natural class [-sonorant] also vanishes, and the pair {d,t} is once again considered further dissimilar. While some phoneme pairs fall sharply in similarity when decreasing inventory size, others fall at a slower rate or simply do not fall, allowing the pair {s,t} to become more similar in measurements of smaller inventories.

2.2.1 Predicted fixed segment /t/-Use in Reduplicants of Native Bengali Bases

In their discussion of OCP effects in Arabic, Frisch et al. examine the relation between the number of shared natural classes (Shared Natural Classes) between any pair of consonants and the observed cooccurrence of those two consonants in triliteral roots. Using this Shared Natural Classes metric, a prediction can be made about fixed segment /t/ use in Bengali echo reduplication. Those bases that begin with consonants sharing a high number of natural classes with /t/ will have a higher tendency not to have reduplicants that begin with /t/, in order to maintain similarity avoidance. The following graph (copied from Figure 11) illustrates the similarity score between /t/ and each consonant of the Bengali inventory.


FPB Predicted Similarity to / t /
0

enough established in the lexicon to undergo fixed segment echo reduplication. To investigate whether borrowings would be treated the same as native words of similar structure, English loanwords were included in the current study.

Most of the consonantal phonemes of English have rough Bengali equivalents used in "Bengali English". Some of the important distinctions between the phonemic inventory of "Bengali English" and that of English as spoken by native English speakers are as follows:

1) English /θ/ is borrowed into "Bengali English" as /t̪ʰ/,
2) English /ð/ is borrowed into "Bengali English" as /d̪/,
3) English /ʒ/ and /dʒ/ are collapsed in "Bengali E

English bases, but that they use calculations based solely on the phonemic inventory of "Bengali English" – the restricted subset of Bengal

2.

fixed segment reduplication cannot be explained in this way. Bengali speakers do not all agree on which bases allow fixed segment /t/ and which do not, and they are not even internally-consistent either, as the same base can take more than one reduplicant at times. Any adaptation of the relativized OCP in Bengali fixed segment reduplication will have to make use of stochastic OT or other such theory, in which constraint rankings are only tendencies, allowing for some exceptions.

A very conservative application of Coetzee & Pater's theory to the Bengali fixed segment reduplication data would posit an OCP constraint against the cooccurrence of any two phonemes that share all the features of /t/ (e.g. [-continuant], [-sonorant], [-spread glottis], etc.). The next constraint down in the hierarchy would assign a violation to every base beginning with a consonant that shares all features with /t/ minus one (e.g. the [spread glottis] feature). A lower-ranked constraint would assign a violation to every base beginning with a consonants that shares all features with /t/ minus two, and so on, until the general OCP-coronal constraint, which assigns a violation to any base-reduplicant pair where the base-initial consonant is coronal.

Applying these constraints to Bengali fixed segment reduplication, certain consonants would receive not only more but also more severe violations when cooccurring with /t/. The consonants that would receive violations from each constraint are shown in

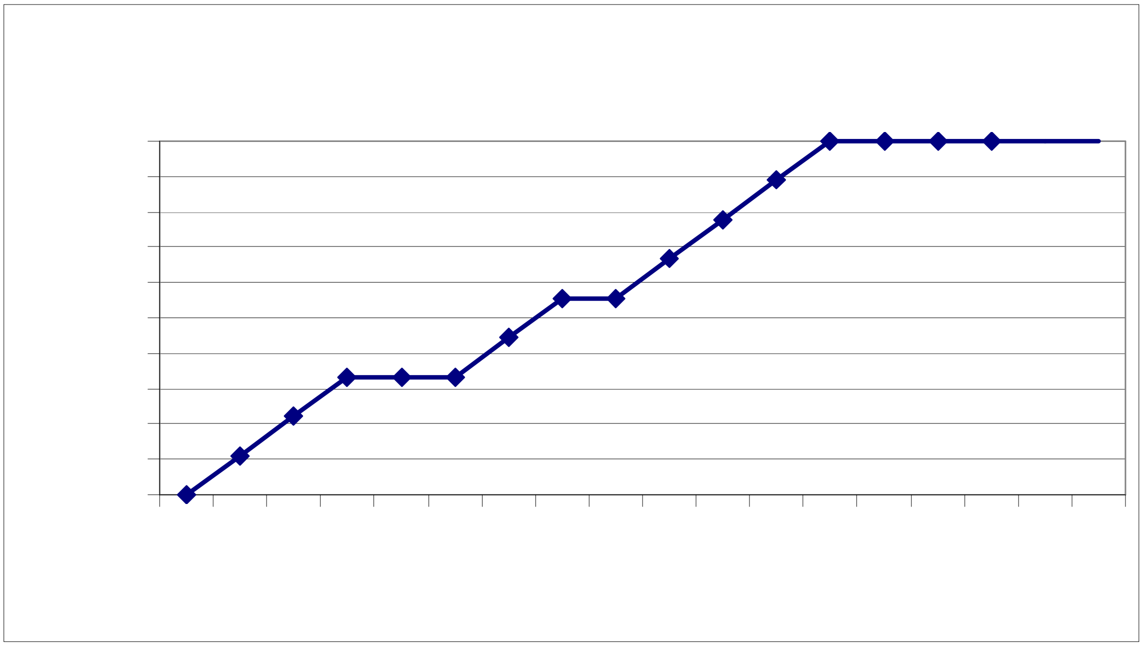
Table 2 below.

Each constraint below…	…assigns one violation to each consonant below when cooccurring with /t/
OCP-COR (αs.g., αvoi, αdist, αd.l., αant, αson, αnas, αlat)	t
OCP-COR (αvoi, αdist, αd.l., αant, αson, αnas, αlat)	t, tʰ
OCP-COR (αdist, αd.l., αant, αson, αnas, αlat)	t, tʰ, d, dʱ
OCP-COR (αd.l., αant, αson, αnas, αlat)	t, tʰ, d, dʱ, t̪, t̪ʰ, d̪, d̪ʱ
OCP-COR (αant, αson, αnas, αlat)	t, tʰ, d, dʱ, t̪, t̪ʰ, d̪, d̪ʱ, s, z
OCP-COR (αson, αnas, αlat)	t, tʰ, d, dʱ, t̪, t̪ʰ, d̪, d̪ʱ, s, z, tʃ, tʃʰ, dʒ, dʒʱ, ʃ
OCP-COR (αnas, αlat)	t, tʰ, d, dʱ, t̪, t̪ʰ, d̪, d̪ʱ, s, z, tʃ, tʃʰ, dʒ, dʒʱ, ʃ, ɹ
OCP-COR (αlat)	t, tʰ, d, dʱ, t̪, t̪ʰ, d̪, d̪ʱ, s, z, tʃ, tʃʰ, dʒ, dʒʱ, ʃ, ɹ, n
OCP-COR	t, tʰ, d, dʱ, t̪, t̪ʰ, d̪, d̪ʱ, s, z, tʃ, tʃʰ, dʒ, dʒʱ, ʃ, ɹ, n, l

Table 2. Bengali consonants that would receive a violation from each relativized OCP constraint, when cooccurring with /t/.

Pairing each Bengali consonant with fixed segment /t/ and applying the constraint hierarchy in Table 1 would predict that base-initial /t/ would cooccur with fixed segment /t/ the least, as this pair violates the highest-ranked OCP constraint. Base-initial /t^h/ (i.e. the segment that shares all features with /t/ except for [spread glottis]) would cooccur with fixed segment /t/ the "next least", as this pair violates the second-highest-ranked OCP constraint. The hierarchy would not assign violations to fixed segment /t/ in cooccurrence with /p/- or /k/-initial bases, as OCP constraints are by the Coetzee & Pater definition (and by most traditional definitions) restricted to major place features.

If each constraint is assigned a value measuring its effectiveness in this hierarchy, with the highest-ranked constraint receiving a value of 9 and the lowest-ranked constraint receiving a value of 1, we can calculate which consonants would be considered more similar to (i.e. would violate more OCP constraints when cooccurring with) /t/. Similarity would be calculated by dividing the numerical value of the highest constraint violated by the consonant by the numerical value of the highest constraint value possible (9), and multiplying this by 100. The similarity of {t,t} would thus be (9/9)x100=100, and the similarity score for {l,t} would be (1/9)x100=88.9. Subtracting the similarity score from 100 produces the dissimilarity score; Figure 20 below measures the dissimilarity score for each consonant with /t/.



(and final) syllable of the root. Only roots composed entirely of two open syllables were considered, in order to avoid the effects of codas

The O/E ratios of all consonants' cooccurrence rates with /t/ are given in Figure 22 below. A score of zero (0) indicates that despite whatever cooccurrence rate we may have expected given the word list, there were no ob

avoidance of fixed segment /t/ in reduplicants of /t/-initial bases. The patterns in Figure 22 suggest that if similarity avoidance in Bengali fixed segment echo reduplication is regulated by the same OCP constraint as the apparent consonant cooccurrence restrictions are, bases starting with the consonants /t/, /l/, /t̪/, /t̪ʰ/, and /d̪/ will avoid reduplicants with fixed segment /t/. Bases starting with consonants such as /pʰ/ (Common East Bengali /f/), /tʰ/, /tʃʰ/ (Common East Bengali /s/), and /h/ would be predicted to allow more reduplicants with fixed segment /t/ than bases starting with other consonants. If it turns out that the Bengali grammar relates O/E cooccurrence rates between each consonant and /t/ to fixed segment /t/-use in echo reduplication, we can posit that the same constraints governing the consonant distribution in the lexicon are also regulating what reduplicants are acceptable given the initial consonant of the base.

2.

$$\mathrm{sim}(C_1, C_2) = \exp\left(\sum_{i=1}^{\#\,\text{features}} w_i(1 - \delta_i(C_1, C_2))\right)$$

Equation 1. Similarity as a decreasing function of feature disparity.

In Equation 1, C_1 and C_2 are the two consonants being measured for similarity, w_i is the weight of the feature f_i, and δ_i (C_1, C_2) is 1 if and only if the two consonants share the same specification for feature f_i and 0 if they do not. The similarity score of a consonant and /t/ ($\mathrm{sim}(C_1, t)$) can be plugged into an equation measuring the probability of fixed segment /t/-use given the base-initial consonant C_1.

$$P = ((m!) \div (n!(m - n)!))\ (1 - \mathrm{sim}(C_1, t))^n\ (\mathrm{sim}(C_1, t))^{m-n}$$

Equation 2. The probability using fixed segment /t/ in the reduplicant of a C_1-initial base n times out of m trials is given by this binomial formula.

In Equation 2, P stands for the probability that a base-initial consonant C_1 will undergo echo reduplication with fixed segment /t/ n times out of a total of m trials. Since similarity scores (sim (C_1, C_2)) range only from 0 to 1, the similarity score for the consonant pair $\{C_1, t\}$ can be subtracted from 1 to derive the dissimilarity score. If given the m and n values (the total number of reduplications for C_1-initial bases and the total number of fixed segment /t/-reduplicants for C_1-initial bases, respectively), a program such as R could calculate the best fit of similarity scores and feature weights.

3.1 METHODS

3.1.1 SUBJECTS

considered similar to /t/, including /h/, /v/, /m/, /f/, /pɹ/, /pl/, /d̪ɾ/, /t̪ʰɾ/, and so on. No word included /t/, /tʰ/, /d/, /t̪/, /t̪ʰ/, or /tʃ/ in non-initial position.

3.1.2.2 Recording of Stimuli

The stimuli were recorded in one sitting inside the sound booth at UCLA's Phonetics Laboratory, using a tabletop Telex M-540 microphone plugged into a order to familiarize the subject with the task before proceeding to more difficult stimuli.

Microsoft Excel's random number generator was used to produce 35 different orderings of 59 stimuli (as the first stimulus of each set type was kept constant) for each of the four stimulus lists. After randomizing all 180 audio and written stimulus lists, each list was individually inspected to ensure that no two stimuli starting with the same consonant or consonant cluster occurred in sequence. Such sequences were reordered with surrounding stimuli to prevent any such instance.

3.1.2.4 Presentation of Stimuli

The experiment was held in Huntington Beach, California, at the home of a local member of the Bengali community. Each of the 30 speakers was asked in which language (i.e. English or Bengali) he or she would prefer to listen to directions (directions on all test materials were written in both English and Bengali), and in which dialect of Bengali (i.e. Standard Kolkata Bengali or Common East Bengali) he or she would prefer to read and listen to Bengali stimuli.[36] For all tasks, response time was not

[36] Out of 30 subjects, 17 chose Common H67Px̰?6ZHPP73H6ZP3W6ZHPP73MoDW3GWM D0H6ZH§3GWM

[illegible] famiMoDW67G,77McD0,61,H§PM,tD,6§11Z73 measured; there was no time limit to complete any t containing the links to the audio files. Subjects were seated in a position from which the computer screen was not visible to them.

3.1.2.4.2 Written Stimuli

For the written judgment survey (Part II), subjects were presented with the

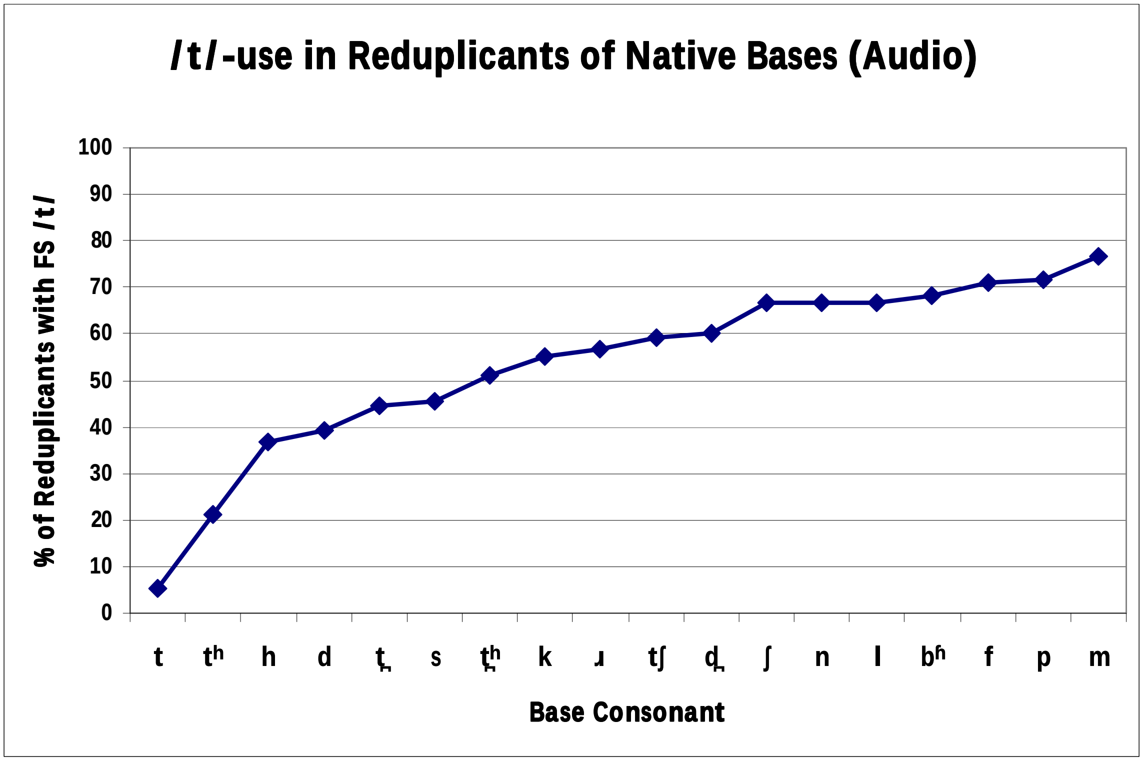


Figure 23.

a77. tthθ0j550θδS59t2F225θδfjF5-kt3θ&F.z0

The results of a repeated-measures Analysis of Variance (ANOVA) with one within-subjects factor (i.e.

uses fixed segment /t/ less often than the fricatives of that minor POA. This is true for the apico-alveolars, the lamino-dentals, and the lamino-postalveolars.

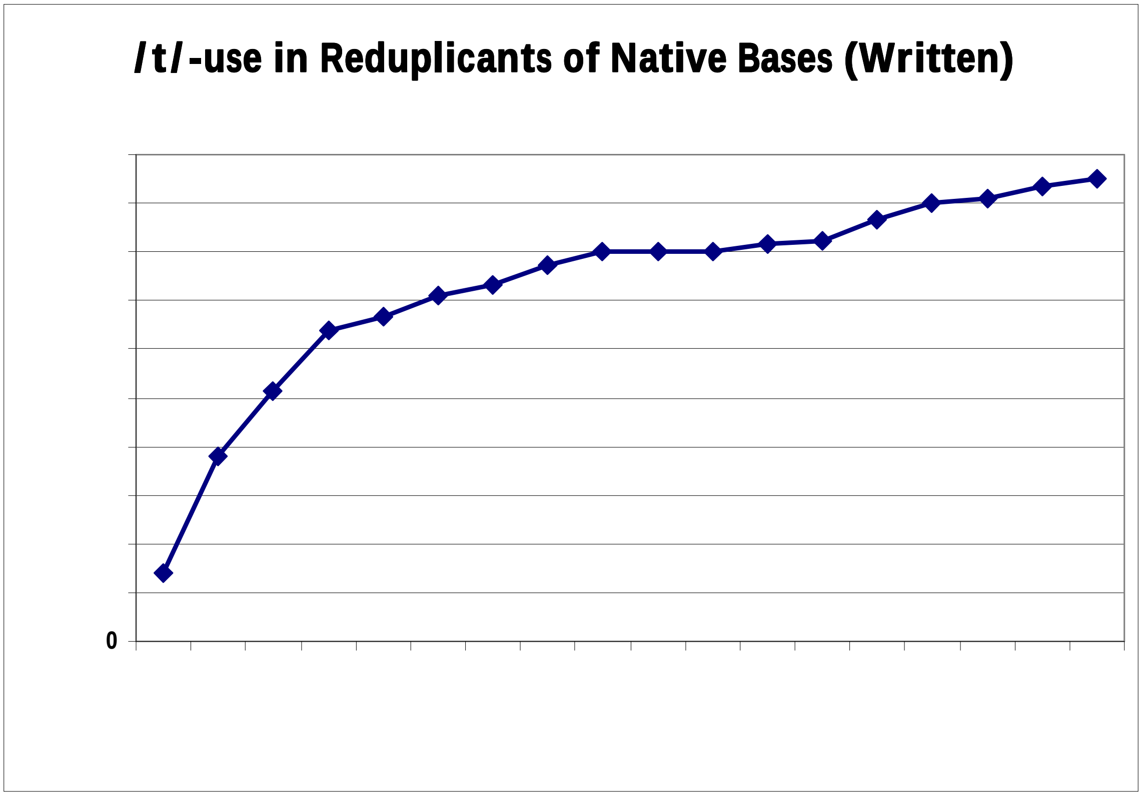
It may be startling to notice in Figure 23 that /h/-initial words used fixed segment /t/ less often than /d/- or /ţ/-initial words; /h/ is the only non-coronal consonant to make use of fixed segment /t/ less than 50% of the time. The /h/-initial English borrowings also exhibited rather unexpected behavior with respect to the percentage of fixed segment /t/-use in their reduplicants. At this time, I can offer no explanation as to its peculiar behavior.

The fact that the bases whose reduplicants allowed the largest percentages of fixed segment /t/-use start with /m/, /p/, and /f/ should be of no surprise. As the backup fixed segments for default /t/ are most typically labial /m/, /p/, and /f/, it would be highly unlikely that a similarity-avoiding speaker would reduplicate an /m/-, /p/-, or /f/-initial base with any of these backup fixed segments.

The patterns of dissimilation suggest that certain features of initial consonants can trigger dissimilation from /t/. For example, the frequency of fixed segment /t/-use ,WM DMfDPk0C73,W,MmDW13MhsD0363WgPM6
in reduplicants seems to be sensitive to the place ([+Z3xP7MgD0,6W3§PPMmDW6P7ZP7H6§WZMtD,
cpann 1HPGMsD03PoG fa0W6PP,,,MhDH6GH,WM

segment. When the base-initial consonant and fixed segment /t/ share that feature,

ħ


/ t / -use in Reduplicants of Native Bases (Written)
0

3.2.2 REDUPLICANTS OF ENGLISH BORROWINGS

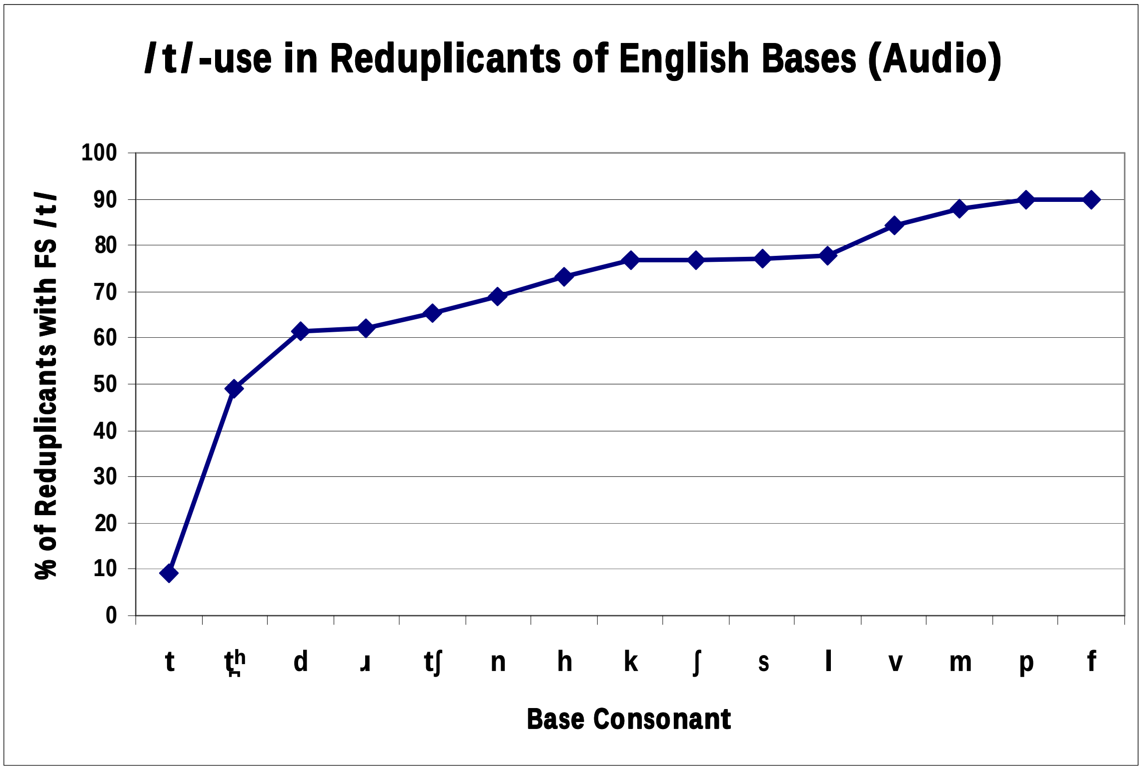


Figure 25. Percentage of fixed segment /t/-use in reduplicants of English borrowings of var

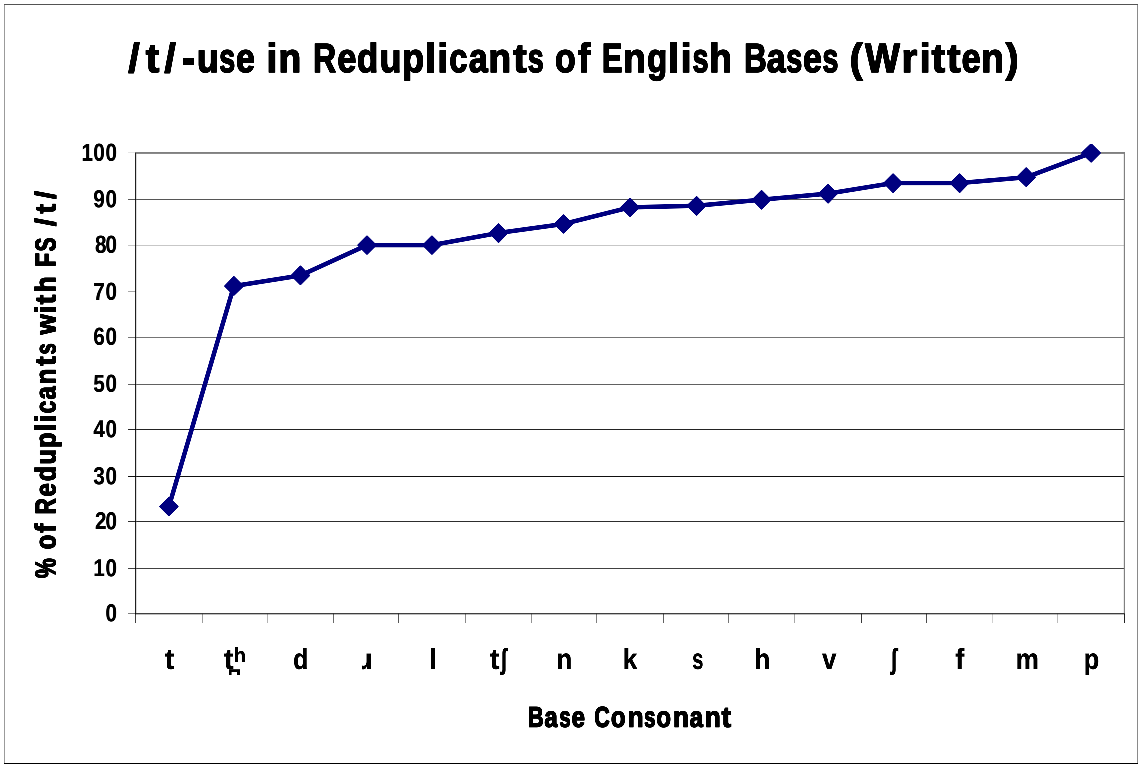


Figure 26. Percentage of fixed segment /t/-use in reduplicants of English borrowings of varying initial consonants, when presented via written test format.

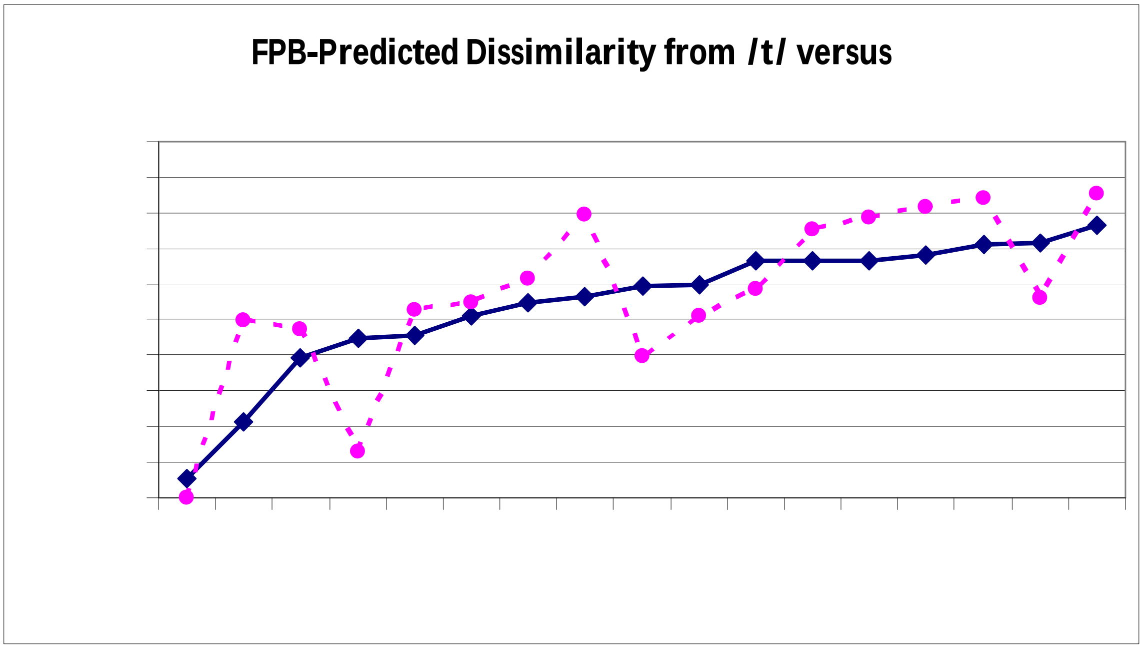
Clearly, English bases accept far more reduplicants with f§,_1G73G3M16DH633ZG3M§,MlDH63C

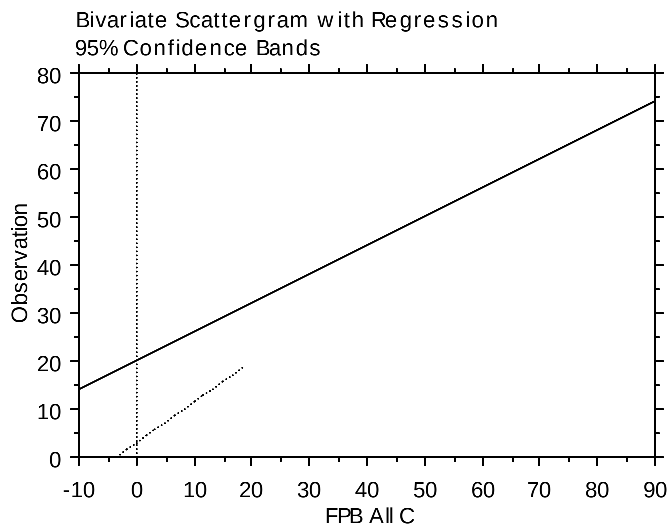
3.2.3 Reduplicants of Sanskritic and English Borrowings with Initial Clusters

While indeed fascinating, the cluster-initial base data could not be included in this analysis due to time and space constraints.

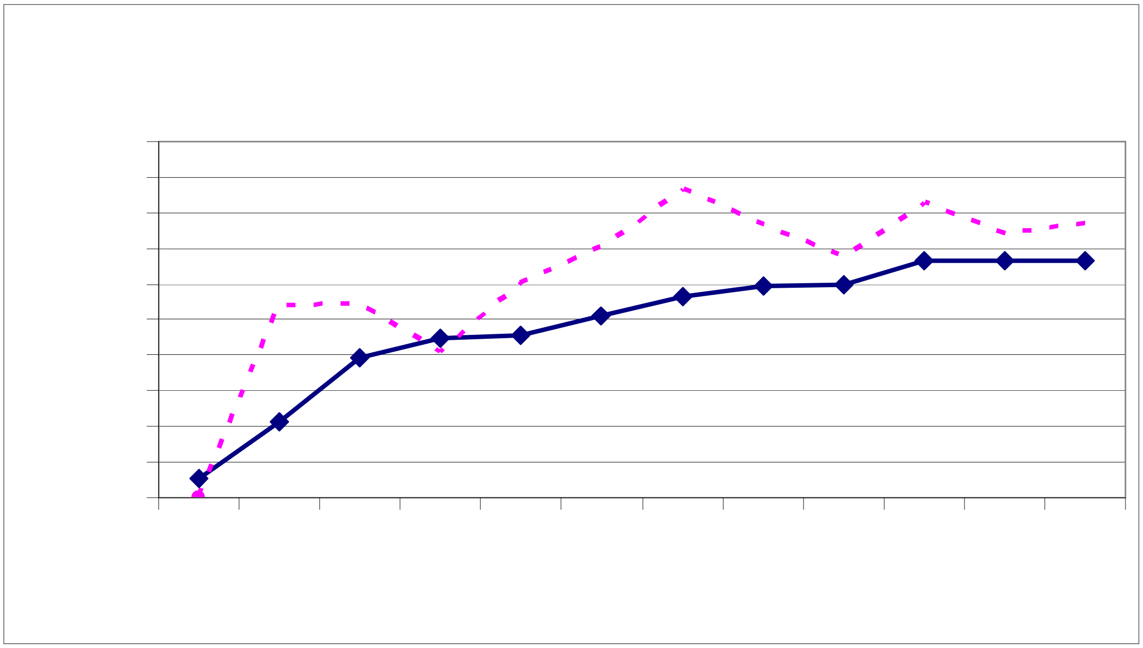
3.3 Analysis

scattergram depicting the correlation of the observed data with the Frisch et al. predictions minus /h/ is given in Figure 30.





Bivariate Scattergram with Regression
95% Confidence Bands
80
70
60
50
40
30
20
10
0
Observation
-10
0
10
20
30
40
50
60
70
80
90
FPB All C



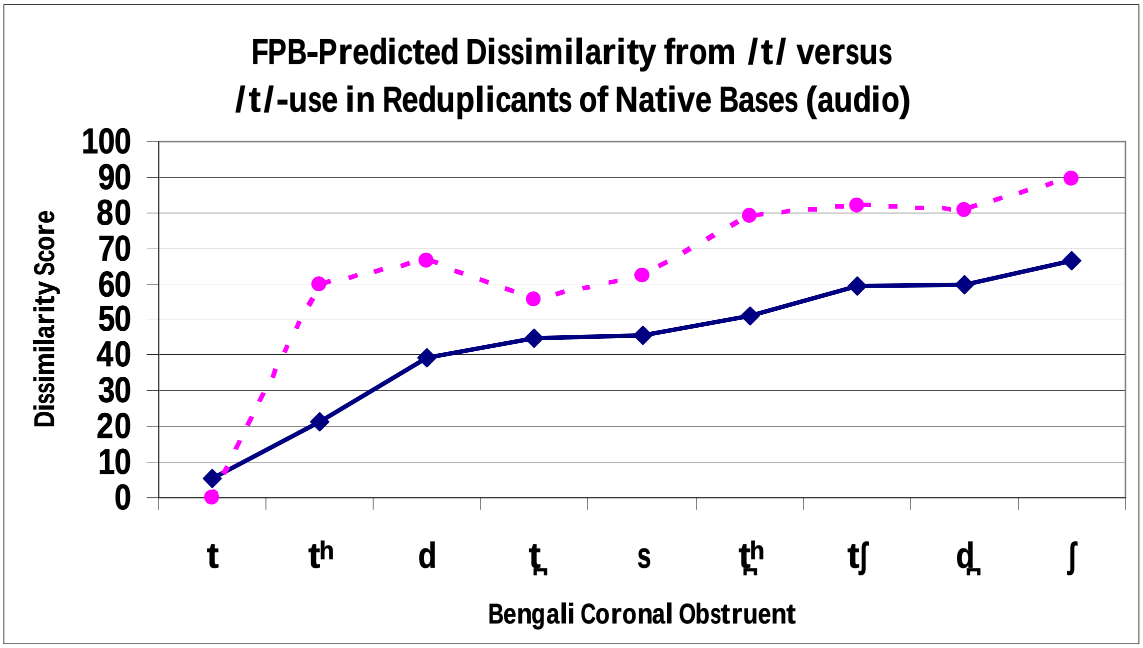
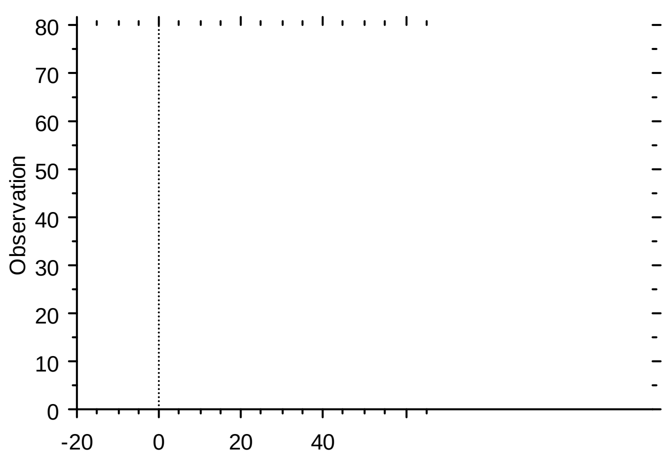


Figure 33. Observed fixed segment /t/-use in reduplicants of native words presented in audio recording format (solid line), versus the predicted fixed segment /t/-use as per the Frisch et al. model of similarity based on Shared Natural Classes, measured across Bengali coronal obstruents only (dotted line).



3.3.2 RELATIVIZED OCP CONSTRAINTS

Applying the Coetzee & Pater model of relativized OCP constraints to determine consonant similarity to Bengali fixed segment reduplication, a hierarchy of more specific constraints against the cooccurrence of /t/-like segments ranked over a more general constraint against the cooccurrence of all coronals can be proposed. One possible hierarchy, first shown in Table 1, is repeated in

	OCP-COR (αs.g., αvoi, αdist, αd.l., αant, αson, αnas, αlat)	OCP-COR (αvoi, αdist, αd.l., αant, αson, αnas, αlat)	OCP-COR (αdist, αd.l., αant, αson, αnas, αlat)	OCP-COR (αd.l., αant, αson, αnas, αlat)	OCP-COR (αant, αson, αnas, αlat)	OCP-COR (αson, αnas, αlat)	OCP-COR (αnas, αlat)	OCP-COR (αlat)	OCP-COR
tana-tana	*!	*	*	*	*	*	*	*	*
tʰana-tana		*!	*	*	*	*	*	*	*
dana-tana			*!	*	*	*	*	*	*
ţana-tana				*!	*	*	*	*	*
sana-tana					*!	*	*	*	*
ţʰana-tana				*!	[illegible]	*	*	*	*
ɹana-tana							*!	*	*
tʃ tana			*!						

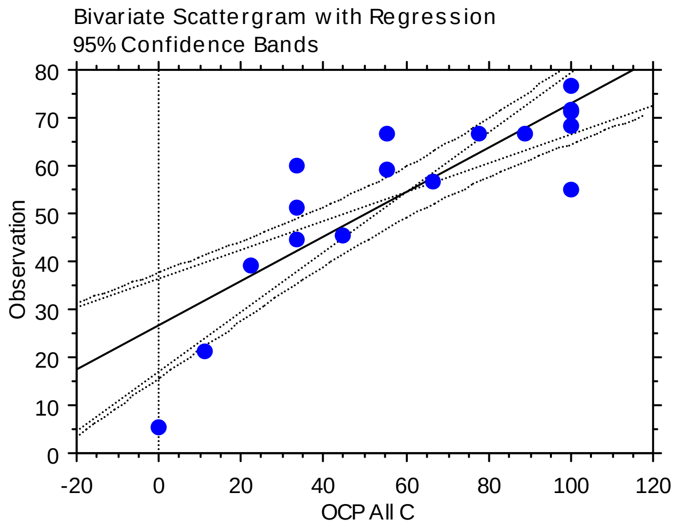


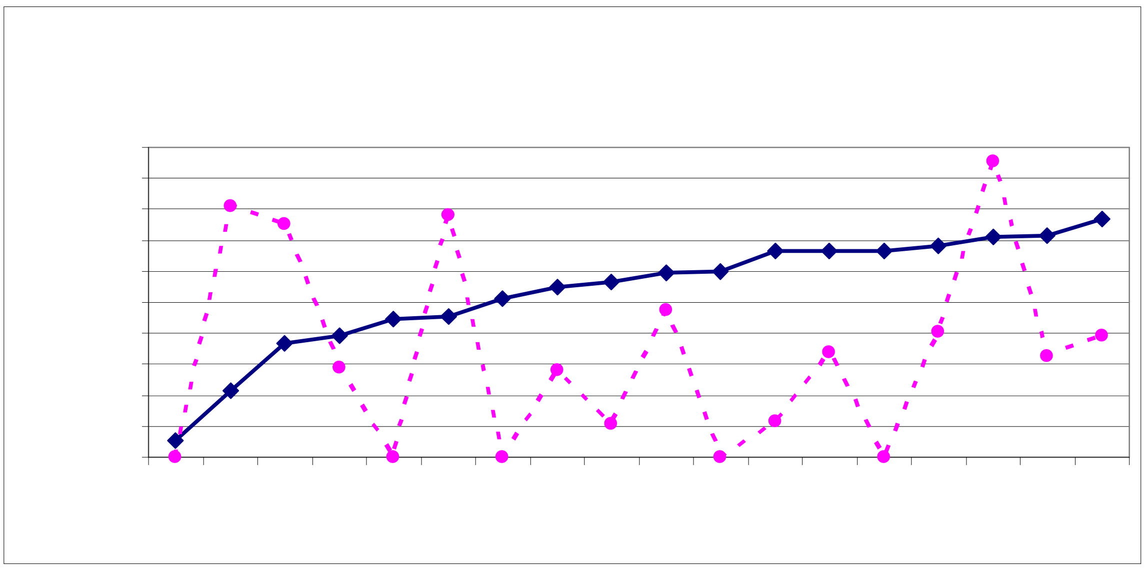
Figure 37. Fixed segment /t/-use predicted by a relativized OCP constraint hierarchy graphed against the observed fixed segment /t/-use in reduplicants of native Bengali words presented in audio.9t3ṭ&&9 3θ27wzwäN[9e3&9i3θ2Fzkj2Fwθ5Bf5jk0wlN'wêNqw2j0kN'wêjt

hierarchy, although their observed behavior shows that they are distinct – voiceless aspirated /t̪ʰ/-initial bases, for example, allow fewer fixed segment /t/-reduplicants than do /d̪/-initial bases.

The ability to combine features into each OCP constraint with more features specified in higher-ranked constraints is both a benefit and a shortcoming of the relativized OCP metric of similarity. Although this allows for language-specific combinations of features, it does not break down the idea of major place of articulation into smaller places, which appears to be a salient aspect for measuring similarity in Bengali, with apico-alveolars, lamino-alveolars, and lamino-dentals all contrasting within the coronal major place of articulation.

3.3.3 C

overrepresented in Bengali roots of the shape CVCV, the reduplication of /tʰ/-initial bases with fixed segment /t/ is extremely low. The predictions of a metric based on consonant cooccurrence (the O/E value of the pair, multiplied by 30 to scale predictions up) are shown with a dotted line below in Figure 29, with the observed fixed segment /t/-usage graphed in a solid line.



accordingly, it was found that only four of the seventeen relevant features[40] were weighted more heavily than others (which maintained the default weight of 0.100). While features such as [lateral] and [labial] were found to carry a weight of only 0.100, the feature [distributed] was found to carry four times as much weight, with a w-value of 0.400.

Table 3 below includes the four features found to carry more weight than the default 0.100 assigned to all other features. Note that these four features are the most important in distinguishing the consonants judged most similar to fixed segment /t/ (e.g. /t/, /tʰ/, /d/, /t̪/, /s/, etc.) in Figure 23.

Heavily-Weighted Feature	Weight
[voice]	0.554
[distributed]	0.400
[strident]	0.249
[spread glottis]	0.198

Table 3. Feature weights predicted by the feature-weighting metric to be greater than default 0.1.

Because they often are the only feature distinguishing certain consonants from /t/, it is understandable that these features would be weighted more heavily than other features. Converting these features weights into consonant similarity scores (using Equation 2), where larger sums of shared feature weights (remember all features other than those mentioned in

[40] All features are listed in Appendix C.

Table 3 is provided in Figure 42 below. The correlation is not only highly significant but also relatively strong [$p < 0.01$, r^2

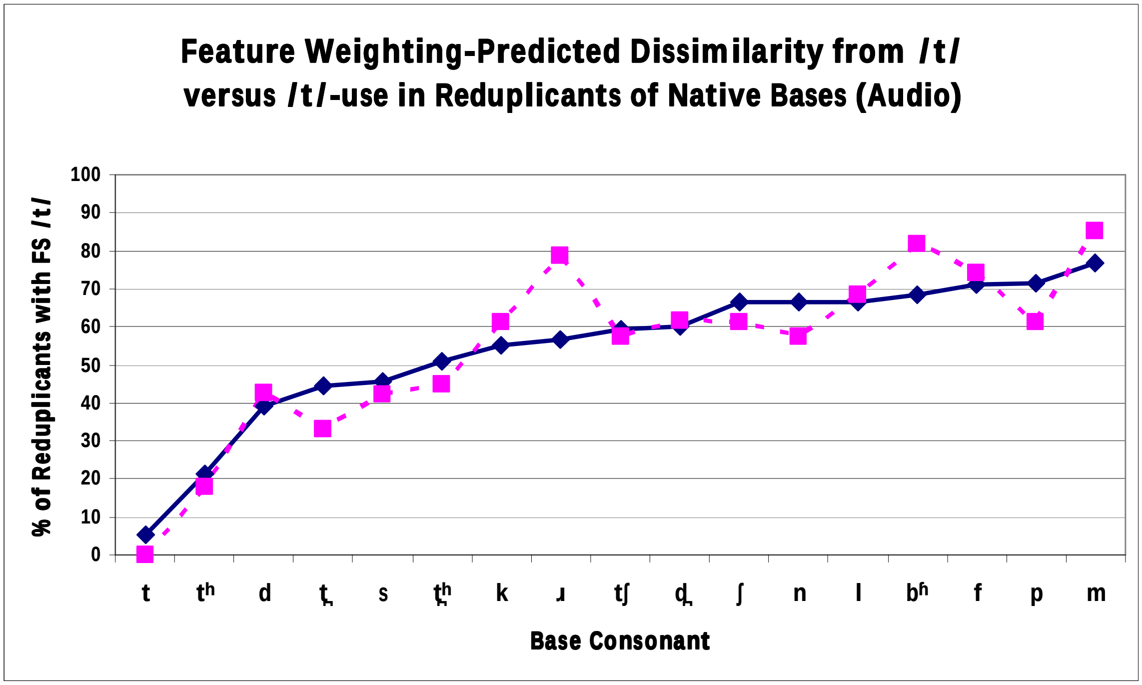
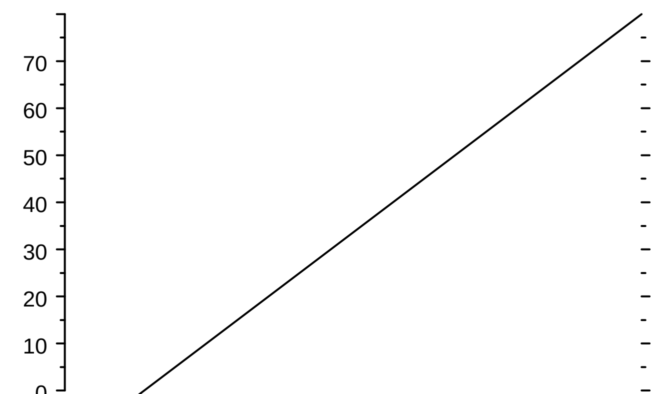


Figure 43. Observed fixed segment /t/-use in reduplicants of native words presented in audio recording format (solid line), versus the predicted fixed segment /t/-use as determined by feature weighting as described in
Table 3 (dotted line). The data point for /h/-initial bases is removed.



Similarity measured across the entire phoneme inventory with the data point for /h/-initial bases removed. [$p < 0.01$, $r^2 = .855$].

The correlation between the feature weighting metric and the observed data is not only exceptionally tight, but also attentive to the distinctions between most of the coronal consonants. Other metrics, such as the Frisch et al. shared natural classes metric, could not accurately predict the behavior of dentals and alveolars unless the domain of similarity calculations was restricted to coronal obstruents only. Unfortunately, restricting the domain to just the coronal obstruents may keep the Shared Natural Classes correlation strong within coronal obstruents at the expense of the close correlation with the noncoronals, which are all considered to be equally dissimilar from /t/ in the strictest interpretation of the Shared Natural Classes metric. Also, unlike the relativized OCP hierarchy, the weighted features model does not treat dentals all equally; most important distinctions are carefully reflected in this metric.

Whether describing similarity across the entire phoneme inventory or just the coronal obstruent subset, the Frisch et al. Shared Natural Classes metric could not predict that Bengali speakers would consider /t^h/ to be the most similar non-identical segment to /t/. The weighted features metric, however, can beautifully replicate this observation. Unfortunately, with the limited number of repetitions run in R to determine the appropriate feature weights, the weighted feature model could not predict that /d/ would be the next most similar consonant to /t/ after /t^h/. Nonetheless, the high value for the coefficient of correlation between the weighted feature predictions and the observed data along with the ability to predict the close coronal consonants that share more natural classes with /t/ will use fixed segment /t/ less often than bases starting with coronal consonants that share fewer natural classes with /t/, which will use fixed segment /t/ less often than bases starting with non-coronal consonants. Although the overall observed pattern of dissimilation can be predicted by the shared natural classes metric, it seems to be too rigid to deal with the language-specific features of Bengali when it comes to homorganic consonants. The Shared Natural Classes metric accurately predicts homorganic consonant cooccurrence phenomena within Arabic roots, accurately describing how coronal obstruents rarely cooccur with other coronal obstruents while they can far more freely cooccur with coronal sonorants, how the occurrence of oral gutturals (i.e. uvular fricatives) is underrepresented in roots that contain either dorsal consonants (velar and uvular stops) or gutturals of any kind (glottal, pharyngeal, or oral), and many other cooccurrence phenomena. However, the intricate distinctions of voicing, aspiration, and laminal versus apical tongue orientation in Bengali coronals are not predicted by this theory. It appears that the Shared Natural Classes metric of similarity as presented in Frisch et al. (2004) is better suited to the natural classes that best describe Arabic phonemic distinctions than to those that describe the phonemic distinctions of Bengali.

The Coetzee & Pater metric of similarity based on relativized OCP constraints allows for greater freedom in arranging features shared by a pair of consonants, and might thus be more easily tailored to describe language-specific phonemic distinctions. Positing relativized OCP constraints (with the more specific constraints ranked above the more general constraints) with lexically-specific faithfulness constraints protecting certain forms accurately describes the consonant cooccurrence patterns seen in Muna roots. The particular voicing and prenasalization specifications of Muna consonants can be better encoded in these constraints, allowing the OCP to be sensitive to those distinctions that carry the greatest weight in phonemic contrasts in Muna. Applying this theory to the Bengali inventory could encode distinctions in tongue orientation, voicing, and aspiration in the relativized OCP, but requiring that each successive OCP constraint be more general than the one above it forces certain feature combinations to be overlooked, ignoring distinctions in aspiration and voicing within a particular tongue orientation, for example. Once again, the particular combinations of features interacting with both major (e.g. coronal) and minor (e.g. alveolar) place of articulation lessen the applicability of the relativized OCP metric to Bengali echo fixed segment reduplication.

Comparing cooccurrence of a base-initial consonant with reduplicant-initial fixed segment /t/ to the cooccurrence of that consonant with /t/ within roots in the Bengali lexicon is equally unfruitful, as the OCP effects seen in the lexicon do not line up with fixed segment /t/-use in echo reduplication. While there are OCP effects in the lexicon, with certain consonants occurring very rarely, if at all, with /t/ in roots, these effects do not seem to be playing a significant role in the productive grammar, insofar as echo reduplication is concerned. This observation has interesting implications for both the Coetzee & Pater and Frisch et al. studies. Both of these studies formalize consonant cooccurrence in the lexicon as an aspect of the synchronic grammar, suggesting that speakers have an implicit awareness of consonant similarity as based on the patterns in their vocabulary. Frisch et al. hypothesize that this similarity can be measured by calculating the number of natural classes shared between consonants, and that this similarity is avoided within Arabic roots. Coetzee & Pater instead posit relativized OCP constraints interlaced with lexically-specific faithfulness constraints in order to describe the effects of similarity avoidance in Muna roots. However, both theories would be unable to describe both (a) the OCP effects in lexical consonant cooccurrence and (b) the OCP effects in fixed segment /t/-use in echo reduplication. While the cooccurrence patterns of certain Bengali consonants are clearly over- or underrepresented, these phenomena do not correspond to the over- or underrepresentation of fixed segment /t/ use in echo reduplicants of words starting with those consonants.

This observed distinction between patterns in the lexicon and patterns in reduplication phenomena suggests that the same language can have two sets of active OCP constraints, with one set maintaining similarity avoidance by preventing roots with certain consonant combinations from entering the lexicon and another set actively promoting use of particular fixed segments in the grammar in order to create the most dissimilarity between a base and its echo reduplicant. Another analysis would posit that cooccurrence restrictions in the lexicon are shaped by generations of different OCP constraints that are no longer synchronically active, while similarity avoidance in the productive aspects of grammar (e.g. in echo reduplication) obey a synchronically active OCP constraint (or set of constraints) that has little to no effect on the lexicon.

Assigning a particular weight to each feature used in the phoneme inventory seems to be the most effective metric in describing the data observed in this study. Features that play a significant role in distinguishing consonants from one another in a particular language may be weighted more heavily to reflect their relative importance. Other features, especially those that are only used to further distinguish consonants that already do not share very many features, would consonant similarity, maintaining a balance between application to Bengali and the applicability elsewhere.

If speakers do measure similarity by summing the values of weighted features, where do they acquire these weights? Although this study does not attempt to answer this question empirically, some possible sources of feature weights are discussed here merely as speculations and hypotheses for further investigation. The simplest, although probably least likely, hypothesis is that (1) feature weights are universal, as are the features they associate with. Speakers of all languages would be predicted to judge the similarity of consonants in exactly the same way, with the phoneme inventory as the only language-specific component to the calculations. Another hypothesis could state that (2) weights are based on language-specific perceptual similarity. This is a testable hypothesis, as speakers of a language could be asked to participate in a study in which they would be asked to discern which consonants are more similar to each other than to other consonants. This hypothesis incorporates a language-specific component that would presumably be shaped by the phoneme inventory of the language. 1137M D0,3,6Z,7MpD0,631,ZGMrD0P63GH,,MeD0H67Z,P,WMsD,611PW,MuD0

universality and language-specificity, but the consonant cooccurrence data seen in this study suggest that the lexicon has little or nothing to do with OCP effects in echo fixed segment reduplication. Another hypothesis could be that (4) weights are incorporated into the grammar as the speaker acquires the construction in which it will be used. In the case of Bengali, Common East Bengali speakers would acquire the feature weights of their language as they acquire the echo fixed segment reduplication construction, possibly adjusting weights as they are exposed to more examples of the reduplication.

this study attempts to very crudely compare existing theories of similarity, the issue of free parameters deserves some mentioning. Using the feature weighting metric, which has been shown to more accurately model the Common East Bengali data, one must consider that for each feature in the grammar, there would be one free parameter, i.e. its assigned weight. Similarly, as each relativized OCP constraint in the Coetzee & Pater analysis is posited based on the patterns of the lexicon of the language, the relativized OCP metric involves n-1 free parameters, where n is equal to the number of constraints posited. These models stand in contrast with the Frisch, et al. shared natural classes metric, which in its basic form requires no free parameters. The metric derives similarity scores simply based on the feature specifications of the phonemes in a language, which is surely an advantage of this metric over those that require additional information.

It appears that while Common East Bengali speakers indeed measure the similarity of consonants in fixed-segment echo reduplication, they do not base these calculations on the raw number of natural classes shared across each consonant pair, the severity of relativized OCP violations accrued by each consonant pair, or the root-internal cooccurrence restrictions on each consonant pair. The data observed in this study suggests that speakers may be calculating the similarity of consonants by summing together the weights of the features they share, where certain features would be more heavily weighted in particular languages. Comparing the observed dissimilation patterns in Common East Bengali fixed-segment echo reduplication to the predictions of these different similarity metrics calls into question both the universality of any measure of similarity, and the tacit assumption that OCP effects in the lexicon should pattern with productive dissimilation patterns in the grammar.

5 APPENDICES

5.1 APPENDIX A: TOTAL REDUPLICATION TYPES IN BENGALI

Total Reduplication is used in Bengali to derive constructions that refer to ongoing actions, attenuation[41], adjectives, distributive/plurality (of adjectives, locatives, or pronominals), plural numerals, manner adverbs, frequency/temporal adverbs, intentional adverbs, reciprocal adverbs, sequences, adjectival intensification, habitual actions, and habitual behavior, as shown in the following examples.[42] The following is not meant to be an exhaustive list of Bengali reduplication types; many more are not mentioned simply for sake of brevity.

Ongoing Actions

(32)	tʃillajt̪e	'to yell'
	t̪uj-ki tʃillajt̪e ajsos?	'Have you come to yell?'
	t̪uj-ki tʃillajt̪e tʃillajt̪e ajsos?	'Have you come yelling (all the way)?'

Attenuation

[41] This label, along with many other labels for reduplicative constructions described in this study, is taken from Moravcsik (1978).

[42] The examples in these appendices, other than those explicitly described otherwise, were constructed with the help of my primary consultant, Farida Amin Khan.

(33)	**dʒɔɹ**	**'fever'**
	hæɹ dʒɔɹ lagse.	**'She has a fever.'**
	hæɹ dʒɔɹ dʒɔɹ lagt̪ese.	**'She's feeling a little feverish.'**

Adjectives

(34)	**haʃi[43]**	**'smile'**
	haʃi haʃi mukʰ	**'smiling face'**

Distributive Plurality (Adjectives)

(35)	**bʱɔtka**	**'bulky'**
	ami bʱɔtka dʒut̪a pind̪i na.	**'I don't wear bulky shoes.'**
	ami bʱɔtka bʱɔtka dʒut̪a pind̪i na.	**'I don't wear (any sort of) bulky shoes.'**

Distributive Plurality (Locatives)

(36)	**pɔd̪e**	**'at a step', 'at a position'**
	pɔd̪e pɔd̪e bipod̪	**'There are problems at every step.'**

Distributive Plurality (Pronouns)

(37)	**keː**	**'who'**

bʱæː bʱæː kojɹa kanḍḻo. 'He was wailing.'

5.2 Appendix B: Non-Echo Fixed-Segment Reduplication Types in Bengali

5.2.1 Bengali Reciprocal Fixed-Segment Reduplication for

5.2.2 BENGALI RECIPROCAL FIXED-SEGMENT REDUPLICATION FOR SANSKRITIC AND FOREIGN WORDS

Bykova (1981) describes the Sanskritic reciprocal action/state reduplicative construction as the reduplication of a nominalized verb with the final fixed segment –a attached to the first member of the pair.

(50)	dʒog[47]	'contact'
	dʒoga dʒog[48]	'communication'
(51)	kʰɔboɹ	'news'
	kʰɔboɹa kʰɔboɹ	'exchange of information or news'

5.2.3 BENGALI MONOSYLLABLE FIXED-SEGMENT REDUPLICATION

Bykova (1981) also describes another reduplicative

As described in Chatterji (1986), another reduplicative construction involves the reduplication of a finite verb with a final fixed segment –i (or –j post-vocalically) attached to the first member of the pair, which also receives a rising tone on the final syllable.

(53)	kinlo.	'He bought it.'
	kinlǒj kinlo.	'He went ahead and bought it anyway.'[49]

5.2.5 BENGALI MONOSYLLABIC VOCALIC FIXED-SEGMENT REDUPLICATION

Yet another fixed-segment construction in Bengali is the reduplication of monosyllabic nouns and adjectives, replacing the vowel with fixed segment /a/. The construction is typically associated with a completive or habitual meaning.

(54)	t^hik	'right', 'correct', 'fixed'
	t^hik t^hak	'totally fixed', 'ship-shape', 'all set'

(55)	poz	'pose'
	poz paz	'habit of always striking a pose', 'vanity'

[49] The 'anyhow' here is translated as "in spite of some obstacles or prohibitions" in Chatterji (1986:185).

5.3 APPENDIX C: FEATURE SPECIFICATIONS USED

Common East Bengali Phonemes

Bengali Consonant	consonantal	sonorant	continuant (artic.)	continuant (acou.)	delayed release	approximant	nasal	voice	spread glottis	LABIAL	labiodental	CORONAL	anterior	distributed	strident	lateral	DORSAL
k	+	-	-	-	-	-	-	-	-	-	-	-	0	0	0	-	+
k^{h}	+	-	-	-	-	-	-	-	+	-	-	-	0	0	0	-	+
g	+	-	-	-	-	-	-	+	-	-	-	-	0	0	0	-	+
$\text{g}^{\text{ɦ}}$	+	-	-	-	-	-	-	+	+	-	-	-	0	0	0	-	+
ŋ	+	+	-	+	-	-	+	+	-	-	-	-	0	0	0	-	+
tʃ	+	-	-	-	+	-	-	-	-	-	-	+	-	+	+	-	-
tʃ^{h}	+	-	-	-	+	-	-	-	+	-	-	+	-	+	+	-	-
dʒ	+	-	-	-	+	-	-	+	-	-	-	+	-	+	+	-	-
$\text{dʒ}^{\text{ɦ}}$	+	-	-	-	+	-	-	+	+	-	-	+	-	+	+	-	-
t	+	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-
t^{h}	+	-	-	-	-	-	-	-	+	-	-	+	+	-	-	-	-
d	+	-	-	-	-	-	-	+	-	-	-	+	+	-	-	-	-
$\text{d}^{\text{ɦ}}$	+	-	-	-	-	-	-	+	+	-	-	+	+	-	-	-	-
t̪	+	-	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-
t̪^{h}	+	-	-	-	-	-	-	-	+	-	-	+	+	+	-	-	-
d̪	+	-	-	-	-	-	-	+	-	-	-	+	+	+	-	-	-
$\text{d̪}^{\text{ɦ}}$	+	-	-	-	-	-	-	+	+	-	-	+	+	+	-	-	-
n	+	+	-	+	-	-	+	+	-	-	-	+	+	-	-	-	-
p	+	-	-	-	-	-	-	-	-	+	-	-	0	0	0	-	-
f	+	-	+	+	+	-	-	-	-	+	+	-	0	0	0	-	-
b	+	-	-	-	-	-	-	+	-	+	-	-	0	0	0	-	-

Additional English Phonemes

English Consonant	consonantal	sonorant

t^h		t^hoŋa	!	t^hoŋga	‘bag’
t^h		t^hoka		t^hoka	‘knock’
t^h		t^hæka		t^hæka	‘obstruction’
t^h		t^hele		t^hejlla	‘h. pushed’
t^h		t^heʃe	"	t^hajʃʃa	‘h. stuffed’
d	#	dibe	#	dibba	‘container’
d	#	dana	#	dana	‘fin’
d	#	dole	#	dojlla	‘h. rubbed’

t	t	;	taɹki	‘turkey’
t	t		tajmiŋ	‘timing’
d	d	# <=	difɹens	‘difference’
d	d	# =	dansiŋ	‘dancing’

ɹ	ɹ	1	ɹifil	‘refill’
ɹ	ɹ	1 ;	ɹifɔɹm	‘reform’
ɹ	ɹ	:	ɹilæks	‘relax’
n	n	9	nɔvel	‘novel’
n	n			

sm	sm	VW	smudɖli	‘smoothly’
fɹ	fɹ	< =	fɹanse	‘in France’
fɹ	fɹ	< $	fɹizaɹ	‘freezer’
fɹ	fɹ	<$	fɹizbi	‘frisbee’
sɹ	ʃɹ	X Q	sɹabon	Bengali month
sɹ	ʃɹ	X	sɹomik	‘worker’
sɹ	ʃɹ	XY	sɹoddʱa	‘respect’
sɹ	ʃɹ	XQ	sɹeni	‘class’
sn	sn	Z	sneho	‘affection’
sn	sn	Z [	snigdʱo	‘cool’
sn	sn	Z	snomæn	‘snowman’
sn	sn	Z	snikaɹ	‘sneaker’
sk	sk	\	skule	‘at school’
sk	sk	\ $	skedʒul	‘schedule’
kɹ	k	Ṁ	kɹiʃi	‘agriculture’
kɹ	k	M	kɹimi	‘worm’
kɹ	kɹ	] &	kɹiɾa	‘sport’
kɹ	kɹ	]	kɹækaɹ	‘cracker’
kɹ	kɹ	]	kɹipal	‘cripple’
sp	sp	^ 7;	spɔɹʃo	‘touch’
sp	sp	^ 7	speʃal	‘special’
sp	sp	^	spikaɹ	‘speaker’
sp	sp	^ 7	spæniʃ	‘Spanish’

5.7 APPENDIX E: PAIRWISE t-TEST RESULTS

The results of pairwise t-tests to show statistical distinctions between the likelihood of certain base-initial consonants using fixed segment /t/ significantly more

6 REFERENCES

, ( ) **Alam, Mahbubul (2000).** 9 ' ` 9: Q @ % - 'c l Q Bhasha Shourôbh: Bêkorôn o Rôcona – Shôshṭho Shôngskorôn (The Fragrance of Language: Grammar and Composition – Sixth Edition). Dhaka, Bangladesh: Muhammad Ayyub Ali Publishers.

van den Berg, René (1989). A grammar of the Muna language. Dordrecht, Netherlands: Foris.

Bhaskararao, Peri (1977). Reduplication and onomatopoeia in Telugu. Poona, India: Centre

Fitzpatrick-Cole, Jennifer (1994). **The Prosodic Domain Hierarchy in Reduplication.**

Lidz, Jeffrey (2001). Echo Reduplication in Kannada