The Interaction of Palatal Coarticulation and Palatal Harmony in Kazan Tatar

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Both vowel harmony and vowel-to-vowel coarticulation are processes of long-distance vowel-to-vowel assimilation, effected when the features of one vowel trigger systematic change in its neighbors. This paper presents a phonetic investigation of palatal coarticulation in Kazan Tatar, a language with left-to-right palatal harmony, by examining disharmonic words, and seeks to apply the results to the relationship between harmony and coarticulation. A distinctive asymmetry in the coarticulatory processes emerges: right-to-left palatal coarticulation is pervasive, but left-to-right palatal coarticulation is notably absent in Tatar. This asymmetry leads to the hypothesis that gradient and categorical processes sharing the same triggers, targets, target feature, and direction cannot coexist, leading to the suppression of the phonetic process.

Keywords: phonetics, phonology, coarticulation, vowel harmony, Tatar

1 Introduction

Palatal or front-back vowel harmony and vowel-to-vowel coarticulation are assimilatory processes operating at different levels, but possessed of remarkable similarities. Both processes have been documented in many languages and in relation to various features. What coarticulation effects at the phonetic level, harmony effects phonologically. However, this similarity makes it difficult to uncover the interaction between the processes. Beddor & Yavuz (1995) attempted this very task with regard to harmony and coarticulation affecting the feature [back] in Turkish by examining disharmonic words; they found that the coarticulatory process proceeding in the opposite direction to harmony was far more widespread in the language than that paralleling it (Beddor & Yavuz 1995). The present study also uses disharmonic words to discover whether a similar effect is present in Kazan Tatar.

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The paper is laid out as follows. Section 2 provides background on the Tatar language, vowel-to-vowel coarticulation, and vowel harmony. Section 3 introduces the methods used in this study, and the results of the investigation are presented in Section 4. In Section 5, the results are discussed and some conclusions drawn.

2 Background

This section provides background information on Kazan Tatar, focusing particularly on the vowel inventory and sociolinguistic situation of the language, as well as vowel-to-vowel coarticulation, vowel harmony, and the diachronic bases of harmony.

2.1 Kazan Tatar

Tatar is a Turkic language spoken by more than 5 million speakers worldwide (Comrie 1997: 899); approximately 1.5 million speakers reside in the Republic of Tatarstan in Russia (Sahan 2002: 9). Tatar belongs to the Kipchak or northwestern branch of the Turkic language family; the dialect investigated here, Kazan Tatar, is spoken in Kazan, the capital of Tatarstan. Both Russians and Tatars reside in Tatarstan, where the sociolinguistic situation is asymmetrically bilingual: in 2002, 93% of Tatars in Tatarstan reported themselves fluent in Russian, but only 4% of Russians in Tatarstan considered themselves speakers of Tatar (Faller 2011: 13), despite the fact that each ethnic group comprises roughly half the overall population. Efforts to promote the Tatar language are underway, but, due to encroachment from Russian, the language is in a state classified by Wertheim (2004: 2) as “potentially reversible ‘gradual language death’”.

There are ten vowel phonemes in Kazan Tatar, divided into two harmonic classes. Each vowel has a harmonic pair, equivalent in height and rounding but opposite in backness, leading to the symmetric vowel system shown in Table 1. The mid series of vowels are reduced in duration and highly centralized; therefore, this study focuses on the more acoustically distinct high and low vowels, particularly /i/, /a/, and /ä/. (For an acoustic investigation of Tatar round vowels, see Conklin (2015).) /a/ has two allophones - [ɒ] in initial syllables and [ə] in non-initial syllables. /ä/ also possesses two allophones, [æ] and [ɛ], but these occur in relatively free variation. The lower allophone [æ] appears more often in stressed positions and clear speech.

<table>
<thead>
<tr>
<th></th>
<th>Front Unrounded</th>
<th>Front Rounded</th>
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<th>Back Rounded</th>
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<tbody>
<tr>
<td>High</td>
<td>/i/</td>
<td>/ä/</td>
<td>/ʊ/</td>
<td>/a/</td>
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<tr>
<td>Mid</td>
<td>/e/</td>
<td>/õ/</td>
<td>/ɔ/</td>
<td>/o/</td>
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<tr>
<td>Low</td>
<td>/ä/</td>
<td>--</td>
<td>/a/</td>
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</tbody>
</table>

Table 1: Vowel Phonemes of Tatar

1 The phoneme /i/ is controversial; Poppe (1968) and Berta (1998) consider it a diphthong /əj/, while Comrie (1997) argues for its inclusion as a phoneme on the basis of harmonic alternations with /i/. For a more extended discussion, see Conklin (2015: 20-21).
2.2 Coarticulation

Vowel-to-vowel coarticulation is a common phonetic process occurring when some vowel acts on an adjacent vowel, shifting one of the target vowel’s phonetic properties closer to that of the triggering vowel. The property investigated in this study is backness, as realized acoustically through the second formant. Two types of coarticulation regarding backness are investigated. Carryover coarticulation proceeds from left to right, with the triggering vowel’s features carrying over onto a later target vowel; anticipatory coarticulation proceeds from right to left, with the target vowel affected in anticipation of a following trigger. Both anticipatory and carryover coarticulation have been found in many languages: studies documenting coarticulation have been conducted in English (Beddor et al. 2002, Majors 2006, Fowler & Brancazio 2000), Shona (Beddor et al. 2002), Swahili (Manuel & Krakow 1984), Ndebele (Manuel 1990), Turkish (Beddor & Yavuz 1995), and Thai (Mok 2011). This study will present an acoustic analysis of carryover and anticipatory coarticulation with regard to backness in Kazan Tatar.

2.3 Vowel Harmony

Kazan Tatar exhibits palatal harmony in both roots and affixes, such that all vowels in a single word are either front or back; typical lexical items are shown in (1). Suffixes have two allomorphs, one belonging to each harmonic class, and the choice of allomorph is determined by the harmonic class of the root.

(1) a. saqal saqallar
[saqal] [saqallar]
‘beard’ ‘beards’

b. kerfek kerfeklär
[kerfek] [kerfeklär]
‘eyelash’ ‘eyelashes’

Native roots obey harmony almost without exception (Comrie 1997: 903), but a large portion of the Tatar lexical inventory consists of loan words from Arabic, Persian, and Russian. Russian loans, many of which are more recent, exhibit varying degrees of phonological assimilation, as is to be expected, given the bilingualism present in Tatarstan. However, among older loans from Arabic and Persian, even words that are otherwise phonologically assimilated may be disharmonic in the root, and the harmonic class of suffixes appended to these roots is not systematically predictable. The current study exploits this trove of older disharmonic loanwords to catch a glimpse of the interaction between harmony and coarticulation in an otherwise fully harmonic language.

Researchers studying the origins of harmony have posited a direct diachronic link between vowel-to-vowel coarticulation and vowel harmony (Ohala 1994a, 1994b; Linebaugh 2007; Majors 2006). According to Ohala (1994a), the phonologization of harmony is rooted in listener misperception of phonetic coarticulation as intentional, phonological assimilation. A left-to-right harmony system must, therefore, have its roots in a left-to-right coarticulatory process. Over
time, listeners misperceive coarticulated vowels as different phonemes – phonemes that have harmonized with their neighbor. As listeners reproduce vowels according to this belief, a harmonic system emerges.

3 Methods

3.1 Research Questions and Hypotheses

This study investigates palatal coarticulation in Kazan Tatar and seeks to determine (1) whether it is present; (2) in what direction(s) it operates; and (3) which vowels, in the set /i/, /a/, and /ä/, act as triggers and which as targets. To accomplish this purpose, the formant values of each vowel in harmonic and disharmonic contexts are measured and compared. It is hypothesized that carryover (left-to-right) coarticulation will be present in a-ä and ä-a words, while anticipatory coarticulation will be present across the vowels tested. The first hypothesis is based on informal observation during elicitation, and the second on the general cross-linguistic tendency of /i/ to resist coarticulation (see, e.g., Beddor & Yavuz 1995: 48).

3.1 Methodology

Data was provided by a single female participant, a native speaker of Tatar who also speaks Russian, English, Spanish, and Arabic, with the hope of expanding the study to more participants in the future. Data was elicited in a set carrier phrase shown in (2). The variety shown in (2a) was used in the initial recording session and that in (2b) in all other sessions.²

(2) a. Min alma dip äjtem.
I. NOM apple QUOT³ say.PST-1-sg
‘I said “apple.”’

b. Bez alma dip äjttek.
We. NOM apple QUOT say. PST-1-pl
‘We said “apple.”’

Six elicitation sessions were conducted in a sound-attenuated room in the researcher’s university; written, oral, and pictorial stimuli were used to elicit a large data set, of which only a smaller subset were used in the study. Two-syllable words containing either two instances of the same vowel or disharmonic sequences of differing vowels, with vowels from the set /a/, /i/, and /ä/, were examined in this study. The number of tokens elicited for each type of word is shown in

² This switch was to facilitate vowel annotation, since the boundary between /z/ and /a/ is clearer than that between /n/ and /a/.
³ The quotative particle ‘dip’, here labeled QUOT, marks direct speech and derives from the verb ‘di-’ translated ‘say’; the ‘-p’ morpheme is reported variously as a gerund (Poppe 1968: 212) or a participle (Greed 2014: 76). Greed (2014:75) also notes that “it has become fully grammaticalized as a quotative particle,” yet still retains its original usage as a participle as well.
The slight discrepancies in count between disharmonic words in B and G and harmonic words in A and H, and D and G, represent places where formant data could not be obtained from the recording, usually due to interfering noise, such as a cough. The syllabic structure of all tokens was of the form C₀VC₁VC₀; the notation used to represent these words throughout this paper is of the form V₁-V₂, with the analyzed vowel underlined.

<table>
<thead>
<tr>
<th>Disharmonic Type</th>
<th>No. of Instances</th>
<th>Harmonic Comparison Type</th>
<th>No. of Instances</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. a-i</td>
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<td>a-a</td>
<td>38</td>
</tr>
<tr>
<td>B. ä-a</td>
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<td>D. a-ä</td>
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</tr>
<tr>
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<td>i-i</td>
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<tr>
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<td>ä-ä</td>
<td>10</td>
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<tr>
<td>G. ä-a</td>
<td>10</td>
<td>a-a</td>
<td>40</td>
</tr>
<tr>
<td>H. i-a</td>
<td>14</td>
<td>a-a</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 2: Comparison Pairs and Number of Tokens

Underlined vowels were annotated by hand in Praat; F2 measurements were extracted automatically at vowel midpoint by a Praat script using a Burg LPC-based algorithm. Each group of vowels in a disharmonic word type was compared to its counterpart in a harmonic environment, creating eight paired groups for comparison, as shown in Table 2, with each row representing a single comparison pair. (This design is adapted from Beddor & Yavuz (1995).) Four of these pairs – those in which the analyzed vowel occurs in the first syllable – measure anticipatory coarticulation by comparing the degree of difference in articulations of the target vowel when it is followed by a specific disharmonic vowel rather than a harmonic vowel (a second instance of the target phoneme). The last four pairs, in which the target vowel occurs in the second syllable, measure carryover coarticulation. Individual ANOVAs were used to calculate the significance of the difference between each of the two sets of formant values in a comparison pair; higher F2 values indicate front vowels, and lower F2 values, back vowels.

4 Results

The degree of coarticulation for each disharmonic vowel pairing (a-i, ä-a, i-a, and a-ä) was measured by comparing the F2 values of disharmonic vowels with values from harmonic a-a, i-i, and ä-ä words. Values were matched for syllable number across condition, as indicated by underlining in Tables 2, 3, and 4 (e.g., first-syllable disharmonic vowels were only compared to first-syllable harmonic vowels, not second-syllable harmonic vowels). The degree of difference for each comparison pair was measured using one-way univariate ANOVAs. Comparison pairs A – D measured anticipatory coarticulation and pairs E – H measured carryover coarticulation. The results of the ANOVAs and mean formant values are reported in Tables 3 and 4.
With regard to anticipatory coarticulation, an effect of harmonic condition was found for pairs a-i/a-a (p<0.01**), ä-a/ä-ä (p<0.001***), and a-ä/a-a (p<0.001***). The F2 value of front vowels /ä/ and /i/ was lowered in the disharmonic condition, and that of back vowel /a/ was raised. In comparison pair C – i-a/i- – the mean F2 of /i/ in the harmonic condition (M = 2810.25 Hz, SD = 109.992) was nearly 300 Hz higher than in the disharmonic condition (M = 2587.50 Hz, SD = 201.262).

Carryover coarticulation was measured in comparison pairs F – H by analyzing the F2 values of second-syllable vowels across harmonic conditions. These pairs were intended to uncover any coarticulatory effect induced by a first-syllable trigger in a following target vowel. (Comparison pair E was also intended to measure carryover coarticulation, but it was not fully analyzed due to a lack of tokens.) However, none of the ANOVAs measuring the degree of difference across harmonic conditions were significant.

5 Discussion and Conclusion

The results of the current study suggest that palatal coarticulation occurs only in the anticipatory direction in Kazan Tatar, as shown by the shift in F2 triggered in /i/ and /ä/ by /a/ and in /a/ by /i/ and /ä/. Carryover coarticulation was not present in any of the vowels tested, as demonstrated by the non-significant results for comparison pairs F – H. Thus, the hypothesis that

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The α-level adopted for this study is p<0.05. * indicates significance at the p<0.05 level, ** at the p<0.01 level, and *** at the p<0.001 level.
anticipatory coarticulation would be present across the vowels tested was supported; however, the hypothesis that carryover coarticulation would be present and particularly detectable in a-ä and ä-a sequences was not supported, as no carryover coarticulation was found. This lack of carryover coarticulation echoes the results of Beddor & Yavuz’s (1995) study on Turkish, which detected primarily anticipatory coarticulation in disharmonic words in Turkish.\(^5\) Three possible explanations account for the striking and repeated absence of carryover coarticulation and the pervasive presence of anticipatory coarticulation in these two studies.

The first possible explanation for the mismatch in directionality between coarticulation and harmony in both Turkish and Kazan Tatar refers to word-final stress. In both languages, harmony proceeds from left-to-right, while stress is on the final or rightmost syllable of the word. Majors (2006) and Beddor & Yavuz (1995) both recognize that stressed vowels have a stronger articulatory influence and thus a stronger coarticulatory effect than unstressed vowels; therefore, in languages with word-final stress, anticipatory coarticulation is expected. However, while this explanation accounts for the presence of anticipatory coarticulation in both languages and may even predict that anticipatory coarticulation will be more pervasive than carryover, it does not account for the striking and complete absence of carryover coarticulation found in Kazan Tatar. While word-final stress doubtless plays a contributing role in explaining the present results, the extent of its explanatory power cannot be measured without further experimental work (see section 5.1). Meanwhile, other potential explanations of the results must be considered.

It is also possible that the phonological process of left-to-right vowel harmony prohibits the parallel operation of left-to-right coarticulation. Beddor & Yavuz hint in this direction when they write that “once a phonetic behavior is phonologized, it becomes a phenomenon largely distinct from the behavior which gave rise to it” (Beddor & Yavuz 1995: 49). Under this interpretation, the directionality of harmony and coarticulation are not inherently linked, but may be influenced separately by outside factors. Nevins (2010: 31-32) explains how the historical development of Turkish from Proto-Turkic may account for Beddor & Yavuz’s (1995) data, since Proto-Turkic is thought to have had word-initial stress, leading to the development of left-to-right vowel harmony. When stress later shifted to the final syllable, the coarticulatory pattern followed the stress, but harmony retained the direction it possessed when it was first phonologized.

The present data also suggest a third hypothesis: namely, that the presence of the phonological process of harmony may suppress the parallel phonetic coarticulatory process. The idea that a phonological process can suppress closely related phonetic processes in a language is not novel; Cohn (1990) documented this very phenomenon with regard to nasalization, and Francis et al. (2006) detailed its workings while investigating the interaction between initial consonant voicing, f0, and tone. For nasalization, Cohn investigated English, Sudanese, and French, which differ in the phonological constraints they place on nasalization, and found that the more limiting the phonological constraints related to [nasal], the less phonetic variability was permitted in nasalization (Cohn 1990: 196-197, 203). Similarly, Francis et al. (2006) discovered that, in non-tonal languages, f0 can be affected by the [voice] value of a preceding stop for as long as 100 ms, with higher pitch following voiceless stops. In tonal languages such as

\(^5\) Because Beddor & Yavuz (1995) did not conduct a statistical analysis but only present raw F2 difference scores, it is not possible to comment on the degree of significance of their results. Their study did detect some carryover coarticulation, but in more limited form than anticipatory coarticulation.
Cantonese, though, pitch fluctuation linked to stop consonant voicing persists only 10 ms past the onset of voicing, because phonologically-specified tones interfere with the phonetically-based perturbations in pitch (Francis et al. 2006: 2884). This provides an excellent example of a phonetic process with a basis in articulatory gestures – just like coarticulation – which is suppressed by a phonological process requiring use of the same acoustic cues. Proving whether this hypothesis is in fact valid with regard to the present data will require further research, as described in 5.1.

Some linguists (Ohala 1994a, 1994b; Linebaugh 2007) have taken the diachronic link between harmony and coarticulation as evidence that phonological processes, such as harmony, are explicable through phonetics without recourse to a separate phonology. Linebaugh argues against a separate phonology, asserting that “it is not necessary to assume phonological patterns are shaped by innate features or innate constraints” (2007: iii). However, the fact that phonological processes can suppress related phonetic mechanisms, as demonstrated by Cohn (1990) and Francis et al. (2006), contradict this view, and this contradiction is further supported by the clear divide between phonological and phonetic workings in the present data and that of Beddor & Yavuz (1995). If harmony is purely phonetic – that is, if it is no more than the combined result of underlying phonetic mechanisms – how can changes to the underlying phonetic processes fail to effect change to harmony, as is clearly the case in both Turkish and Tatar? Instead, the data described here, wherein coarticulation operates in the opposite direction of harmony, plead in favor of a distinctly phonological process of vowel harmony and, by extension, a separate and distinct phonology.

5.1 Future Research

There are a number of avenues of future research to be pursued. The first task is to confirm the present results with more participants. Additionally, conducting a similar study in an unrelated harmonic language with word-initial stress and left-to-right harmony (or word-final stress and right-to-left harmony) could rule out the possibility that the current results are produced solely as a result of word-final stress, and studying the coarticulatory patterns of an language with a similar profile to Tatar and Turkish (word-final stress, but left-to-right harmony) but without the shared Turkic history could shed light on the question of phonetic-phonological suppression. Finally, a more exhaustive future study may also include formant measurements at vowel onset and offset as well as midpoint and impose stricter controls on the surrounding consonantal environment in target words.

References


