

## Vowel Harmony in Trabzon Turkish

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**Abstract.** Little is known about patterns of vowel harmony change in language contact situations. Trabzon Turkish (TT), which is spoken in the North East of Turkey and has a language contact history with Pontic Greek, Armenian, and Laz, provides such a context. This study investigates vowel harmony in TT and compares it with Standard Turkish (ST). Based on a quantitative analysis derived from a corpus of written texts in TT, this study shows how TT exhibits partial vowel harmony. TT displays a reduced amount of vowel harmony compared to ST, which suggest that TT might have experienced decay. Additional findings of this study indicate that vowels are influenced by following adjacent consonants, some suffixes have fixed forms with non-alternating vowels, but linear harmony decay across the word is not observed.

**Keywords.** partial vowel harmony; non-standard Turkish; language contact

**1. Introduction.** Vowel harmony (VH) is described as a phonological assimilation process which requires the vowels within a domain to agree in terms of their quality such as height, backness, rounding, or position of tongue root (Kaun 2004, Walker 2012, Rose & Walker 2011, Van der Hulst 2016). While some languages develop VH over time (e.g., Tangale (Kleinewillinghöfer 1996)), harmony in other languages may be disrupted (Binnick 1991, Dombrowski 2013, McCollum 2019). However, there is little detailed work on the patterns that emerge in VH in language contact situations. The main interest of the current research is to fill this gap by investigating VH in Trabzon Turkish (TT), which is a dialect spoken in Trabzon in the North East of Turkey. TT has a rich language contact history mainly between Turkish and Pontic Greek (PG)<sup>1</sup> speakers but also with Laz and Armenian speakers. Among these languages, only Turkish has VH. PG, Laz, and Armenian lack VH of any kind and they also lack three of the Turkish phonemic vowels /ɯ, y, œ/ (Godel 1975, Mackridge 1987, Dum-Tragut 2009, Öztürk & Pöchtrager 2011). This raises the question of what happens when native speakers of a language which has a smaller vowel system compared to Turkish (e.g., PG, Armenian, Laz) acquire Turkish and whether these speakers produce VH or not. Based on a corpus of written texts of TT, the current research examines how VH is manifested in morphologically complex forms in TT.

VH is less extensive in TT compared to Standard Turkish (ST). ST has productive backness and rounding harmonies, and the eight phonemically distinctive vowels /i, y, ɯ, u, a, e, o, œ<sup>2</sup>/ are divided into groups for harmony (i.e. back vs. front vowels, round vs. unround vowels). The trigger is the initial vowel of a word and the features of vowels systematically extend from left to right (except for some loanwords and suffixes containing non-alternating vowels such as the progressive -Ijor<sup>3</sup>). Both backness harmony (applies to all vowels) and rounding harmony (applies to high vowels) are found in roots as well as suffixes. In TT, however, there are many disharmonic forms

\* I would like to thank Bernt Brendemoen for making his work on Trabzon Turkish available. I also thank Sharon Rose for her guidance on this project. Author: Neşe Demir, University of California San Diego ([ndemir@ucsd.edu](mailto:ndemir@ucsd.edu)).

<sup>1</sup> In this study Pontic Greek is used to refer to the Greek varieties spoken in the North East of Turkey. Note that some scholars may use different terms, see further information in Sitaridou (2013) and Schreiber (2019).

<sup>2</sup> In Turkish, [œ] and [ø] are not phonemically distinct. I use [œ] to refer to a mid front round vowel following Brendemoen (2002).

<sup>3</sup> See (Arik 2015) for a list of disharmonic affixes in Turkish.

and both types of harmonies are only partially productive. Examples (1)-(4) provide evidence for this.<sup>4</sup>

- (1) a. ara-r-di-ler (cf. ST ara-r-duu-lar)  
 look.for-AOR-PST-3PL  
 ‘they used to look for’  
 b. jap-ti-ler (cf. ST jap-tuu-lar)  
 do-PST-3PL  
 ‘they did’

In ST forms in (1-a) and (1-b), the past tense (PST) suffix -DI<sup>5</sup> is realized with the back vowel [u] and the person marker -lAr surfaces with a back vowel as [-lar] due to the low back unrounded vowel [a] in the root, so backness harmony applies across the word. However, in TT forms in (1), -DI is realized with [i], which is the front counterpart of [u]. This violates backness harmony as the root is back and the suffix has a front vowel. However, the person suffix is realized as [-ler] in both cases harmonizing with the preceding front vowel of the PST, therefore making (1-a) and (1-b) partially productive.

Unlike the PST suffix in (1), which appears to have a fixed vowel [i], the dative (DAT) suffix -(j)A has both back and front realizations in TT (2), but they do not always obey harmony. This makes it distinct from ST disharmonic affixes, which always have a fixed vowel that does not alternate. While the DAT always satisfies backness harmony in the ST forms as indicated in (2), this is not the case in TT. The front suffix vowels [e] and [æ] are harmonic following the front vowel [i] in (2-a). Nevertheless, in (2-b), the DAT is realized with a back [a] following a front vowel, making this token disharmonic in terms of backness of vowels. The front suffix vowel [æ] in (2-c) is also disharmonic following a back vowel.

- (2) a. biz-(e/æ) (cf. ST biz-e)  
 we-DAT  
 ‘to us’  
 b. ore-ja (cf. ST ora-ja)  
 there-DAT  
 ‘to there’  
 c. bura-jæ (cf. ST bura-ja)  
 here-DAT  
 ‘to here’

As for rounding harmony, a TT vowel may lack rounding where ST has it (3-a), or have rounding where ST does not have it (3-b). Note that backness harmony is not violated in (3-a) and (3-b) although rounding harmony is violated, which makes these forms partially harmonic. Although TT has been argued to be heavily influenced by contact languages that lack the Turkic vowels /u, y, œ/ (Brendemoen 2002), the vowel [œ] is possible in roots in TT (3-a).

<sup>4</sup> ST forms in these examples are based on the researcher’s native speech, the examples from TT are taken from Brendemoen (2002).

<sup>5</sup> The past tense suffix -DI can take four different forms based on vowel harmony; -Di, -Duu, -Du, -Dy. Using capital letters in the representation of suffixes is a traditional Turkic practice in phonology. They indicate archiphonemes; for example, the consonant in the past tense suffix -DI is [d] following a voiced sound (e.g., [de-di-m] ‘say-PST-1SG’) and [t] following a voiceless consonant (e.g., [git-ti-m] ‘go-PST-1SG’).

- (3) a. kœj-i (cf. ST kœj-y)  
 village-ACC  
 ‘village’  
 b. allah-un (cf. ST allah-um)  
 Allah-GEN.3  
 ‘Allah’s’

TT also provides cases where the same suffix does or does not undergo VH in the same environment. An example is provided in (4), where the genitive (GEN) suffix for the 1<sup>st</sup> person -(I)m is attached to [biz] ‘we’ to derive ‘our’. (4-a), which is the same as the ST form, is harmonic whereas (4-b) violates backness harmony and (4-c) violates rounding and backness harmonies. (4-d) also violates rounding harmony (but backness harmony is not applicable since [ɯ] is a central vowel). The examples in (4) have both between-speaker and within-speaker variation. For example, some speakers strictly use the form in (4-b) or the one in (4-c), but some speakers have variation in their speech, e.g., switching between (4-a) and (4-b), or between (4-b) and (4-d).

- (4) a. biz-im (*same as the ST form*)  
 b. biz-um  
 c. biz-ɯm  
 d. biz-ɯm

To sum up, suffix vowels may be fixed in TT and fail to harmonize with preceding vowels, or vowels may have different realizations that are not dependent on the vowel quality of the preceding vowel. In TT, there are different fixed vowels than ST, and there is variation, which is not attested in ST.

This study aims to contribute to the understanding of how VH may display partial productivity by documenting the patterns and situating them within the context of a historical language contact situation. To get a quantitative sense of the harmonic and disharmonic forms in TT, this research examines actual forms in a TT corpus. The main findings of this study indicate that some suffixes have fixed forms with non-alternating vowels, but a systematic harmony decay across the word is not observed. In addition, velar or labial adjacent vowels are realized as round even when rounding is not predicted by VH, which accounts for some of the disharmony.

The rest of this paper is organized as follows. Section 2 is concerned with the pathways in language change with respect to VH. Section 3 introduces the socio-historical context in the Trabzon area, and Section 4 provides a discussion of the development of TT vowel harmony and the analysis. Section 5 concludes.

**2. Language Change and Vowel Harmony.** When languages undergo change in terms of VH, this may be in two potential directions, either becoming more harmonic or more disharmonic. Both pathways are attested in languages. Languages/dialects exhibiting partial VH such as TT can also be considered as representing a stage in either a developing VH system or a previously more productive system which is undergoing VH decay. The rest of this section provides an overview of how VH systems may change over time.

Both language-specific (internal) factors and language contact (external factor) may lead to the emergence of VH. First of all, coarticulatory influence of vowels (vowel-to-vowel coarticulation) is a well-known phenomenon in languages (Öhman 1966), and many scholars argue that VH emerges in languages due to articulatory and perceptual factors (Ohala 1994, Blevins 2004, Przedziecki

2005, Kimper 2017). Other than internal motivations like articulation and perception, VH may also arise due to external factors such as language contact. For example, the Chadic family is considered to be in the ATR-deficient zone of Central Africa (Kidda 1993, Leger 2011, Rolle et al. 2019). However, Tangale (Western Chadic), has a complete ATR system. Tangale is suggested to have developed ATR harmony due to language contact since Tangale is surrounded by Niger-Congo languages with ATR harmony such as Tula, Waja, and Dadiya (Kleinewillinghöfer 1996, Kidda 1993).

It is also possible for VH to be disrupted in languages that originally have VH. Change in VH systems towards disharmony may occur due to internal and external factors. Internal factors such as i) vowel mergers, ii) surrounding consonants, and iii) domain effects may lead to VH decay.

First, vowel mergers occur when two contrastive sounds merge into a single sound. Since vowel mergers result in a change in vowel systems, they can impact how VH functions. Mergers may lead VH to disappear in some languages such as Uzbek (Comrie et al. 1981, Thomason & Kaufman 1992, Harrison et al. 2002, McCollum 2019). Or, mergers occur on the surface but the merged vowels still function according to their old behaviors and therefore VH stays intact as if vowel merger had not happened. As described in Harrison & Kaun (2003), such behavior of vowel mergers is observed in Namangan Tatar (NT) in the Turkic family, which is a variant of the Standard Literary Tatar (SLT). While in SLT there is a contrast between a high back unrounded vowel [i] and mid-high back unrounded vowel [ë]<sup>6</sup>, these two vowels have undergone vowel merger in NT to [ë]. [i] is left without its back harmonic counterpart [ɯ], and [i] does not enter into any backness harmony alternations in NT. Similar to the case in NT, there are other cases of mergers in which VH is still intact but the vowels function in the harmony system as if they retained their former features (Yul-Ifode 2003, Aziza 2008, Hantgan & Davis 2012, McCollum & Essegbey 2018).

Second, the influence of surrounding consonants in a word may result in VH decay. For example, based on Mahanta (2008)'s description, Assamese (Indo European; India) roots and derived words exhibit regressive ATR harmony. However, when a nasal consonant is the onset of the harmony triggering vowel /i/ or /u/, harmony is blocked (e.g., /se.kɔ.ni/ but \*/se.ko.ni/ 'strainer'). This type of consonant restriction disrupts harmony, creating disharmonic words, but harmony still applies elsewhere. In Turkic languages, rounding of vowels by adjacent labial consonants is described to be a wide-spread phenomenon (Erdal 1998), which suggests disruptions in rounding harmony in Turkish. This is known as "labial attraction" in ST and is described to occur in a root, where the first syllable contains /a/ followed by a labial consonant (or a consonant cluster containing at least one labial), and the next vowel is a high round /u/ although an unround /ɯ/ is predicted by VH (e.g., [tavuk] 'chicken', [havlu] 'towel') (Lees 1966). A similar phenomenon happens in Nawuri, where the labial glide /w/ conditions vowel rounding (Casali 1995).

Third, vowel disharmony may also arise from domain effects. The domain of VH may shrink and therefore cause VH to apply to only a certain part of a word (e.g., to target vowels close to the trigger, to certain affixes, etc.). An example of a domain effect in VH is described in Kavitskaya (2013). In Crimean Tatar (CT), all vowels participate in backness harmony. Similar to ST, rounding harmony in CT only targets high vowels; however, the manifestation of rounding harmony differs based on the dialect. In Southern (Coastal) CT, rounding harmony affects all vowels in a

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<sup>6</sup> Harrison & Kaun (2003) use the Turkological notation rather than IPA in their transcriptions. [i] refers to [ɯ], and [ë] is presumably [ɤ].

prosodic word (but low vowels block rounding harmony); e.g., /dost-um/ ‘friend-POSS.1SG’ and [tuzluy-um] ‘salt.shaker-POSS.1SG’. In Central CT, rounding harmony is active only in the first two syllables of the word (e.g., [tuzluy-um] ‘salt.shaker-POSS.1SG’, [bojun] ‘neck’). In Northern (Steppe) CT, rounding harmony is totally lost since rounding is only licensed in the initial syllable of the word but the following vowels are not allowed to be [+round] (e.g., [bojuun] ‘neck’, [dost-um] ‘friend-POSS.1SG’). In summary, with respect to rounding harmony, it is possible to imagine that CT progressed from full harmony (as in Southern CT) to partial harmony due to domain contraction (Central CT) and then to no harmony (Northern CT). The domain effect in VH was studied by other researchers too, and the cross-linguistic pattern for VH is that vowels closer to the trigger are more likely to undergo VH (Zymet 2014, McCollum 2015, McPherson & Hayes 2016).

Other than internal factors that may contribute to vowel disharmony such as mergers, surrounding consonants, and domain of harmony, languages may lose VH due to external reasons. This is mainly due to language contact since contact languages can have an influence on the harmony system of a neighboring language. For example, the productive VH in Ohrid Turkish has been lost due to the influence of neighboring Indo-European languages which lack VH, such as Macedonian, Serbian, and Albanian (Dombrowski 2013). Similarly, as described in Nevins & Vaux (2004) and Andersson et al. (2017), Northwestern Karaim, which is a Turkic language spoken in parts of Lithuania and Ukraine, has been in close contact with Russian and Polish. Slavic languages like Russian and Polish distinguish palatalized and non-palatalized consonants by the feature [+/- back]. Due to language contact, Northwestern Karaim is suggested to have undergone a language change process which resulted in shifting the front-back VH into palatal consonant ([back]-based) harmony. The influence of language contact can also be observed in loanwords that are not adapted to fit the regular VH patterns of a language. For instance, French [traktœr] ‘tractor’ is adapted in ST as [t(u)raktœr]. Although Turkish has backness harmony that operates among all vowels, [a] and [œ] in [t(u)raktœr] do not harmonize in terms of their backness in the noun root. One might have expected either [t(u)raktor] or [t(i)rektœr] if harmony had applied to the word. However, having disharmonic loanwords does not necessarily mean the language has lost harmony; for example, a suffix following [t(u)raktœr] harmonize with the preceding [œ] in Turkish (e.g., [t(u)raktœr-y] ‘tractor-ACC’, or [t(u)raktœr-ler] ‘tractor-PL’). Smith (2007) suggests that the effect of loanwords in the borrowing language depends on the number of words borrowed. A few loanwords in a borrowing language does not change the phonology of that language. In the case of large-scale loanword adaptation, the forms/sound patterns of the borrowed words may be incorporated into the borrowing language and therefore cause changes in the phonological system of the borrowing language.

This section demonstrated how VH systems may be marginally or considerably influenced by internal (i.e., vowel mergers, surrounding consonants, domain of VH) or external (i.e., language contact) factors. As for TT, the vowel system appears to have been influenced by contact with mainly PG but also Armenian and Laz, and as a result, VH in TT shows different characteristics from VH in ST. This section also raised the question of whether partial VH in TT can be explained by the internal motivations of disharmony.

**3. Socio-historical Context in the Trabzon area.** It is necessary to discuss the socio-historical context in the Trabzon area to get a better sense of VH patterns in TT and how historical language contact plays a role in TT. Some scholars state that Turks entered the Trabzon area as early as 1057 (Meeker 1971). Nevertheless, other resources (Brendemoen 2002) indicate that the Turkiciza-

tion process of the area started in 1461 (eight years after the conquest of Constantinople; today's İstanbul) after the Ottoman Empire conquered the capital city of the Greek Empire of Trebizond (Trabzon), which was a successor state of the Byzantine Empire. By the time of the Ottoman conquest, the area was largely inhabited by members of the Greek Orthodox community (aka Pontic Greeks) as well as Armenian and Laz communities, who continued to live in the area after the Ottoman conquest. However, many Turkish settlers were sent to the area as a part of the Turkicization process and many inhabitants converted to Islam and Turkified over time. Thus, the Trabzon area has been under the influence of three languages all of which lack VH of any kind: mainly PG but also Armenian and Laz. These languages also lack three of the common Turkic phonemes /u, y, œ/.<sup>7</sup> After the foundation of the Turkish Republic in 1923, Greeks in the area were deported to Greece as part of a population exchange<sup>8</sup>. Today, there are some Greek-speaking Muslim communities in the Çaykara and Köprübaşı districts. Although smaller in numbers compared to the Greek population, there have been settlements of Armenian-speaking Muslims (who are known to as 'Hemshinli') in the Arsin, Yomra, and Araklı districts. According to Brendemoen (2002), it is unlikely that there was a large Laz population in Trabzon, but folkloristic features (e.g., music, dance, stories) belonging to Laz people are common along the entire Eastern Black Sea coast.

**4. Analysis.** To understand VH patterns in TT as compared to ST, it is important to address first how VH developed in Turkish in general. This is because TT might be representative of older stages of Turkish VH, and it may be reflecting the patterns in ST vowel harmony development.

In Turkic languages, the common belief is that backness harmony developed earlier than rounding harmony (Erdal 1998, 2004, Johanson 1998). Johanson (1998) reports that the earliest clearly documented stage of Turkic languages is the East Old Turkic inscriptions of the 8<sup>th</sup> century A.D. He adds that rounding harmony had not developed in Old Turkic but backness harmony was present. However, there were also non-alternating suffixes such as the dative -qa, possessive -(s)i, the post-terminal suffix -mıf, and the nomen actoris -tʃi (which indicates the doer of the action). Round vowels [u, y, o, œ] were present in Old Turkic, but round vowels did not have a regular rounding harmony interaction as in today's Turkish (Erdal 1998, 2004). If we look at the development of VH in the geographic area of today's Turkey, Old Anatolian Turkish (between the 13<sup>th</sup> century and middle of the 15<sup>th</sup> century) also lacked rounding harmony (Brendemoen 2006, Johanson 2006, Mşiri 2007). Middle Anatolian Turkish was the transitioning stage between the middle of the 15<sup>th</sup> century and the beginning of the 17<sup>th</sup> century, when the language showed full characteristics of VH including rounding harmony.

If rounding harmony in (Anatolian) Turkish started to be formed at around the 14<sup>th</sup>-15<sup>th</sup> centuries, this era corresponds to an important period, when the Turkicization of North Eastern Turkey started. Regarding the development of VH in the Eastern Black Sea dialects such as TT, Johanson (2006) and Brendemoen (2006) note that there is a tendency to use /i, u, o/ instead of /u, y, œ/, respectively, and two arguments have been made concerning the development of VH in the Eastern Black Sea dialects. First, Johanson (2006) argues that it is not appropriate to characterize

<sup>7</sup> Pontic Greek contains /i, e, a, o, u, œ/ (and rarely /œ/ see Mackridge (1987, 1991) and Özkın (2013) for further discussion of the Pontic Greek vowel system. According to Godel (1975), Classical Armenian has /i, ε, e, a, ə, o, u/, and Dum-Tragut (2009) describes the phonemic vowels in Standard Modern Eastern Armenian as /i, ε, ə, u, a, ɔ/. In the Laz language, there are five phonemic vowels; /i, e, a, u, o/ (Öztürk & Pöchtrager 2011).

<sup>8</sup> Population exchange is the transfer of (at least two) populations in an opposite direction simultaneously, due to political decisions (e.g., the simultaneous transfer of Orthodox Christians from Turkey to Greece, and Greek Muslims from Greece to Turkey).

North Eastern dialects of Turkish as reflecting disruptions in backness and rounding harmonies due to language contact. Instead, he suggests the deviations from modern Turkish found in these non-standard dialects are a result of the preservation of archaic forms, such as non-harmonic suffix vowels and not fully developed backness or rounding harmonies. In fact, geographical characteristics of the Eastern Black Sea area are also considered to have had an influence on TT by causing archaic forms to be preserved. The fact that this is a mountainous area covered by dense forests and close to riverbeds might have restricted language contact with other varieties of Turkish which developed rounding harmony later, but allowed language contact with non-Turkic languages existing in the area (Brendemoen 2006). Second, Brendemoen (2002, 2006) argues that VH in TT is at the stage of Old Anatolian Turkish, which lacked rounding harmony. He also suggests that TT displays disruption of VH due to multiple different factors including language contact. However, it is important to note that Proto-Turkic, which is stated to have started at around the middle of the first millennium B.C.<sup>9</sup>, contains /u, y, œ/ (Róna-Tas 1998). Since Proto-Turkic had these three phonemic vowels, but in TT these are relatively uncommon, this might be an indicator of VH decay in TT due to language contact instead.

In summary, TT might have emerged due to archaisms and/or language contact factors. First, TT might be representative of archaic Turkish which developed separately from the standard variety of Turkish. If this is correct, TT might follow the developmental stages of ST vowel harmony and develop rounding harmony over time. Second, TT might be a dialectal variety with a reduced vowel inventory that emerged due to language contact. If this is correct, then /u, y, œ/ could have merged with /i, u, o/. If such vowel mergers are present in TT, this may cause partial disharmony in TT. This will be discussed further in Section 4.3. Since it is difficult to draw lines between these two perspectives, the purpose of this research is not to provide evidence and determine which of these possibilities is true. Instead, the goal is to examine how TT behaves in terms of VH (whether this is towards harmony or disharmony).

4.1 METHODS AND DATA. VH in TT was studied through data extracted from Brendemoen (2002), which is a large corpus of transcribed texts of spoken TT. These texts represent the variety of Turkish spoken in Trabzon area in 1978-79 and in 1994. To examine TT vowel harmony, samples from 6 different speakers from various districts of Trabzon were selected (two female, four male, age range = 58-78, mean age = 67.5). A list of inflected TT word tokens was compiled and annotated manually by the researcher. The data gathered for this study contained 1216 inflected words in TT, with 1860 suffixes. For each inflected word, the morphological type of each suffix (e.g., 1PL, PST, AOR) was determined. In addition, each vowel in roots/suffixes were identified. This process also included identifying the adjacent consonantal segments, specification of the features of vowels (e.g., height, rounding, etc.), and whether each of these vowels (except the first one in the word) harmonizes with the previous vowel in terms of backness and rounding. To be able to judge the vowels in TT words as harmonic/disharmonic, backness and rounding harmony rules of ST were taken as a baseline for comparison. Data analysis was done via RStudio.

4.2 HYPOTHESES. Four hypotheses are made for TT vowel harmony.

*Hypothesis 1: Rates of harmony<sup>10</sup> will be lower in TT compared to ST.* — If ST has fully functional backness/rounding harmonies, and TT exhibits only partially productive harmony, then

<sup>9</sup> Based on the assumption that Proto Turkic refers to “the time of the appearance of the first direct data from existing Turkic language, in fact after the separation of the branches of Turkic” Róna-Tas (1998).

<sup>10</sup> Harmony rate refers to percentage of harmonic forms as opposed to disharmonic ones.

backness and/or rounding harmony rates are predicted to be lower in TT.

*Hypothesis 2: TT has more suffixes that do not alternate than ST - some of the suffixes that alternate in ST may occur with a fixed vowel in TT.* — As discussed in Section 4, if TT has harmony, high rates of harmony with non-high vowels is expected as backness harmony has been part of Turkish for centuries and there is no expectation of possible merger of either /e/ or /a/. As for the high alternating suffix vowels, these are predicted to show some level of disharmony in TT. This could be due to merger of /u, y/ with /i, u/ respectively, leading to violations of backness harmony. Or, it could be due to fixed vowel suffixes, leading to violations of both back and rounding harmony.

*Hypothesis 3: Velar and/or labial consonants cause the preceding vowel to be realized as round (even in places where rounding is not expected by VH).* — The rationale behind this is the following. First, Brendemoen (2002) states that a (word-final) velar stop causes rounding of the preceding high vowel. Brendemoen adds that this may be representing an archaic feature of Old Turkic. Otherwise, there is no obvious connection between round vowels and velar consonants, unless the round vowel is back [u]. Second, as discussed in Section 2, labial vowels may also appear with rounded vowels (labial attraction) which may result in breakdown in harmony.

*Hypothesis 4: Harmony decreases towards the right edge of the word.* — This decrease in harmony may be observed according to the order of vowels in the whole word (i.e., the order of syllables). Or, it may be based on the order of suffixes. Derivational suffixes are typically closer to the root compared to inflectional suffixes, and therefore derivational suffixes might be more harmonic. Such observations have been made for other languages (Zymet 2014, McCollum 2015, McPherson & Hayes 2016).

4.3 RESULTS AND DISCUSSION. *Hypothesis 1* tested whether the rates of harmony in TT tokens is lower compared to the matching ST tokens. The results confirm this, particularly with respect to rounding harmony. 69% of TT suffix tokens have harmony, but 31% lack harmony compared to ST, where the suffixes are harmonic in all instances (except for the PROG -Ijor whose second vowel [o] is opaque). The rates of backness and rounding harmony are given in Table 1. Backness harmony is satisfied in TT in 1443 of suffix tokens (83%). Suffixes with non-high vowels (e.g., 3PL -IAr) satisfy backness harmony in 679 tokens (92.8%), whereas suffixes with high vowels (e.g., the ACC -i) obey backness harmony in 764 tokens (75.6%). In other words, high vowels violate backness harmony more often. Rounding harmony, which only applies to high vowels, is satisfied in 660 (65%) of the suffix tokens.

	<i>Backness harmony</i>		<i>Rounding harmony</i>	
	satisfied	violated	satisfied	violated
high suffix vowel	764	246	660	351
non-high suffix vowel	679	53	NA	NA
Total	1443	299	660	351

Table 1: The rates of backness and rounding harmony in TT

*Hypothesis 2* was concerned with whether TT has more suffixes that do not alternate than ST. Results showed that disharmonic forms in TT result from certain suffixes with a fixed high vowel /i/ or /u/. ACC, PST are two frequent suffixes with a fixed vowel /i/ (but several instances of these suffixes with a round vowel /u/ occurred in the corpus). The examples in (5)-(6) demonstrate that

the ACC and PST<sup>11</sup> are realized with /i/ regardless of the quality of the preceding vowel. As seen in (6), the fixed /i/ of the PST can trigger further harmony in the following suffix.

- (5) a. **siz-i** *harmonic* (cf. ST **siz-i**)  
you(pl.)-ACC
- b. **ʃaj-i** *backness violation* (cf. ST **ʃaj-ɯ**)  
tea-ACC
- c. **gyn-i** *rounding violation* (cf. ST **gyn-y**)  
day-ACC
- d. **bun-i** *backness and rounding violation* (cf. ST **bun-u**)  
this-ACC
- (6) a. **de-di-ler** *harmonic* (cf. ST **de-di-ler**)  
say-PST-3PL  
'they said'
- b. **tut-ar-di-ler** *backness violation* (cf. ST **tut-ar-du-lar**)  
hold-AOR-PST-3PL  
'they used to hold'

The other fixed vowel, /u/, occurs primarily in 1PL -(u)k (7), and some derivational suffixes such as -luk (8), but these are infrequent in the data.

- (7) a. **vur-ur-uk** *harmonic* (cf. ST **vur-ur-uz**)  
hit-AOR-1PL  
'we hit'
- b. **jap-ar-uk** *rounding violation* (cf. ST **jap-ar-ɯz**)  
do-AOR-1PL  
'we do'
- c. **kes-er-uk** *backness and rounding violation* (cf. **kes-er-iz**)  
cut-AOR-1PL  
'we cut'
- (8) a. **aj-luk-lar-in-i** *rounding violation* (cf. ST **aj-luk-lar-ɯn-ɯ**)  
month-DER-PL-POSS-ACC  
'their salaries'
- b. **reʃper-luk** *rounding violation* (cf. ST **reʃper-lik**)  
laborer-DER  
'laborer (refers to the state of being a laborer)'

<sup>11</sup> We thank the anonymous reviewer for raising the following consideration about the phonetic representation of the PST in TT. The allomorph of PST may depend on person since in Old Anatolian Turkish this morpheme was -DI in the third person but -DU in the first and second persons, e.g. **aldɯ** '(s)he took', **aldɯq** 'we took' (Kerlake 2005). As indicated in this study, PST realized with [i] are abundant in the data and these correspond to tokens inflected with third person suffixes. TT word tokens containing PST when the word is inflected with 1SG, 2SG, or 2PL are limited in the data, but a few examples like **de-du-m** 'I said', **gel-du-n** 'you (sg) arrived' are found. There are also examples for 1PL where the PST is realized with [u] **gel-ur-du-k** 'we would arrive', **toku-r-du-k** 'we would knit'. In these examples, however, the PST vowel [u] occurs next to a velar consonant so it is difficult to evaluate if vowel rounding is due to the adjacent velar consonant or it is an archaism. If the assumption is archaism, one would still have to account for why tokens like **de-du-m** are realized with a back round [u] following the front unround [e] instead of a front round [y] as in **de-dy-m**, or why examples like **tut-ar-di-ler** (6b) are not realized as **tut-ar-du-lar**.

Suffixes with non-high vowels (e.g., DAT, LOC, ABL, PL, 3PL, NEG) are subject to only backness harmony, and they often (92.8%) harmonize with the preceding vowel (e.g., 3PL in (6), PL in (8-a)).

	<i>In roots</i>		<i>In suffixes</i>	
	ST	TT	ST	TT
/i/	261	240	464	422
/u/	64	47	376	154
/y/	38	23	28	20
/u/	154	124	176	227
/œ/	26	22	0	0
/o/	231	247	58	1

Table 2: The count of /i, u, y, u, œ, o/ in ST compared to TT

Although /i/ and /u/ are the typical high vowels in TT suffixes, there is no complete merger of /u, y/ with /i, u/ (and /œ/ with /o/) in TT. The number of /u, y, œ/ as well as /i, u, o/ are reported for TT compared to ST in Table 2. Non-high suffix vowels /a, e/ are excluded from Table 2 because they are not predicted to have undergone merger. According to Table 2, it appears that /u/ and, although rare, /y/ are possible in TT suffixes (/œ/ and /o/ are not expected in suffixes - except for the PROG -Ijor - because these are non-high rounded vowels). Overall, the number of vowels in TT is smaller than ST. This is because i) other vowels are noted for TT (e.g., central vowels [i, u], a slightly rounded high front vowel [y<sup>ç</sup>], etc.), ii) TT often drops some of the vowels which would be present in ST; for example, the PROG in TT gid-**ejr**-um ‘go-PROG-1SG’ vs. ST gid-**ijor**-um (the deletion of [o] in the PROG is also the reason why there is a lower number of [o] in TT suffixes in Table 2). Note that Table 2 only reports the number of occurrences of vowels in ST and TT but not an ST to TT correspondence of individual vowels. So, although there is a considerable decrease in [u] but a large increase in [u] in TT suffixes, which is suggestive of a merger, specific correspondences between these vowels are not known. Future research must investigate the vowel-to-vowel correspondence and how many of the vowels in Table 2 reflect fixed suffix vowels.

*Hypothesis 3* tested the influence of the adjacent velar and labial consonants on VH. Figure 1-a shows that vowels preceding a velar consonant are strictly [+round] (90/96). Only 6 out of 96 instances of vowels preceding a velar are [-round] (5 of these unround vowels are predicted by rounding harmony and 1 violates rounding harmony). Figure 1-b illustrates whether [+round] vowels preceding a velar consonant satisfy rounding harmony. It is found that such round vowels often violate rounding harmony (62/90). In other words, roundness of a vowel preceding a velar consonant is not due to harmony but it is likely due to the adjacent velar consonant ( $p=0.004$ , Chi-squared test).

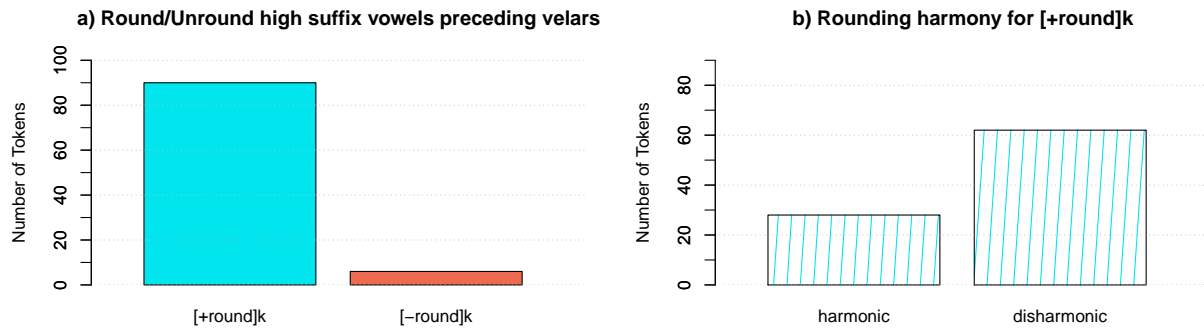


Figure 1. High suffix vowels preceding velar consonants

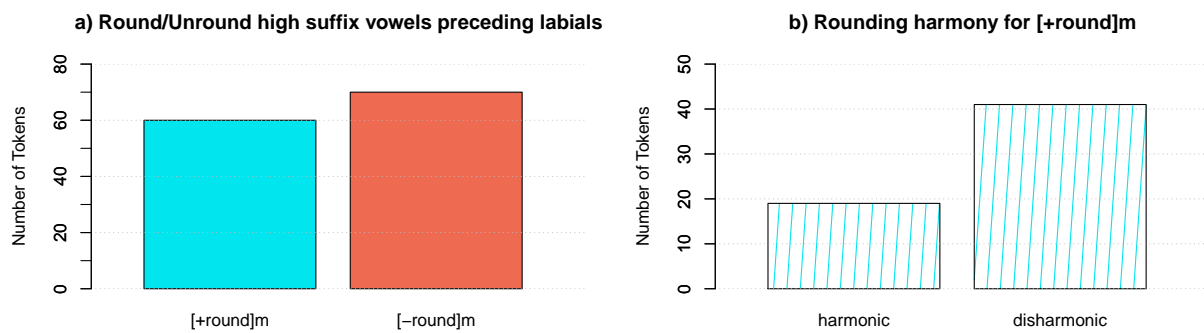


Figure 2. High suffix vowels preceding labial consonants

As for vowels preceding labial consonants, the distribution of high round (60/130) or high unround (70/130) vowels are almost equal (Figure 2-a). So, compared to velar adjacent vowels, labial adjacent vowels allow more instances of unround vowels. Figure 2-b illustrates the rounding harmony in [+round] vowels preceding a labial consonant. The results show that 41/60 round vowels preceding a labial violate rounding harmony, and therefore rounding is highly likely to be conditioned by labials ( $p= 0.029$ , Chi-squared test). (The unrounding of vowels in the [-round]m category illustrated in Figure 2-a is predicted by harmony because 66/70 satisfy rounding harmony and only 4/70 violate it.)

*Hypothesis 4* was concerned with whether VH decreased towards the end of the word in TT. This hypothesis is tested in two ways. First, harmony rates can be examined according to the order of vowels (syllables) in tokens. The percentage of harmony rates according to vowel order are illustrated in Figure 3. There is no linear decrease in backness harmony or rounding harmony based on the order of syllables.

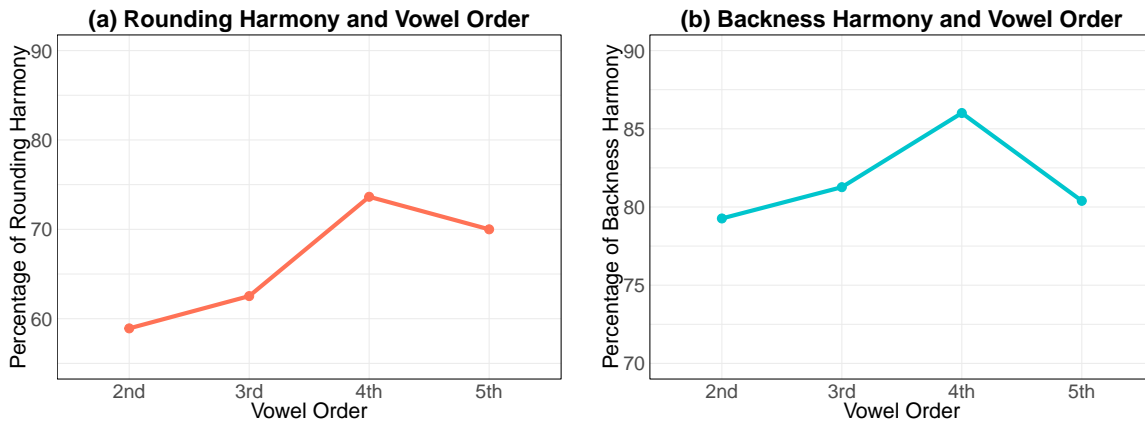


Figure 3. Percentage of rounding and backness harmonies according to vowel order

Second, harmony rates can be examined according to the type (e.g., person, case) and order of suffixes. The results reported in Table 3 show the percentage of rounding and backness harmonies based on the type and order of suffixes. According to Table 3, VH does not systematically peter out across the word based on suffix order. However, there is an obvious linear decrease in rounding harmony for person suffixes. As it was demonstrated in (7), 1PL seems to have a fixed vowel [u] as in -(u)k. If -uk follows a round vowel, it is consistent with rounding harmony, although it may not mean that rounding has actively applied. So, if 1PL is predominant in the corpus compared to other person suffixes, then the linear decrease in the rounding harmony percentages in Table 3 can be explained.

<i>Suffix Type</i>	<i>Rounding</i>			<i>Backness</i>		
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
Person	<b>90.9</b>	<b>45.8</b>	<b>14.3</b>	76.9	89.8	88.9
Case	57.0	96.3	87.5	82.5	83.7	76.5
Tense/Aspect/Modality	65.6	51.4	76.9	84.4	74.1	69.2
Other Inflectional Suffixes	80.6	84.1	66.7	83.3	85.2	57.1
Derivational Suffixes	58.3	-	-	66.7	83.3	-
Clitics	68.2	66.7	57.1	83.8	86.2	62.5
Total (mean)	70.1	68.9	60.5	79.6	83.7	70.8

Table 3: Percentage of rounding and backness harmonies according to the type and order of suffixes (excludes bisyllabic suffixes)

The number of person suffixes containing a high vowel, where rounding harmony applies, is as follows. In the 1<sup>st</sup> suffix position, rounding harmony is fulfilled at 90.9%. In this position, there are 12 instances of person suffixes, and there are only 2 violations of rounding harmony (both are due to 1PL -uk). In the 2<sup>nd</sup> suffix position where rounding harmony is 45.8%, there are 80 instances of person suffixes with a high vowel (55 1PL, 25 other person suffixes). Almost all disharmonic instances are the 1PL -uk (39/80). In the 3<sup>rd</sup> suffix position, rounding harmony is satisfied at 14.3%, but the sample size is too small (There are 7 person suffixes which undergo rounding harmony. 6/7 violate rounding harmony (includes three 1PL -uk) and only 1/7 satisfy rounding harmony). Since the sample sizes for person suffixes in the 1<sup>st</sup> and 3<sup>rd</sup> suffix positions are very small, it may not be accurate to characterize person suffixes as showing linear decrease in harmony rates.

In summary, testing Hypothesis 1 showed that TT has lower backness/rounding harmony rates compared to ST. Investigating Hypothesis 2 demonstrated that some suffix vowels that alternate in ST are produced with a fixed vowel in TT, which results in disharmonic forms. The effect of consonants on VH was examined in Hypothesis 3. Both velar and labial consonants cause disruption in VH by conditioning rounding on preceding vowels. Hypothesis 4 tested the cross-linguistic generalization that VH decreases as the distance between the trigger of VH and the target increases. The results contradict this because there is no systematic linear decrease in TT. There are two possible accounts for the disharmonic TT forms. First, TT might have emerged as a result of second language acquisition of Turkish by PG/Armenian/Laz speakers in the area, who do not have VH and have smaller vowel systems lacking /u, y, œ/. Second, TT might be representing a more productive VH system which has undergone changes due to language contact.

**5. Conclusion.** This study examined VH patterns in TT, which has a rich language contact history with Pontic Greek (as well as Armenian and Laz). TT uses the same VH system as ST but in a more reduced form. The two main factors contributing to partial harmony in TT are i) suffixes with fixed, non-alternating vowels which appear to be mostly high (specifically, [i] and [u]), and ii) the influence of adjacent velar or labial consonants which condition rounding of preceding vowels even when rounding is not predicted by VH. In TT suffixes, [u] shows fewer attestations compared to ST, and [y] is too uncommon in both ST and TT to properly assess. Overall, there is no systematic linear decrease of harmony across the word in TT. This finding does not support the cross-linguistic generalization that VH peters out across the word. Future research on TT should investigate the role of syllable structure as this seems to be another factor influencing VH (Mahanta 2008).

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