

THE PHONETIC REALIZATION OF STRESSED VOWELS IN THE DIALECT OF KATO PEDINA IN IOANNINA

Theofano Christou, Mary Baltazani

University of Ioannina

We examined the realization of stressed vowels in the dialect of Ioannina and the effect of the phonetic environment on them. Specifically, we examined the influence of unstressed high vowel deletion on the duration and formants of neighboring stressed vowels. The study was based on spontaneous speech collected in the village of Kato Pedina near Ioannina. Results show that stressed vowels that occur next to a syllable with a deleted segment (a) have longer duration than corresponding vowels without deletion in their environment and (b) are realized in lower positions in the F1XF2 vowel space than corresponding vowels without deletion in their environment. Furthermore, a comparison between the vowels of the dialect under examination and the vowels of Standard Modern Greek (SMG) revealed that the vowels of this dialect are realized higher than the corresponding vowels of SMG. More specifically, in this dialect, the distance between mid and high vowels is much smaller than the corresponding distance in SMG. In other words, the dialect mid vowels are realized higher than the SMG mid vowels, even when they are stressed. This fact contradicts the assumption that there is no quality difference between stressed vowels in dialects and SMG.

Key words: stressed vowels, high vowel loss, mid vowel raising, vowel space

1. Introduction

Northern Greek dialects, as it is pointed out extensively in the bibliography, present us with an asymmetry between stressed and unstressed vowels: unstressed vowels have been widely reported to delete if they are underlyingly high and raise if they are underlyingly mid. On the other hand, stressed vowels have been reported to be stable and not undergo any changes on the surface, that is, stressed vowels which are underlyingly high do not delete and stressed vowels which are underlyingly mid do not raise, thus having the same quality as the vowels of Standard Modern Greek (SMG) (among others, Bogas 1964,

Newton 1972, Kontosopoulos 1994, Trudgill 2003; however see Trudgill (this volume) for a different view).

Cross-linguistically, several factors have been shown to affect vowel realization. First of all, the ‘maximal dispersion’ hypothesis in Liljencrants and Lindblom (1972) assumes that the number of vowels in a system affects their spectral quality. Based on this hypothesis, scholars of Northern Greek dialects have been presupposing that dialectal vowels, at least stressed ones, have the same quality as the vowels of SMG since both systems have the same number of vowels. However this presupposition has not been instrumentally examined so far, to our knowledge.

There are several acoustic, quantitative reports on the vowel system of Standard Modern Greek, supporting the phonological, impressionistic report that the vowels in the SMG system are maximally dispersed and symmetrical with no overlap between them (Dauer 1980, Kontosopoulos *et al.* 1988, Jongman *et al.* 1989, Hawks *et al.* 1995, Botinis *et al.* 1997, Fourakis *et al.* 1999, Sfakianaki 2002, Baltazani 2006). On the other hand, there are very few acoustic reports on dialectal vowel systems (for the Cypriot Greek dialect see Arvaniti, 1999 and Eftychiou (this volume); for the Griko dialect see Romano (this volume); for the Cretan dialect spoken in Sfakia see Trudgill (this volume)). This paper presents a quantitative, acoustic examination of the realization of stressed vowels in a northern dialect of Greek spoken in Kato Pedina, in the area of Ioannina.

One of the aims of this study, therefore, is to determine to what degree the dialectal vowels we examined have the same quality as their corresponding SMG vowels. In this paper we offer evidence that the vowels in the dialect of Ioannina differ from the SMG vowels, in that they are not maximally dispersed. Instead, the mid vowels have a much shorter distance from the high vowels than the corresponding vowels of SMG. Trudgill (this volume) reports a similar distribution for the vowels in the dialect of Sfakia in Crete.

In addition to the ‘maximal dispersion’ principle, the realization of vowels has been shown to be influenced cross-linguistically by several other factors, among which are intrinsic vowel height (Peterson & Lehiste 1960) and position in the utterance (Pierrehumbert and Talkin 1992, Keating, Cho, Fougeron & Hsu 2003). Moreover, deletion of a neighbouring segment can make a vowel longer, a phenomenon widely known as compensatory lengthening (among many others, Hayes 1989, Goldsmith, 1990). Another aim of this study is to examine whether stressed vowels undergo changes in their realization (a) when there is high vowel deletion in a neighbouring syllable and (b) depending on their position in the utterance. We offer evidence that the vowels in this dialect are realized in lower positions in the vowel space when there is high vowel deletion in a neighbouring syllable and that their realization is not influenced by their position in the utterance.

In the remainder of the paper we first present the methodology of our experimental study in section 2.1, then, in section 2.2, the duration results and finally, in section 2.3, the spectral results. Section 3 offers a discussion of the results.

2. Our study

2.1. Method

The dialect we examined is spoken in the village of Kato Pedina, in the area of Zagori, in Ipiros. We collected spontaneous speech material from two female speakers of this dialect in their 80's, who discussed everyday matters for about 50 minutes. They are both females in their 80s. One of the two travels often to Athens and because of influences of SMG in her speech was excluded. Consequently, the material in this paper is based on material from the second speaker, AP.

Our aim was twofold: first, examine the realization of stressed vowels in this dialect and the influence that the phonetic environment exerts on them, and second, determine the degree of similarity between the dialectal stressed vowels and those of SMG.

There were 168 tokens of stressed vowels in our corpus. Table 1 shows the distribution of each vowel in two categories, depending on whether there was high vowel deletion in a neighbouring syllable (*with deletion* column) or not (*no deletion* column). We excluded words that were focused because focus influences duration according to the bibliography (Baltazani, 2006).

Table 1. Distribution of stressed vowel tokens in our corpus.

Vowel	With deletion	No deletion
[i]	19	15
[e]	25	23
[a]	30	10
[o]	11	16
[u]	11	8

We measured the duration and spectral quality of the stressed vowels in our corpus. Three types of comparison were made: (a) we compared the vowels in the two categories shown in Table 1 to determine the effect of high vowel deletion on the realization of stressed vowels in this dialect, (b) we compared the vowels from three prosodic positions—utterance initial, utterance medial, and utterance final—to determine the effect of prosodic position on the realization of stressed vowels in this dialect, and (c) we compared the vowels of

this dialect to those of SMG to determine whether the two sets have similar realization. The analysis and all measurements were made using *Pitchworks* (Scicon).

2.2. Duration Results

Our measurements revealed that stressed vowels in words where deletion has occurred have longer duration than vowels in words without deletion. This difference occurred consistently in all the prosodic positions. The following three figures show this difference for each of the three prosodic positions examined: Figure 1 for words in phrase initial position, Figure 2 for words in phrase medial position and Figure 3 for words in phrase final position. In Figure 1, the bar for [o] in the deletion environment is missing because there were no words for that condition in our corpus.

Figure 1. Vowel duration in phrase initial words with deletion (grey) and no deletion (black).

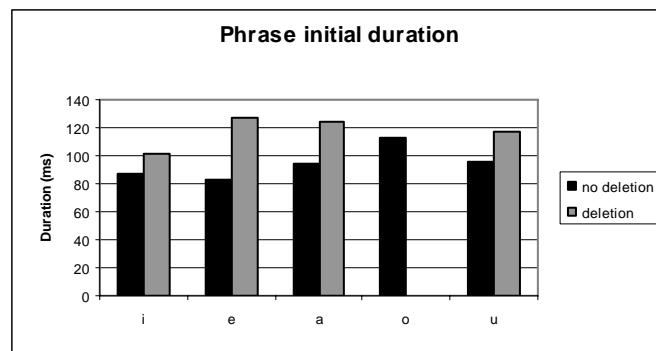


Figure 2. Vowel duration in phrase medial words with deletion (grey) and no deletion (black).

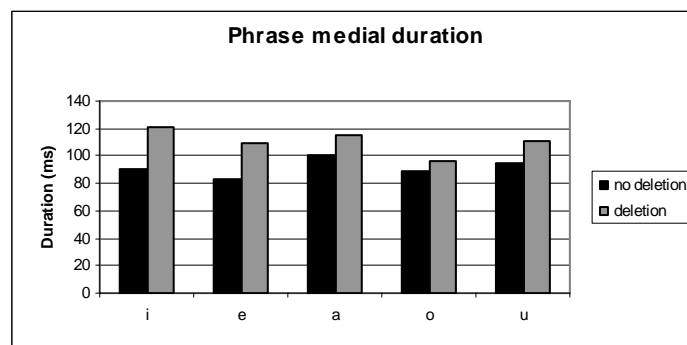


Figure 4 shows the average duration of each vowel across the three prosodic positions (initial, medial and final). The black bars show the duration of vowels in words without deletion and the grey bars in words with high vowel deletion in a neighbouring syllable.

Figure 3. Vowel duration in phrase final words with deletion (grey) and no deletion (black).

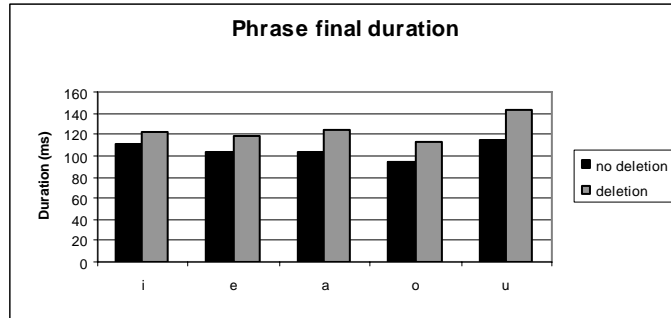
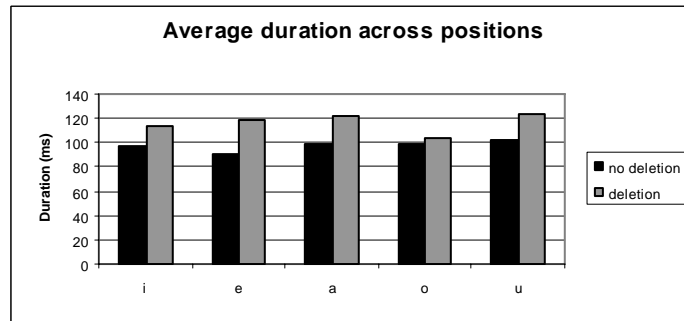


Figure 4. Vowel duration in words without (black) and with deletion (grey). Values are averages across the three prosodic positions.



A comparison among the three prosodic positions showed that in general vowels in utterance final position tend to be longer than in the other two positions. Figure 5 shows duration of vowels that do not have deletion in their environment. For all vowels except [o], vowels in utterance final position tend to be longer than in the other two positions. In utterance initial and medial position, there does not seem to be much difference in duration (again with the exception of [o], which is longest in utterance initial position).

Figure 6 shows duration of vowels that have deletion in their environment. Among these vowels, utterance final ones show the longest values for only three of the five vowels, [i], [o] and [u]. The vowels [e] and [a] are the longest in utterance initial position.

Figure 5. Duration in three prosodic positions: (a) initial (black), (b) medial (gray) and final position (striped), for vowels without deletion in their environment.

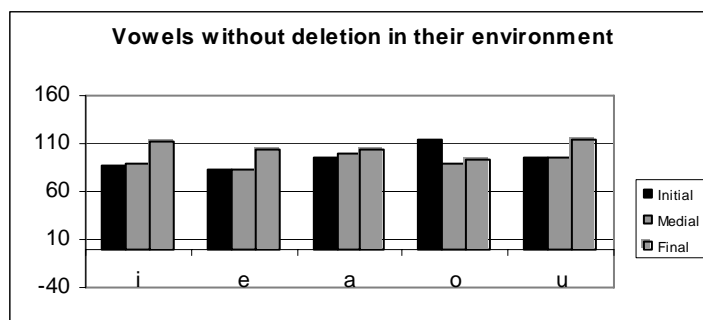
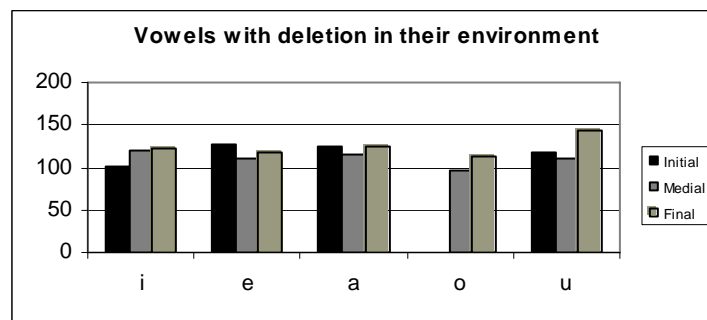


Figure 6. Duration in three prosodic positions: (a) initial (black), (b) medial (gray) and final position (striped), for vowels with deletion in their environment.

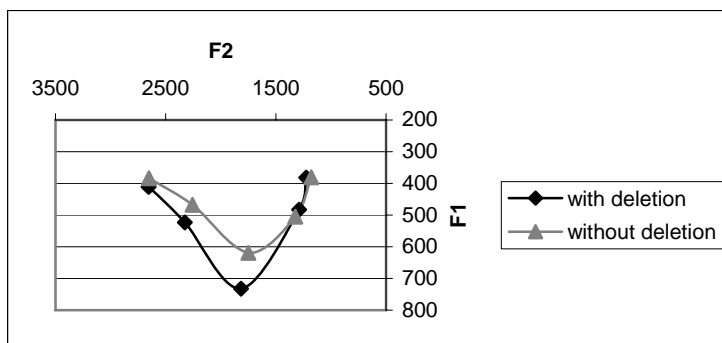


2.3. Spectral Results

In this section we show (a) the effect of high vowel deletion on the quality of stressed vowels and (b) the comparison in quality between the dialectal vowels and those of SMG.

Figure 7 shows the average values of formants from all prosodic positions (initial, medial, and final). Average values were used because no effect of prosodic position on the values of formants was found. The black line shows the formants of vowels with deletion in their environment and the grey line shows the formants of vowels with deletion. Vowels without deletion in their environment are realized higher in the F1XF2 space while vowels with a neighbouring vowel deleted are realized lower. For [u] and [o] the graph shows no difference between the two vowel categories, but we believe that this is due to insufficient data, something that was also reported for the duration measurements.

Figure 7. Average values of formants from all prosodic positions (beginning, middle, and end of the utterance).



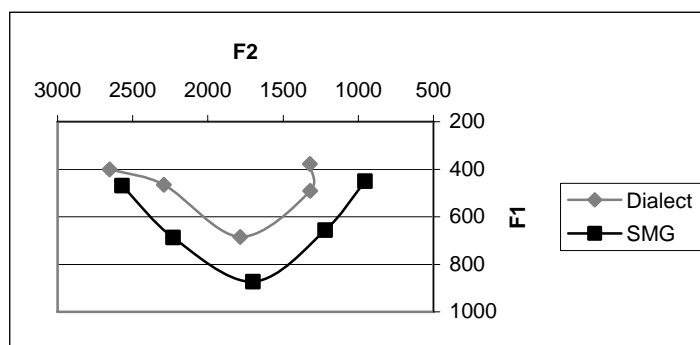
As a reference for the comparison in quality between the dialectal vowels and those of SMG we relied on the formant values reported for SMG in Sfakianaki (2002), which involves the acoustic analysis of Greek men's, women's and children's vowels. Since the present study is based on data from a female speaker, we will compare our data with only the data from female speakers in Sfakianaki (2002), which are shown in Table 2.

Table 2: Formants of vowels of female speech in Modern Greek (from Sfakianaki, 2002).

Vowel	F1	F2
i	469Hz	2571 Hz
e	687 Hz	2231 Hz
a	873 Hz	1699 Hz
o	657 Hz	1219 Hz
u	451 Hz	955 Hz

Figure 8 shows that for all vowels in this dialect, the F1 value is smaller than the corresponding SMG F1 value. This means that the dialectal vowels are realized higher in the F1XF2 space than their corresponding SMG vowels. There is no such difference in the F2 value, except for the vowel [u], which is realized with a bigger F2 value in this dialect. This means that all dialectal vowels occupy the same position in the front-back dimension as do SMG vowels, except [u], which is realized in a considerably more fronted position than the SMG [u].

Figure 8. Formants of dialectal vowels (grey) and SMG vowels (black).



In addition to this general height difference in the two vowel systems, there is a further difference specifically in the realization of the mid vowels: the distance between the dialectal mid and high vowels is smaller than the corresponding distance in SMG. Table 3 shows the Euclidean distance¹ between mid and high vowels in the dialect under consideration in the left column and between the corresponding SMG vowels in the right column. Bigger numbers mean greater distances between the two vowels measured. The distance between the dialectal vowels is smaller, especially so for the back vowels, a fact which is also evident in Figure 7.

Table 3: Euclidean distance between mid and high vowels in the dialect and in SMG.

	Dialect	SMG
[i]-[e]	367	404
[u]-[o]	114	335

3. Discussion and conclusion

In this paper we have offered evidence for three characteristics of the vowels in the dialect of Kato Pedina in the area of Zagori. First, stressed vowels in this

¹ The Euclidean distance is the square root of the sum of the squares of the difference between the vowel formant frequencies ($ED = \sqrt{((F1V1 - F1V2)^2 + (F2V1 - F2V2)^2)}$).

dialect that occur next to a syllable with a deleted segment have longer duration than corresponding vowels without deletion in their environment. As already stated at the beginning of this paper, this phenomenon can be viewed as an instance of compensatory lengthening (Hayes 1989, Goldsmith, 1990).

The second characteristic of the dialectal vowels we examined is that vowels in this dialect that occur next to a syllable with a deleted segment are realized in a lower position in the F1XF2 vowel space than corresponding vowels without deletion in their environment. Cross linguistically, a correlation has been found between the duration of a segment and its spectral quality, in that vowels with a shorter duration tend not to fully reach their articulatory target, a phenomenon known as *target undershoot* (Lindblom 1983, 1990). In other words, shorter vowels often tend to be realized in more centralized positions in the F1XF2 space while longer vowels tend to be realized in more peripheral positions, which are nearer the target articulation. The data presented in this paper can be accommodated under the target undershoot hypothesis.

The third characteristic of the dialectal vowels we examined arises in comparison to the vowel system of SMG. The vowels of SMG are arguably maximally dispersed and symmetrical with no overlap between them (Dauer 1980, Kontosopoulos *et al.* 1988, Jongman *et al.* 1989, Hawks *et al.* 1995, Botinis *et al.* 1997, Fourakis *et al.* 1999, Sfakianaki 2002, Baltazani 2006), conforming to the 'maximal dispersion' hypothesis in Liljencrants and Lindblom (1972), which assumes that the number of vowels in a system affects their spectral quality. Based on this hypothesis, scholars of Northern Greek dialects have been presupposing that dialectal vowels, at least stressed ones, have the same quality as the vowels of SMG since both systems have the same number of vowels. However, the results of the present study suggest that the dialectal vowel system does not conform to the maximal dispersion hypothesis. The comparison between the vowels of the dialect under examination and the vowels of SMG revealed that the vowels of this dialect are realized higher than the corresponding vowels of SMG. More specifically, in this dialect, the distance between mid and high vowels is much smaller than the corresponding distance in SMG. In other words, the dialect mid vowels are realized higher than the SMG mid vowels, even when they are stressed. This fact contradicts the assumption that there is no quality difference between stressed vowels in dialects and SMG.

The results of this study are of course tentative because they are based on data from only one speaker. Not only data from many more speakers of this area should be collected, but data from other sub-varieties of the Northern Dialect should be examined to determine the extent of the vowel characteristics discovered here. Data collected from the area of Sfakia in Crete (Trudgill (this volume)) suggest that this phenomenon of the small distance between the high and mid vowels may be wide spread across dialects of Greece.

REFERENCES

- Arvaniti, A. (1999). Cypriot Greek. *Journal of the International Phonetic Association* 29 (2): 173-178.
- Baltazani, M. (2006). Focusing, prosodic phrasing, and Hiatus resolution in Greek. In *Laboratory Phonology 8*, Luis Goldstein, Douglas Whalen, Catherine Best (eds.), Mouton de Gruyter, Berlin, 473-494.
- Bird, S., & Ellison T. M. (1992). One-level phonology: Autosegmental representations and rules as finite-state automata. *Computational Linguistics*, 20(1), 55-90.
- Bogas, E. (1964). *Ta glosika idiomata tis Ipirou. A: Gianniotiko kai alla lexilogia*. Ioannina, Etairia Ipirotikon Meleton.
- Botinis, A., Fourakis, M. and J. W. Hawks (1997). A perceptual study of the Greek vowel space using synthetic stimuli. In *Eurospeech '97: Proceedings of the 5th European Conference on Speech Communication and Technology*, Patras: University of Patras.
- Chambers, J. K., & Trudgill, P. (1998). *Dialectology* (2nd Ed.). Cambridge: Cambridge University Press.
- Dauer, R.M. (1980). The reduction of unstressed high vowels in Modern Greek. *Journal of the International Phonetic Association* 10: 17-27.
- Eftychiou, E. (this volume). Vowel-Lenition in Cypriot Greek and its Implications for Consonant-Vowel Coarticulation.
- Fourakis, M., Botinis, A. and M. Katsaiti (1999). "Acoustic characteristics of Greek vowels". *Phonetica* 56: 28-43.
- Fudge, E. C. (1969). Syllables. *Journal of Linguistics*, 5, 253-286.
- Goldsmith, J. (1990). *Autosegmental and metrical phonology*. Oxford: Blackwell.
- Hayes, Bruce (1989). Compensatory Lengthening in Moraic Phonology. *Linguistic Inquiry*, 20: 253-306.
- Hawks, J.W. and M.S. Fourakis (1995). "The perceptual vowel spaces of American English and modern Greek: a comparison". *Language and Speech* 38: 237-252.
- Jongman, A., M. Fourakis, and J. Sereno (1989). The acoustic vowel space of Modern Greek and German. *Language and Speech* 32: 221-248.
- Keating, P., T. Cho, C. Fougeron, and C. Hsu (2003). Domain-initial strengthening in four languages. *Laboratory Phonology 6*, 145-163. Cambridge University Press.
- Κοντοσόπουλος, Ν. (1994). *Διάλεκτοι και ιδιώματα της Νέας Ελληνικής*. Αθήνα, Εκδόσεις Γρηγόρη.
- Κοντοσόπουλος, Ν., Ν. Ξηρομερίτης, και Α. Τσίτσα (1988). Ακουστικές έρευνες επί των ελληνικών φθόγγων. *Glossologia* 5-6: 103-122.
- Liljencrants J. and B. Lindblom (1972). Numerical simulation of vowel quality systems: The role of perceptual contrast. *Language* 48: 839-862

- Lindblom, B. (1963). Spectrographic study of vowel reduction. *JASA*, 35(11), 1773-1781.
- Lindblom, B. (1983) Economy of Speech Gestures. *The Production of Speech*. P. MacNeilage (ed) Springer, New York.
- Lindblom, B. (1990) Explaining Phonetic Variation: A Sketch of the H&H Theory. *Speech Production and Speech Modelling*. W.J. Hardcastle & A. Marchal (eds). 403-439.
- Moon, S. J. & B. Lindblom, (1994). Interaction between duration, context, and speaking style in English stressed vowels. *JASA*, 96(1), 40-55.
- Newton, B. (1972). *The Generative Interpretation of Dialect: A Study of Modern Greek Phonology*. Cambridge: Cambridge University Press.
- Peterson, G. and I. Lehiste, (1960). Duration of syllable nuclei in English. *Journal of the Acoustical Society of America*, 32, 693-703.
- Pierrehumbert, J., & D. Talkin, (1992). Lenition of /h/ and glottal stop. In G. Docherty, & D.R. Ladd (Eds.), *Papers in laboratory phonology II: Gesture, segment, prosody*: 90–119. Cambridge: Cambridge University Press.
- Romano, A. (this volume). Acoustic data about the Griko Vowel System.
- Sfakianaki, A. (2002). The acoustic characteristics of Greek vowels produced by adults and children. In Makri-Tsilipakou, M. (ed.) *Selected Papers on Theoretical and Applied Linguistics*. Aristotle University of Thessaloniki. 383-394.
- Trudgill, P. (2003). Modern Greek dialects: a preliminary classification. *Journal of Greek Linguistics* 4, 45-63.
- Trudgill, P. (this volume). Vowel Dispersion Theory and Greek Dialect Vowel Systems.

Περίληψη

Εξετάσαμε την επίδραση του φωνητικού περιβάλλοντος στα τονισμένα φωνήεντα του Βορείου Ιδιώματος. Συγκεκριμένα, εξετάσαμε την επίδραση που έχει η αποβολή κάποιου γειτονικού άτονου υψηλού φωνήεντος στη διάρκεια και στους διαμορφωτές των τονισμένων φωνηέντων. Το υλικό στο οποίο βασίστηκε η μελέτη προέρχεται από αυθόρμητη παραγωγή λόγου μιας ομιλήτριας του ιδιώματος των Ιωαννίνων. Τα αποτελέσματα δείχνουν ότι τονισμένα φωνήεντα δίπλα στα οποία κάποιο άτονο φωνήεν έχει αποβληθεί (α) διαρκούν περισσότερο από τονισμένα φωνήεντα όπου δεν έχει σημειωθεί τέτοιου είδους αποβολή και (β) πραγματώνονται σε χαμηλότερες θέσεις στο φωνητικό πεδίο F1XF2 από αντίστοιχα φωνήεντα χωρίς αποβολή στο περιβάλλον τους. Επίσης η σύγκριση των διαλεκτικών φωνηέντων με αυτά της KNE έδειξε ότι τα πρώτα πραγματώνονται σε υψηλότερες θέσεις από τα δεύτερα. Πιο συγκεκριμένα, στη διάλεκτο η απόσταση μεταξύ υψηλών και μέσων φωνηέντων είναι μικρότερη από την ανάλογη απόσταση στην KNE. Με άλλα λόγια τα μέσαφωνήεντα της διαλέκτου πραγματώνονται υψηλότερα από αυτά της KNE, ακόμη και όταν είναι

τονισμένα. Το γεγονός αυτό διαψεύδει την υπόθεση ότι δεν υπάρχει ποιοτική διαφορά μεταξύ τονισμένων φωνηέντων στις διαλέκτους και στην ΚΝΕ.