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Angelos Lengeris

University of Kent

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Vowel raising, deletion and diphthongization in Kozani Greek

Angelos Lengeris, Evia Kainada & Nina Topintzi
Aristotle University of Thessaloniki

1. Introduction

Many studies conducted during the last years have documented the existence of extensive cross-dialectal differences in the acoustic characteristics of vowels (e.g. Clopper & Pisoni 2006; Clopper, Pisoni & de Jong 2005; Hagiwara 1997; Adank, Van Hout & Smits 2004, 2007). Research on the phonetics and phonology of vowels in Greek dialects is limited and mainly based on impressionistic analyses of dialectal speech (e.g. Chatzidakis 1905; Papadopoulos 1927; Newton 1972; Browning 1991; Kontossopoulos 1994). This study examines the acoustic characteristics of vowels in Kozani Greek, a northern Greek dialect, focusing on three phenomena that characterize the dialect, namely unstressed high-vowel deletion, unstressed mid-vowel raising, and stressed mid-vowel diphthongization.

The three aforementioned vocalic phenomena are typically found in northern Greek dialects and discussed in the impressionistic studies mentioned above, as well as in Trudgill (2003) and Dinas (2005). More specifically, northern Greek dialects delete the unstressed high vowels /i/ and /e/, e.g. /pijéni/ > [pijén] 'he/she goes'; raise the unstressed mid vowels /e/ and /o/ to /i/ and /u/ respectively, e.g. /peðí/ > /piðí/, 'child' /polá/ > /pulá/ 'many'; and diphthongize the stressed mid vowels /e/ and /o/, e.g. /péfto/ > [pjéfto] 'I fall'. In fact, according to Kontossopoulos (1994) and Trudgill (2003), the extremity of vowel deletion and raising can be used to classify northern Greek dialects into three categories. In *extreme Northern* dialects, unstressed high vowels /i, u/ are consistently deleted and unstressed mid vowels /e, o/ are consistently raised to /i, u/ respectively. In *Northern* dialects, unstressed high vowels /i, u/ are deleted in word final position and unstressed mid vowels /e, o/ are raised. Finally, in *semi-Northern* dialects, unstressed high vowels are deleted in word final position, but unstressed mid vowels are not raised. One of the goals of this study is to assign Kozani Greek to one of these categories based on an acoustic analysis of vowel deletion and raising.

Recent exceptions to the impressionistic descriptions of northern Greek dialects are Topintzi and Baltazani's (2012) work on Kozani Greek and Christou and Baltazani's (2010), Kainada and Baltazani's (2015) and Kainada and Baltazani's (2013) work on Ipiros Greek. These studies have shown that, contrary to what happens in Standard Modern Greek (SMG) whereby vowels are maximally dispersed (Jongman, Fourakis & Sereno 1989; Hawks & Fourakis 1995; Botinis, Fourakis & Hawks 1997; Fourakis, Botinis & Katsaiti 1999; Lengeris, Kainada, Baltazani & Iverson 2015) both in perception and production, the vowel systems of Kozani and Ipiros Greek are not symmetrical. Focusing on Kozani Greek, Topintzi and Baltazani (2012) found that (a) vowel deletion does not apply categorically even when conditions favour its application; (b) its phonetic output is gradient and involves a number of stages; and (c) there are asymmetries between /i/ and /u/ deletion, specifically /u/ deletes more than /i/. The current study extends Topintzi and Baltazani's (2012) work in Kozani Greek in two ways. First, apart from unstressed /i/ and /u/ deletion, it also examines unstressed /e/ and /o/ raising and stressed /e/ and /o/ diphthongization in the dialect. Second, while Topintzi and Baltazani (2012) examined read speech materials from a single Kozani Greek speaker, this study examined conversational speech from eight dialectal speakers. Speech materials were collected as part of VOCALECT (http://www.vocalect.eu/), a large-scale project that investigates the phonetics and phonology of vowels across Greek dialects.

2. Methodology

2.1 Speakers and speech elicitation

Eight speakers of Kozani Greek (4 female and 4 male, 77-88 years old) were recorded directly onto a laptop computer via a Blue Yeti USB microphone set at cardioid direction at a sampling rate of 44.1 kHz. Dialectal speakers conversed freely with a native speaker of the dialect about their childhood, work, hobbies etc. for around 30 minutes. None of the speakers had spent a period of more than six months away from his/her village prior to the recording.

2.2 Acoustic analysis

Dialectal speech materials were acoustically analyzed in PRAAT (Boersma & Weenink 2014). Based on waveforms and spectrograms, two phonetically trained annotators manually segmented 2,386 vocalic tokens from 2 minutes of speech from each Kozani Greek speaker and identified instances of unstressed /i/ and /u/ deletion, unstressed /e/ and /o/ raising and stressed /e/ and /o/ diphthongization. The first (F1) and second (F2) formant frequencies were measured at the centre of vowels when vowels were not deleted and at 25% and 75% of vowels in cases of diphthongization.

3. Results

3.1 Vowel deletion

Figure 1 shows the number of times the unstressed high vowels /i/ and /u/ were deleted by Kozani Greek speakers in initial, medial and final position in the word (and in monosyllabic words). Overall, /i/ tokens were more frequent than /u/ tokens in the corpus (531 tokens *vs* 118 tokens, respectively), which is a very common pattern in Greek (see e.g. Nicolaidis 2003; Protopapas, Tzakosta, Chalamandaris & Tsiakoulis 2012). Both /i/ and /u/ deletions were common in the corpus, with /i/ deletion being, overall, more frequent (55% of the time) than /u/ deletion (39% of the time). When considering the effect of position in the word on high vowel deletion, /i/ deletion was more frequent in final position (67% of the time) than in any other position (initial position = 7%, medial position = 46%, monosyllabic words = 37% of the time) and /u/ deletion was equally frequent in initial and
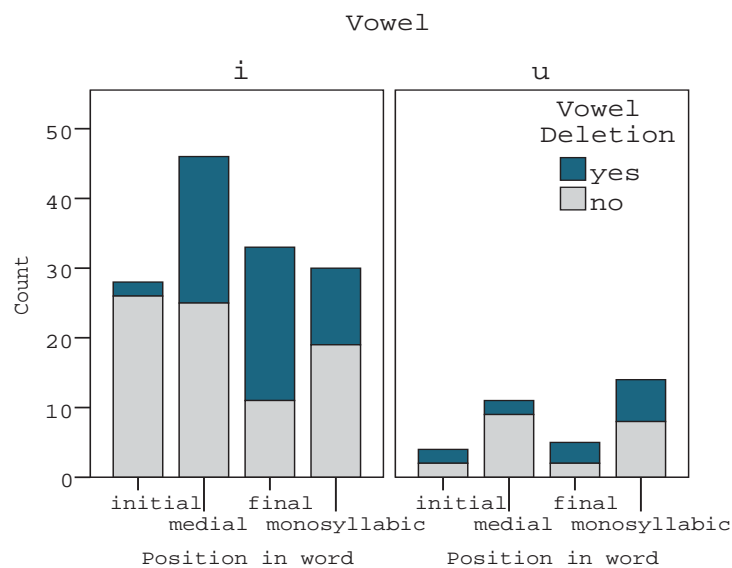

Figure 1: Number of times /i/ (left panel) and /u/ (right panel) were deleted in initial, medial and final word position and in monosyllabic words.
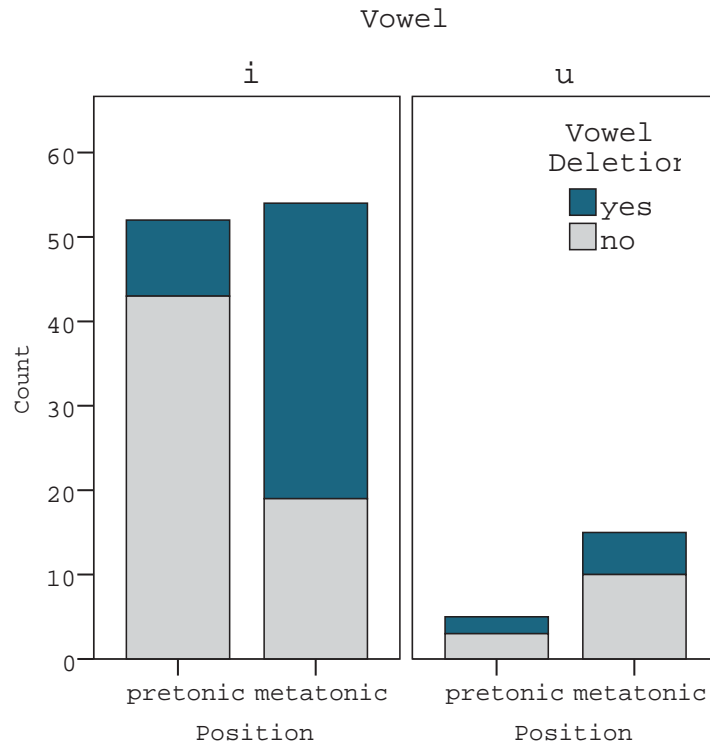
Figure 2: *Number of times /i/ (left panel) and /u/ (right panel) were deleted in pre-tonic and meta-tonic position.*

final position (both 60% of the time), followed by monosyllabic words (43% of the time) and medial position (18% of the time) (but note that because there were only a few /u/ instances in initial and final position these results should be treated with caution).

As regards the effect of position of stress on high vowel deletion, as can be seen in Figure 2, meta-tonic /i/ deletion was much more frequent than pre-tonic /i/ deletion (65% *vs* 17%). Similarly, meta-tonic /u/ deletion was more frequent than pre-tonic /u/ deletion (43 *vs* 34%) but, again, given the small number of /u/ instances these results should be treated with caution.

3.2 Vowel raising

Figure 3 shows the number of times the unstressed mid vowels /e/ and /o/ were raised by Kozani speakers in initial, medial and final position in the word (and in monosyllabic words). Overall, /e/ and /o/ occurred frequently in the corpus (512 and 456 tokens respectively). Both /e/ and /o/ were raised often, with /o/-raising being slightly more frequent (/o/ = 42% *vs* /e/ = 35%). In addition, /e/-raising was somewhat more frequent (42% of the time) in final than in any other position (initial = 22%, medial = 36%, monosyllabic = 28% of the time) while /o/-raising was largely equally frequent across positions in the word (initial = 44%, medial = 40%, final = 40%, monosyllabic = 45% of the time).

When considering the effect of stress on mid vowel raising, as can be seen in Figure 4, meta-tonic /e/-raising was much more frequent (43% of the time) than pre-tonic /e/-raising (23% of the time) while pre- and meta-tonic /o/-raising were roughly equally frequent (38 and 42%).

Figure 5 shows the positioning of unstressed raised and non-raised /e/ and /o/ in the vowel space (and the position of /i/ and /u/ for comparison). It can be seen that (a) raised /e/ differed from non-raised /e/ by having a lower F1 and a higher F2 and (b) raised /e/ was closer to /i/ than to non-raised /e/ (especially in terms of F1). Similarly, raised /o/ differed from non-raised /o/ by having a lower F1 and a lower F2 and (b) raised /o/ was closer to /u/ than to non-raised /o/ (again especially in terms of

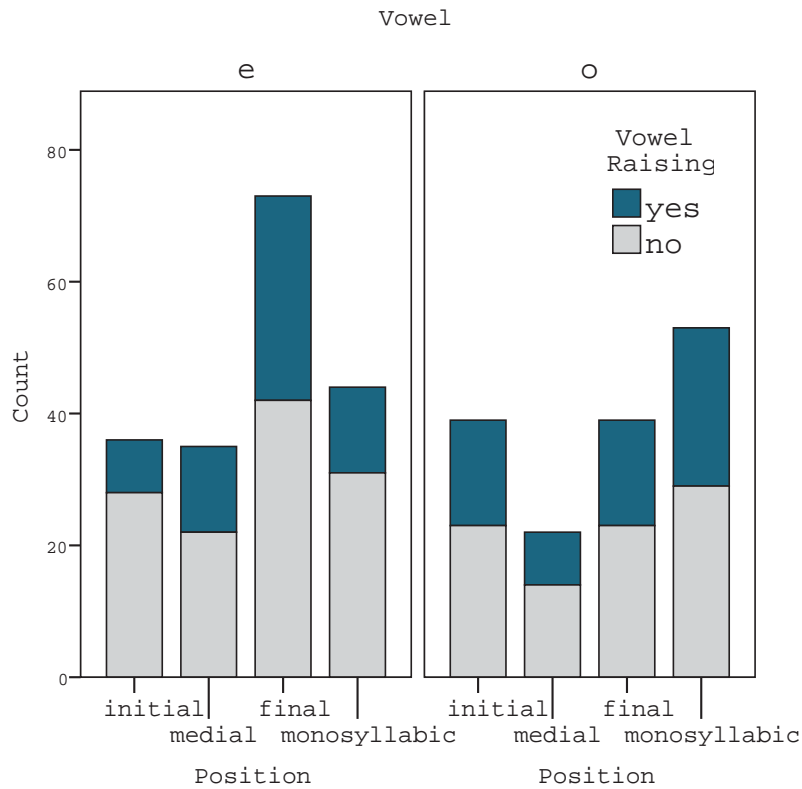F1 but also in terms of F2). The acoustic analysis therefore confirmed mid vowel raising in Kozani Greek.

Figure 3: Number of times /e/ (left panel) and /o/ (right panel) were raised in initial, medial and final position in the word and in monosyllabic words.
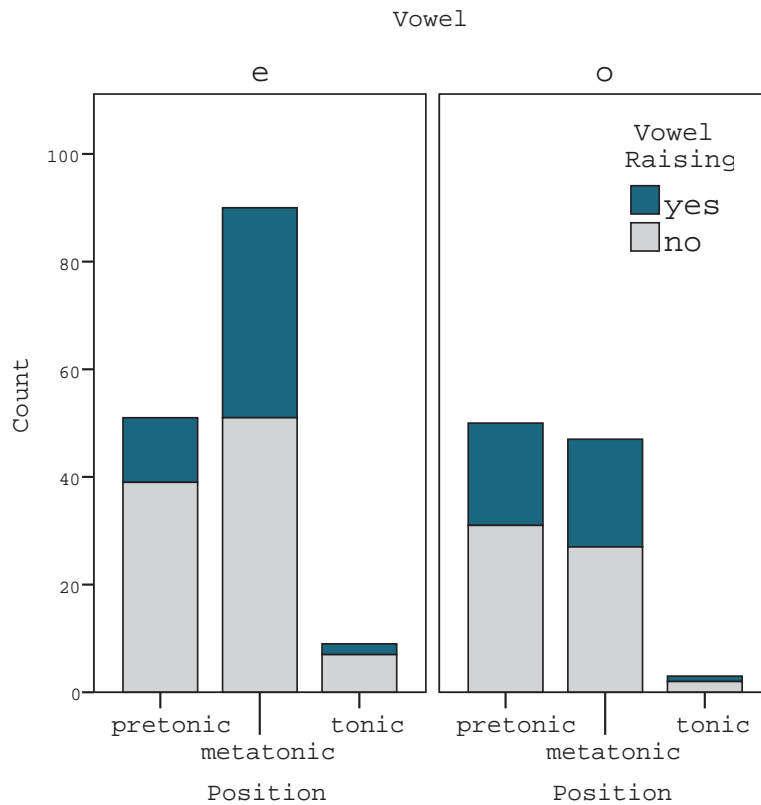

Figure 4: Number of times /e/ (left panel) and /o/ (right panel) were raised in pre-tonic and meta-tonic position.
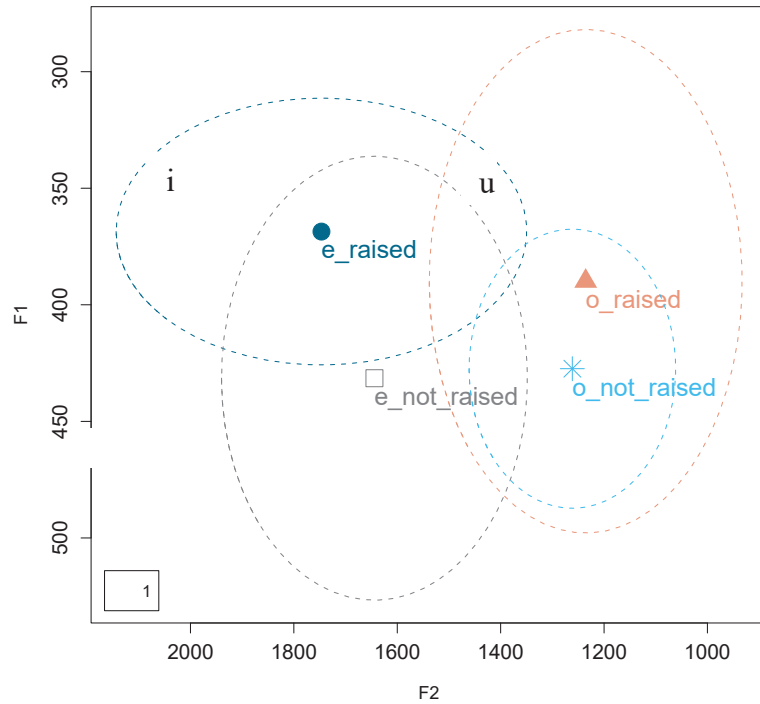
Figure 5: *Positioning of unstressed raised and not raised /e/ and of unstressed raised and non-raised /o/ in the vowel space (/i/ and /u/ are also shown for comparison).*

3.3 Vowel diphthongization

Figure 6 shows how many times the stressed mid vowels /e/ and /o/ were realized as diphthongs by Kozani speakers in initial, medial and final position in the word. Overall, vowel diphthongization was rare in the corpus; /e/ was diphthongized only in initial position (14% of the time); /o/ was diphthongized in all positions, specifically 14% of the time in initial position, 30% in medial position and 11% in final position.
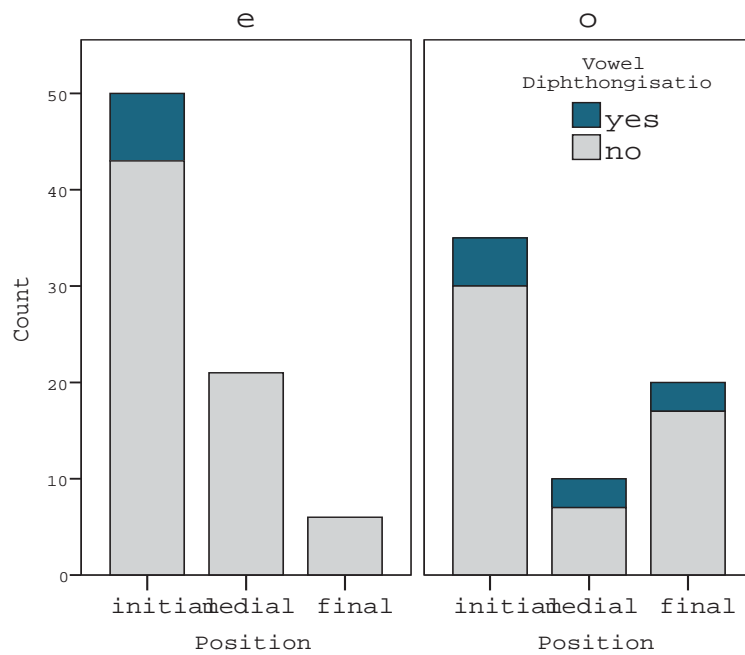

Figure 6: *Number of times /e/ (left panel) and /o/ (right panel) were diphthongized in initial, medial and final position in the word.*
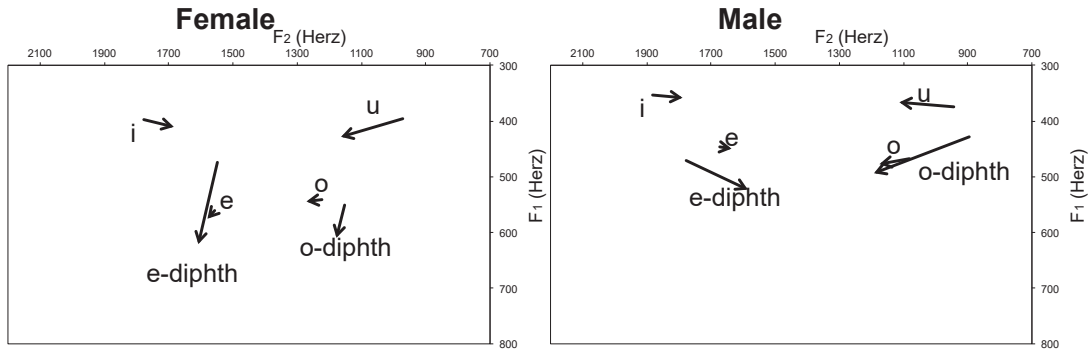
Figure 7: Direction of formant movement for diphthongized and non-diphthongized vowels produced by female (left panel) and male (right panel) Kozani speakers.

Figure 7 displays the direction of F1-F2 formant movement for stressed mid vowels /e/ and /o/ spoken by female (left panel) and male (right panel) Kozani speakers (and for high vowels /i/ and /u/ for comparison). The direction and magnitude of F1-F2 formant movement of mid vowels classified as diphthongized confirms this classification (see also Appendix I for mean beginning and ending F1 and F2 formant values).

3.4 Overall Kozani Greek vowel system

A final analysis concerned the positioning of the five Greek vowels spoken by female (left panel) and male (right panel) Kozani speakers in stressed and unstressed position. Vowels spoken by male SMG speakers in similar speech conditions (conversational speech) from Lengeris (2012) are also given for comparison (see also Appendix II for mean F1 and F2 formant values). It can be seen that unstressed vowels occupy a considerably smaller area than stressed vowels, which is expected in Greek (Baltazani 2007; Fourakis et al. 1999; Lengeris 2012). What is noteworthy in Kozani Greek is the degree of unstressed vowel reduction compared to SMG which can be observed when comparing our results with the results reported in Lengeris (2012); while both SMG and Kozani Greek unstressed vowels occupy a smaller vowel space area than stressed ones, the Kozani Greek unstressed vowel space is particularly small mainly because of mid vowel raising, but also because unstressed /a/ is also raised compared to the stressed /a/ (Figure 8, right panel).
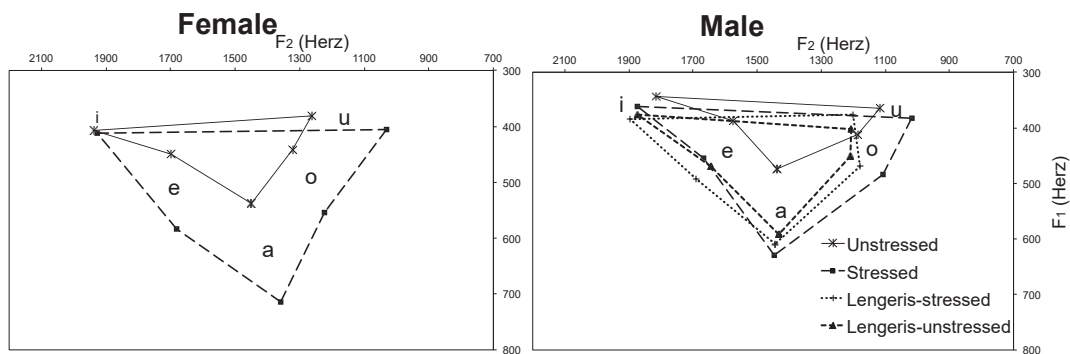

Figure 8: Positioning of the five Greek vowels spoken by female (left panel) and male (right panel) Kozani speakers. The positioning of SMG vowels from Lengeris (2012) are also given for comparison (see text for details).

4. Discussion

This study examined three well-known vocalic phenomena in Kozani Greek, unstressed high-vowel deletion, unstressed mid-vowel raising, and stressed mid-vowel diphthongization. Speech materials were drawn from conversations between eight dialectal informants and the experimenter, a native speaker of the dialect.

One main finding regarding the frequency of occurrence of the three vocalic phenomena was that unstressed high vowel deletion and mid vowel raising occurred frequently (but not always) in the corpus, while stressed mid vowel diphthongization was rare. Focusing on high vowel deletion, /i/ was deleted 55% of the time and /u/ 39% of the time; /i/ deletion was favoured in final position while /u/ deletion occurred approximately at equal frequency across position in the word; and both /i/ and /e/ deletion were more frequent meta-tonically than pre-tonically. These results are somewhat different to those reported in Topintzi and Baltazani (2012), also examining high vowel deletion in Kozani Greek. In their study, /u/ was deleted more frequently than /i/ (75% *vs* 43%), which is the opposite to what was found in our study and /u/ deleted more often pre-tonically, which was not the case in our study. Such differences can partly be attributed to the fact that, as mentioned in /section 1, Topintzi and Baltazani (2012) examined a single (male) Kozani Greek speaker reading a text while our study examined conversational speech from eight Kozani Greek speakers, both female and male. Perhaps more importantly, Topintzi and Baltazani (2012) used a looser term of vowel deletion that includes processes such as vowel devoicing, which elevated the number instances that were classified as deleted compared to our study.

As regards mid vowel raising, we found that /e/ was raised 35% of the time and /o/ 42% of the time, with /e/ raising being more frequent in final than in any other position and /o/ raising occurring at approximately equal frequency across position in the word. Meta-tonic /e/-raising was much more frequent than pre-tonic /e/-raising, while pre- and meta-tonic /o/-raising were roughly equally frequent.

The acoustic analysis of unstressed raised mid vowels /e/ and /o/ showed that they are very similar to underlying /i/ and /u/ respectively, confirming the impressionistic observation that they 'sound' very alike to /i/ and /u/. The acoustic analysis of stressed diphthongized /e/ and /o/ confirmed the characteristic for diphthongs F1-F2 formant movement. Future experiments, whereby Kozani Greek and speakers from other Greek dialects including SMG will be asked to identify raised and diphthongized /e/ and /o/ after contextual information has been removed, could provide further information on how dialectal pronunciations are perceived.

An examination of all five Kozani Greek vowels in the acoustic space supported the view that dialectal vowel spaces are not maximally dispersed and is consequently in line with a number of studies in Greek (Trudgill 2003) and other languages/dialects (e.g., Adank, Van Hout & Smits 2004, 2007; Clopper, Pisoni & de Jong 2005; Jacewicz, Fox, Holt & Salmons 2006; Recasens & Espinosa 2006). This is especially so, when one looks at the unstressed Kozani Greek vowel space area and compares it to the unstressed SMG vowel space area (Lengeris 2012).

Using the taxonomy proposed by Kontossopoulos (1994) and Trudgill (2003) (cf. section 1), Kozani Greek can on the face of it be classified as an extreme northern Greek dialect given that vowel deletion and raising were not restricted to the final position. At the same time, the non-obligatoriness of vowel deletion and raising in the dialect, is incompatible with a grouping alongside extreme northern Greek dialects. As discussed in Kainada and Baltazani (in press), rather than assuming three distinct categories it may therefore be preferable to assume the existence of a continuum whereby dialects are more or less prone to exhibit dialectal phenomena.

In sum, the results of the current study confirmed, using acoustic measurements, the application of high vowel deletion, mid vowel raising and mid vowel diphthongization in Kozani Greek and demonstrated how such phenomena result in an asymmetrical dialectal vowel system.

Acknowledgments

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Appendix I

	Female				Male			
	F1 beg	F1 end	F2 beg	F2 end	F1 beg	F1 end	F2 beg	F2 end
e	560	575	1556	1578	446	450	1672	1636
e diphthong	474	621	1547	1607	471	524	1778	1585
o	542	545	1222	1270	468	477	1082	1176
o diphthong	551	609	1152	1177	429	494	894	1192
i	398	410	1778	1685	353	359	1882	1789
u	396	429	971	1165	374	366	943	1114

Appendix II

	Female				Male			
Vowel	Stressed		Unstressed		Stressed		Unstressed	
	F1	F2	F1	F2	F1	F2	F1	F2
i	412	1927	408	1937	361	1872	344	1813
e	583	1682	450	1698	455	1666	387	1573
a	714	1359	538	1449	630	1446	474	1437
o	555	1222	441	1321	484	1106	412	1187
u	406	1031	381	1263	383	1018	365	1117
					Lengeris (2012)			
i					385	1895	376	1872
e					492	1690	470	1643
a					609	1444	592	1432
o					470	1179	451	1208
u					376	1200	403	1206