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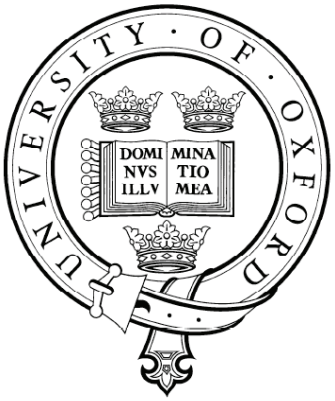

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Phonetic Variation in Spontaneous Speech: Vowel and Consonant Reduction in Modern Greek Dialects

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Abstract

The paper looks at phonetic variation in spontaneous speech in Athenian, Cypriot and Thessalian Greek. It is shown that while casual fast speech in all three varieties showed reduction of unstressed vowels and consonant lenition, the extent of these processes varied between the varieties. Therefore it is argued that although variation in time and effort is generally language-independent, it may be realized differently even in several varieties of the same language. The similarities between Greek dialects and the neighbouring languages suggest that language contact along with other factors may have contributed to the expansion of one of the variants which was also common to other languages involved in the contact.

Keywords

Greek Dialects, Phonetics, Segmental Reduction, Variation

1.0 Introduction

Human speech is inherently variable. Perkell (1990) discusses two major reasons for within-speaker variation in phonetics: the variability of the motor control system and speakers' adjustment depending on listeners' need for clarity of articulation. Due to the nature of the speech organs no sound can ever be pronounced in exactly the same way. Speakers also have a certain degree of control over the time and effort they 'invest' in various articulatory gestures depending on the situation in which the communication takes place. Lindblom (1990) describes such adjustment in terms of output-oriented control, or 'hyperspeech', and system-oriented control, or 'hypospeech'. On the one hand, system constraints require limiting what Lindblom (1983) calls 'energy expenditure per unit time', that is speakers tend to minimize articulatory effort to the extent that is possible. On the other hand, output constraints

ensure preservation of sufficient contrast necessary for lexical access and successful communication. The interaction between these constraints creates a continuum from clear speech, which requires greater articulatory effort (cf. Perkell, Zandipour, Matthies, & Lane, 2002 for experimental results), to quick casual speech, which shows greater tendency towards hypoarticulation and segmental reduction.

This study focuses on several specific cases of hypoarticulation common to faster speech. In vowels, shorter duration may lead to formant undershoot or greater assimilation of vowel to the adjacent segments. The resulting changes in quality are traditionally described as "vowel reduction" (cf. Lindblom, 1963; Moon & Lindblom, 1994). For consonants, less effortful articulation is often preferred in casual quicker speech leading to lenition of consonants. For example, stop consonants may be pronounced with incomplete closure or without closure (cf. Kirchner, 2001); intervocalic phonetically voiceless consonants are often phonetically voiced, in order to avoid the effort of "turning off" voicing and then "turning it on" again (cf. Ohala, 1983).

Barry and Andreeva (2001) suggest that such tendency for articulatory reduction is universal and language-independent. They analyzed spontaneous speech processes in six European languages including Greek and argued that the similarities between them were greater than the possible differences. Thus they found that all languages showed reduction of intervocalic clusters, lenition of stops, centralization of unstressed vowels and syllable loss. They conclude that comparable reduction phenomena are universal for all languages, at least in the context of the European languages covered in their study.

In this paper I will look at spontaneous speech processes in three regional varieties of Modern Greek in order to establish whether such processes are subject to regional variation or they operate universally as Barry and Andreeva suggested. The three varieties chosen for this study are Cypriot, Athenian and Thessalian Greek. Cypriot and Thessalian Greek represent respectively South-Eastern and Northern Greek dialects and show different treatment of most regional features (cf. for example Kontosopoulos, 2001; Newton, 1972b; Trudgill, 2003). Athenian Greek was chosen in order to provide some benchmark data which would be as close as possible to a natural colloquial form of Standard Modern Greek.

1.1 Vowel reduction in Modern Greek dialects

According to published descriptions, in Athenian and Cypriot Greek, the distribution of vowels is not dependent on stress (cf. Mackridge, 1985; Newton, 1972a) and all vowels can occur both in stressed and unstressed position without much variation in quality (Arvaniti, 1999a).

In contrast, in Thessalian Greek, like in most Northern Greek dialects, [o] and [e] are rare in unstressed position and usually alternate with [i] and [u]; etymological high vowels /i/ and /u/ are often dropped in unstressed position (cf. Papadopoulos, 1926; Tzartzanos, 1909). Thus χωράφι 'field' pronounced [xorˈafi] in Athenian Greek in Thessalian Greek appears as [xurˈafj], παιδί 'child' Athenian [peðˈi] corresponds to [piðˈi].

Nevertheless, some cases of vowel reduction have also been attested in areas outside the traditional Northern dialects area. Theophanopoulou-Kontou (1973), in her study of fast speech rules in Standard Modern Greek, refers to 'laxing' of unstressed high vowels as one of the general rules of the Modern Greek koiné, which occurs in almost all speech styles. According to Theophanopoulou-Kontou, unstressed /i/ and /u/ in all environments become shorter and 'lose a part of their sonority'. Devoicing or loss of unstressed /i/ and /u/ in Standard Modern Greek were also reported in experimental studies by Dauer (1980a) and Arvaniti (1999b). Chatzidakis (1892) noted that unstressed /i/ between consonants is sometimes lost also in Southern Greek dialects, for example in Crete; however, it cannot be compared to loss of /i/ in Northern Greek where it is much more regular. Recently Eftychiou (2007) reported that lenition of close vowels is very common in Cypriot Greek, at least in utterance final position.

Recent acoustic studies of vowel quality in Standard Modern Greek have shown that the difference in quality between stressed and unstressed vowels in this variety may also be greater than it is usually believed to be. Baltazani (2005) and Nicolaidis (2003) found that Standard Modern Greek shows a tendency for centralization of unstressed vowels as well as devoicing or loss of high vowels. Fourakis et al. (1999) and Nicolaidis (2003) also found upward shift of the vowel space for unstressed/shorter vowels in Standard Modern Greek.

1.2 Consonant lenition in Modern Greek dialects

Lenition of stop consonants has been reported both in Cypriot and in Athenian Greek. Newton (1972a) describes Cypriot voiceless stops as 'voiceless, unaspirated and quite lenis'; he notes that lenition is especially common near vowels, sonorants and /z/. In an experimental study of Cypriot geminates, Tserdanelis and Arvaniti (1999) noticed that single stops and affricates were lenited in intervocalic position, while geminates were not. However further investigation (Arvaniti & Tserdanelis, 2000) did not support this finding and there was no consistent difference either in the root mean squared amplitude (RMS amplitude) or in the difference in amplitude between first and second harmonic at the onset of the

following vowel (adopted as an indicator of the lenis-fortis distinction). Contrary to this finding, in a recent experimental study on Cypriot Greek by Eftychiou (2007), /t/ was most often pronounced as partially voiced stop. Other realizations included fully voiced stop, approximant and voiceless stops.

In one of the first experimental phonetic studies of Standard Greek, Dauer (1980b) noted that intervocalic consonants (especially /s/ and /t/) in casual speech and at rapid tempo may be voiced or partially voiced. Dauer found that the duration of consonants in Standard Modern Greek could be affected by stress, but there was substantial variation between speakers. Although medial voiceless stops may have longer durations in stressed syllables than in the unstressed syllables, this was not necessarily the case. Intervocalic stops in causal speech were voiced more often in unstressed syllables and in consonants with shorter durations. Dauer (1980b) also notes that stops between open vowels may be lenited, but only in very casual speech. In an experimental study of Standard Modern Greek stop consonants, Botinis et al. (2000) found that voiceless stops showed variability from partly voiced to completely voiceless. Greek consonants in spontaneous speech were also analyzed in a detailed articulatory study by Nicolaidis (2001), who found variation in the degree of constriction and the overall degree of contact in the pronunciation of plosive [t], depending on its duration. There were also tokens of [k] with incomplete velar constriction. Both [t] and [k] were often partially or fully voiced in intervocalic position or between vowel and voiced consonant.

2.0 Data and methodology

The present study is based on a data sample extracted from spontaneous monologues of 21 speakers: 7 speakers for each of the three varieties. The recordings were made respectively in Cyprus, Athens and Thessaly (Karditsa). All speakers in Cyprus and Thessaly were natives of the area; Athenian speakers have lived in Athens at least since the 1950s and did not show any noticeable regional features in their speech. The speakers in all three regions were selected following the same criteria: at the time of the recording all of them were over 70 years old; most speakers only had primary education, none of them had complete secondary education. The speakers were interviewed by the author in informal settings and were not instructed about the choice of language.

The data sample consisted of the same disyllabic words which occurred most frequently in all three varieties. The most frequent words were identified on the basis of a word index compiled for all recordings on the basis of orthographic transcription. The index consisted only of

nouns, adjectives, verbs and numerals. The data sample includes all occurrences of the chosen words in the recordings when they were part of a continuous monologue. Cases when a token was pronounced in isolation were excluded since they often filled the hesitation pause and thus showed specific rhythmic patterns. Tokens where the quality of the recording did not allow further acoustic analysis were also discarded.

The durations were measured manually on the spectrogram and double-checked on the waveform following the conventions suggested by Peterson and Lehiste (1960). Vowel amplitude was measured at 1 ms intervals and the highest value (peak amplitude) was used for the amplitude analysis. Peak amplitudes were normalized by dividing the absolute peak amplitude of each vowel by the peak amplitude of the word in which the vowel occurred. Formant frequencies were measured using Wavesurfer[1] speech processing software and manually checked against the spectrogram for accuracy. The formant frequency closest to the middle of the segment was used for further analysis. To compare the combine effect of both formants on differences between stressed and unstressed vowels, the Euclidean distance between stressed and unstressed vowels (ED_{stress}) was calculated using the following formula

$$(1) \qquad ED_{stress}=[(F1_{stressed}-F1_{unstressed})^2+(F2_{stressed}-F2_{unstressed})^2]^{1/2}$$

where $F1_{stressed}$ and $F2_{stressed}$ are the formant frequencies of the stressed vowel and the $F1_{unstressed}$ and $F2_{unstressed}$ are the formant frequencies of the unstressed vowel.

3.0 Results

3.1 Vowel reduction

Stressed and unstressed vowels were compared in words with vowels of the same phonemic quality in both syllables (285 tokens). The comparison of vowels within the same word reduced the impact of such factors as speech tempo or sentence stress. Unfortunately, the number of the most frequent words containing unstressed /u/ was insufficient for any statistical analysis.[2] Where possible the results obtained for two vowels within the same word were compared with those for vowels which occurred in a similar phonetic context in different words, since vowel

[1] http://www.speech.kth.se/wavesurfer/.

[2] The very low incidence of /u/ was also noticed by Nicolaidis (Nicolaidis, 2003), who excluded /u/ from some of her analysis of Greek vowels in spontaneous speech (cf. also Dauer, 1980a).

quality may depend on adjacent segments (cf. Perkell, 1990; Stevens & House, 1963).

In some tokens there was no proper vowel in the acoustic signal, preventing the measurement of formant frequencies. In all dialects vowel loss affected unstressed /i/ in /spˈiti/ *'house'*, which was omitted in 74% of cases in Thessalian Greek, 14% of cases in Athenian Greek and 10% of cases in Cypriot Greek. This shows that the so-called 'vowel loss' in Thessalian Greek does not affect all high unstressed vowels even within a given word. Furthermore, it also agrees with observations by Chatzidakis and Arvaniti and experimental results by Eftychiou (2007) that vowel loss is also present in Southern dialects, though it is not as common as in the Northern dialect. Words with vowel elision were excluded from further analysis and not included in the number of tokens given above.

A difference between stressed and unstressed /i/ (see Figure 1) was found only in Thessalian Greek, where the unstressed vowel appeared to be more central (F1 345 Hz vs. 362 Hz, F2 1517 Hz vs. 1812 Hz, Wilcoxon signed ranks test, $p<0.05$)[3]. In Cypriot and Athenian Greek there was no significant difference between the stressed and unstressed vowel. Furthermore, the Euclidean distance between stressed and unstressed /i/ in Cypriot Greek was significantly smaller than in the other two varieties (151 vs. 497 in Athenian and 505 in Cypriot, Mann-Whitney U test, $p<0.001$).

In Cypriot Greek unstressed /a/ (see Figure 1) was found to be closer to the centre of the vowel space than its stressed counterpart in the same word (F1 647Hz vs. 668 Hz, F2 1607 Hz vs. 1591 Hz, Wilcoxon signed ranks test, $p<0.05$). In Thessalian Greek unstressed /a/ had a lower F1 (713 Hz vs. 738 Hz, Wilcoxon signed ranks test, $p<0.05$) and lower F2 (1555Hz vs. 1659Hz, Wilcoxon signed ranks test, $p<0.05$). This supports the observation by Chatzidakis (1892) that the so-called vowel reduction in Northern dialects affects not only /o/ and /e/, but also /a/. There was no difference in formant frequencies of stressed and unstressed /a/ in Athenian Greek.

Comparison between stressed and unstressed /a/ in different words but in a similar phonetic context (after alveolars) revealed further differences. In Cypriot Greek comparison between stressed /a/ and unstressed /a/ after alveolar consonants showed a significant difference in F2 with the unstressed vowel being less retracted (1591 Hz vs. 1409 Hz, Mann-Whitney U test, $p<0.05$). Similarly in Athenian Greek unstressed /a/ had a lower F1; that is, it was slightly more centralized than stressed /a/ in the

[3] Although the mean F2 frequencies of stressed and unstressed /i/ differ by almost 300 Hz, this difference was not statistically significant (Wilcoxon signed-ranks test, $p=0.345$, cf. also quite large standard deviations for stressed and unstressed /i/).

same context (796 Hz vs. 660 Hz, Mann-Whitney U test, $p<0.05$). In Thessalian Greek unstressed /a/ had significantly higher F1 after velars than after alveolar: the difference between stressed and unstressed vowel was even greater if both vowels occurred after alveolars (738 Hz vs. 587 Hz for unstressed vowel, Mann-Whitney U test $p<0.001$). The mean formant frequencies of unstressed /a/ after alveolar consonants in Thessalian Greek (F1 587.26 Hz, F2 1433 Hz) were very close to the centre of the vowel space.

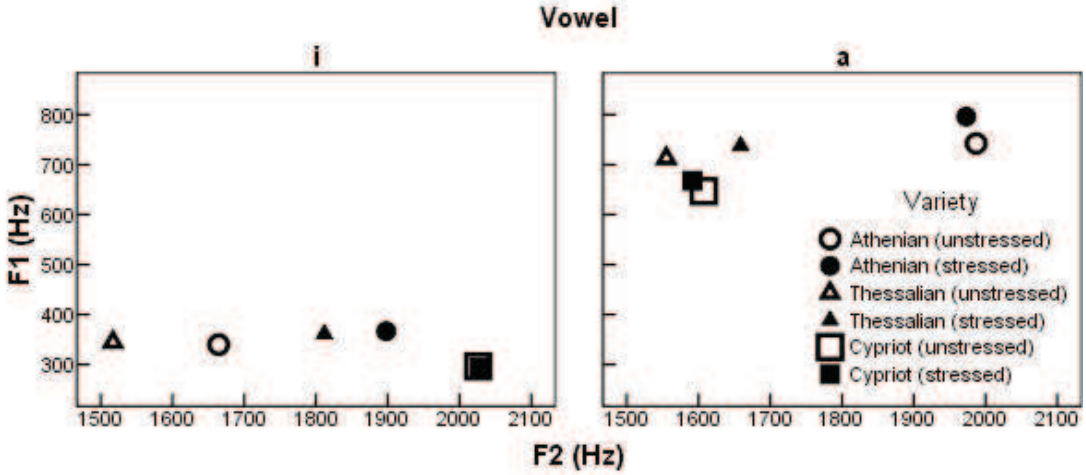

Figure 1: Mean formant frequencies (Hz) for stressed and unstressed /i/ (left) and stressed and unstressed /a/ (right) in all three varieties[4].

Unstressed /e/ (see Figure 2) differed from stressed /e/ in the same word in Cypriot and Thessalian Greek, although the difference was greater in Thessalian Greek (F1 ratio 1.3 vs. 1.09 Mann-Whitney U test, $p<0.001$). In Cypriot Greek there was a very small, but statistically significant difference in F2 between unstressed and stressed /e/ (1843 Hz vs. 1820 Hz, Wilcoxon signed ranks test, $p<0.01$), which was greater for unstressed vowels. As a result, unstressed /e/ was also more peripheral than stressed /e/. In Thessalian Greek as expected, there was a significant difference in F1 between stressed and unstressed /e/ (498Hz vs. 390Hz, Wilcoxon signed ranks test, $p<0.001$). Unstressed /e/ had a lower F1 and there was no statistical difference between the F1 of unstressed /e/ and stressed /i/. In Athenian Greek there were no significant differences between the quality of stressed and unstressed /e/ in a different phonetic context in the same word.

A comparison of stressed and unstressed /e/ when both were preceded by /p/ showed no difference in F1 or F2 between the stressed and

[4] In Cypriot Greek there was almost no difference between stressed and unstressed /i/ and therefore the markers overlap.

unstressed vowel in Cypriot Greek[5]. Unlike Cypriot Greek, the distinction between stressed and unstressed /e/ in Thessalian Greek was also preserved for vowels in different words, but identical phonetic context (Mann-Whitney U test, $p<0.001$). However, unstressed /e/ in Thessalian Greek differed in F2 from unstressed /i/ in the same phonetic context, with unstressed /i/ being more central (1517 Hz vs. 1728 Hz, Mann-Whitney U test, $p<0.05$). (It should be noted that the number of unstressed /i/ tokens was very small, since most unstressed /i/ in Thessalian Greek were elided). Notably, in Athenian Greek the F1 of unstressed /e/ was lower than in stressed /e/ in the same context (538 Hz vs. 479 Hz, Mann-Whitney U Test, $p<0.05$).

Cypriot Greek was the only variety where unstressed /o/ (see Figure 2) had a higher F1 than stressed /o/ (505Hz vs. 433 Hz, Wilcoxon signed ranks test, $p<0.05$); that is, unstressed /o/ was lower than stressed /o/. In Athenian Greek, (see Figure 2) there were no significant differences between the quality of stressed and unstressed /o/ in a different phonetic context in the same word. When the stressed and unstressed /o/ were compared in the same context, stressed /o/ had higher F1 than the unstressed /o/ (588 Hz vs. 508 Hz, Mann-Whitney U Test, $p<0.001$). As expected, in Thessalian Greek there was a significant difference between stressed and unstressed /o/ in both formant values (F1 495Hz vs. 425Hz, F2 1269 vs. 1095Hz, Wilcoxon signed ranks test, $p<0.001$). Unstressed /o/ had lower F1 and F2 and was more distant from the centre of the vowel space. This confirms that /o/ in Thessalian Greek is higher when in unstressed position. Nevertheless, there was a significant difference (Mann-Whitney U test, $p<0.001$) between the F1 of unstressed /o/ and stressed /u/. However, this difference is related to the difference in phonetic context between unstressed /o/ after a preceding velar consonant and stressed /u/ after a preceding labial consonant). Comparison of unstressed /o/ with the data for stressed /u/ in the same phonetic context showed no significant difference in F1 between the two vowels in this variety of Greek (Mann-Whitney U test, $p=0.879$). However, the F2 of stressed /u/ was lower than for unstressed /o/ (1041 Hz vs. 1438, Mann Whitney U test $p<0.001$); that is, unstressed /o/ was not quite as grave as stressed /u/. Due to the lack of tokens with unstressed /u/, it is not possible to say at this stage whether this difference would be preserved for unstressed /o/ and /u/.

[5] It should be noted that there was no significant difference in F2 of unstressed /e/ in different contexts.

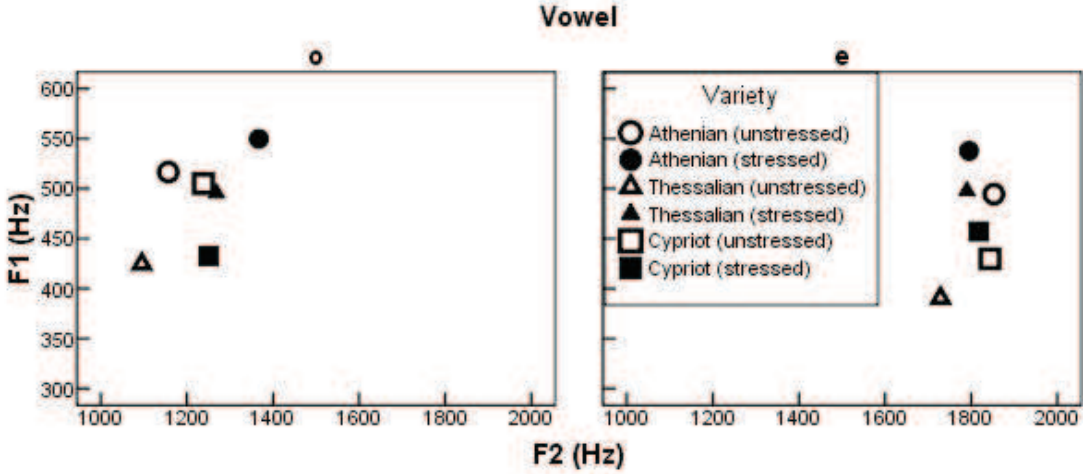

Figure 2: Mean formant frequencies (Hz) for stressed and unstressed /e/ (right) and stressed and unstressed /o/ (left) in all three varieties.

Acoustic analysis of formant frequencies of stressed and unstressed vowels in Thessalian, Cypriot and Athenian Greek has confirmed some earlier impressionistic descriptions. It has provided acoustic evidence for the so-called 'vowel raising', which is considered to be the most typical feature of the Northern Greek dialects. In Thessalian Greek unstressed /e/ differed significantly in F1 from the stressed /e/ and was similar to both unstressed and stressed /i/. Unstressed /o/ also had a lower F1 than the stressed /o/ and in a similar phonetic context was not distinguished from the stressed /u/. Both vowels in unstressed positions were higher than their stressed counterparts. However, it was found that in some cases mid vowels were preserved in unstressed position, that is vowel raising applies frequently, but not universally. Acoustic analysis showed that the two other vowels, /i/ and /a/, also differed in stressed and unstressed position, but in this case the unstressed vowel was more central than the stressed one (markedly for /i/, only slightly for /a/). In accordance with the previous descriptions, unstressed /i/ was elided in 74% of cases.

It was found that in Athenian Greek unstressed /e/ and /o/ had a lower F1 than the corresponding stressed vowel, but this difference was not consistent and depended on the phonetic environment. Unstressed /a/ in Athenian Greek also had a higher F1 than the stressed /a/.

In Cypriot Greek, unstressed vowels also differed from the stressed vowels, with the exception of /i/. The distance between stressed and unstressed vowels in Cypriot Greek was much smaller than in Thessalian Greek and unstressed vowels remained significantly different from each other. Notably, unstressed /o/ had a higher F1 and was more central than stressed /o/ only in Cypriot Greek. In the other two varieties unstressed /o/ had lower F1 than stressed /o/. Comparison of Euclidean distances between stressed and unstressed vowels for all varieties showed that the

stress effect was significantly smaller in Cypriot Greek than in the other two varieties (Cypriot Greek 165 Hz vs. Athenian Greek 321 Hz, Thessalian Greek 265 Hz, Mann-Whitney U test $p<0.001$).

Analysis of the correlations between vowel quality, vowel duration and vowel amplitude confirmed previously noted differences between stressed and unstressed vowels. It was found that in Athenian and Thessalian Greek, the higher F1 frequency of stressed /e/, /o/ and /a/ was correlated with longer duration and greater amplitude in comparison to unstressed vowels. Furthermore, in Athenian Greek variation in F1 of unstressed /e/ and /o/ was negatively correlated with duration; that is, the F1 of longer vowels was closer to the F1 of the corresponding stressed vowels. In Thessalian Greek this was the case for unstressed /a/, while the quality of unstressed /e/ and /o/ appeared to be independent of duration. Unlike Athenian and Thessalian Greek, Cypriot Greek exhibited little correlation between F1 and duration, but shorter vowels appeared to be more central than longer vowels.

3.2 Consonant lenition

Lenition of stop consonants was attested not only in Cypriot, but also in Athenian and Thessalian Greek. The data sample contained 628 tokens where stop consonants occurred in word-initial, although not necessarily phrase-initial, position. There were 355 occurrences of /p/, 215 occurrences of /t/ and 57 occurrences of /k/.

The percentage of cases when these consonants were pronounced with or without closure is shown in Table 1. In all varieties voiceless plosives were sometimes pronounced without closure. In most cases fricativization was accompanied by voicing, while stop consonants were usually voiceless. Though word-final /t/ was sometimes pronounced as a voiceless fricative, no such pronunciation was attested for word-initial /t/ in this data sample. Pronunciation with closure and voicing (voiced stop) only occurred in about 5% of cases in each variety, mainly after nasals and sometimes after vowels. Therefore in what follows I will focus on the distinction between voiceless stops and voiced fricatives or approximants.

Table 1: *Percentage of tokens pronounced with or without closure in three varieties of Greek.*

	/p/		/t/		/k/	
	Stop	No closure	Stop	No closure	Stop	No closure
Athenian	80.2%	19.8%	80.5%	19.5%	85.7%	14.3%
Thessalian	87.8%	12.2%	89.2%	10.8%	64.7%	35.3%
Cypriot	47.7%	52.3%	61.0%	39.0%	37.5%	62.5%

Table 1 shows that while in Athenian and Thessalian Greek all consonants were usually pronounced with closure, in Cypriot Greek the pronunciation without closure occurred as often or more frequently as the stop pronunciation (except for /t/, for which see below). The observed difference between Athenian and Thessalian Greek on the one hand and Cypriot Greek on the other hand was significant for all three consonants (chi-square test, $p<0.001$ for /p/ and /t/ and $p<0.05$ for /k/).

Interestingly, the pronunciation of these consonants did not depend on whether the token occurred after a pause or phrase-medially. Only in the case of /t/ in Cypriot Greek was the consonant more often lenited in phrase-medial position than phrase-initially (54% vs. 75%, chi-square test, $p<0.05$). In phrase-medial position, Cypriot Greek /p/ and /t/ were more often lenited in intervocalic position than when preceded by the consonant (61% vs. 33%, $p<0.001$ for /p/, 90% vs. 0%, $p<0.001$ for /k/). However, it should be noted that there were only 14 tokens of /k/ which occurred in phrase-medial position.

In Cypriot (and possibly Thessalian) Greek, consonants were more often lenited before unstressed vowels than before stressed vowels (58% vs. 41%, Chi-square test, $p<0.001$ for Cypriot Greek and 20% vs. 10%, $p<0.05$ for Thessalian Greek). The different stress pattern of tokens with /k/ and /t/ explains why in both these varieties /t/ was more often pronounced with closure than /k/.

In all three varieties consonants before stressed vowels were longer than consonants before unstressed vowels (Mann-Whitney U tests, $p<0.001$ in all cases), which agrees with the results reported for word-initial stop consonants by Botinis et al. (2001).

In Cypriot Greek, consonants pronounced with closure in some cases were longer than consonants pronounced without closure: /p/ before unstressed vowel 105 ms vs. 72 ms. (Mann-Whitney U test, $p<0.01$), /t/ before stressed vowel 95 ms vs. 56 ms (Mann-Whitney U test, $p<0.01$). However, one cannot talk about a consistent overall difference in duration between the two pronunciations. The difference in duration between different pronunciations was not consistent in all positions, except that /p/

in all varieties was longer before stressed vowels than before unstressed vowels.

It was also found that in agreement with results reported by Eftychiou (2007) for controlled speech, duration of consonants in Cypriot Greek depended on whether the following vowel was elided or not. Analysis of a further 84 tokens of /t/ in the word /spˈiti/ *'house'* showed that in Cypriot Greek there was a significant difference in the duration of the consonant depending on whether the final vowel was omitted or not (65 ms if the vowel was absent vs. 17 ms if the vowel was present, Mann-Whitney U test, $p<0.001$). In other varieties there was no significant difference, but it should be noted that in Athenian Greek the vowel was never omitted if the consonant duration was longer than 87 ms, which suggests the opposite relationships from the Cypriot Greek. In Thessalian Greek, where the vowel was omitted more often than in the other two varieties, the consonant was in most cases pronounced as a voiced fricative although its pronunciations as a voiced stop or a voiced fricative were also attested.

4.0 Discussion

Casual fast speech in Thessalian, Athenian and Cypriot Greek showed reduction of unstressed vowels and consonant lenition. At the same time, the extent of these processes varied between the varieties. In Thessalian and Athenian Greek, stop consonants lenition was less common than in Cypriot Greek, though unstressed vowels were usually reduced. In Cypriot Greek vowel quality showed almost no dependency on stress, while most stop consonants were lenited. Thus the observed differences between the varieties show that while variation in time and effort is generally language-independent, it may be realized differently even in several varieties of the same language.

Vowel reduction in Athenian Greek and consonant lenition in Cypriot Greek have not been attested in studies based on laboratory speech in these varieties, although the lenis quality of Cypriot consonants is mentioned in impressionistic descriptions. Therefore there is little doubt that in this case the pronunciation observed in spontaneous speech is the result of gestural undershoot of the articulatory target. However, in some cases hypoarticulation may eventually lead to a change of articulatory target. For example, in Thessalian Greek high vowels are pronounced instead of etymological mid vowels even in slow clear speech. Therefore it can be argued that in Thessalian Greek the reduction of unstressed vowels is no longer the result of more casual pronunciation, but has acquired conventional status (for futher discussion see Loukina, in press).

The idea that linguistic change originates in variation is not new (cf. for example Janse, 2000). Ohala suggested that in order to factor out variation, listeners apply what he called 'corrective rules' (cf. Ohala, 1981; Ohala, 1989, 1993). Inappropriate application of such rules may eventually lead to under-differentiation or over-differentiation of contrasts (cf. also Weinreich, 1968). The specific details of this model may differ. Thus Faber (1992) talks about the different sensitivity of listeners to small variation in speech rather than misperception as in Ohala's model. Blevins (2004) emphasizes that sound change occurs only when the results of gestural reduction or strengthening are re-interpreted and reproduced as new sounds. However, all these models share two basic assumptions: the inherent variability of speech production and categorical nature of speech perception, which may lead to structural changes in the sound system of the given language.

The results of this study showed that phonetic variation in the three varieties of Greek has taken different directions. Labov (1986) suggested that different direction of variation may be due to differences in properties of the specific linguistic systems and their development. The observed differences in spontaneous speech variation between the three varieties of Greek may be juxtaposed with other traits of the sound systems of these varieties. In Cypriot Greek consonants in general seem to be more prone to various reduction and strengthening processes than vowels or than the consonants of Athenian or Thessalian Greek[6]. Apart from the lenition of stop consonants, Cypriot also has geminates, which from a phonetic point of view can be described as fortis and which generally resist lenition in spontaneous speech. There is no such contrast in Thessalian, nor in Athenian Greek. It may be noted that other dialectal phenomena of Cypriot Greek which have not been discussed here have also sometimes been described in terms of weakening and strengthening. Thus according to some descriptions Cypriot shows (or used to show) loss of intervocalic fricatives, which can be seen as another case of lenition. On the other hand, consonant+/j/ clusters in this variety show occlusivization (that is strengthening) of /j/ to palatal stop [c] (cf. Drachman & Malikouti-Drachman, 1996; Malikouti-Drachman, 1999). On the contrary, in Cypriot Greek there is little difference in quality between stressed and unstressed vowels, but stressed vowels often lack acoustic prominence (Loukina, 2008). In this respect Cypriot Greek differs from Thessalian and Athenian Greek, where vowels in unstressed

[6] Chatzidakis (1892) suggested that the regional sound changes result from co-articulation in the Southern Greek and from greater prominence of stressed vowels in the Northern Greek. Notably, my results corroborate Chatzidakis' theory, though I argue that originally changes in both vowels and consonants are conditioned by hypoarticulation.

syllables are subject to reduction, while stressed vowels are consistently associated with acoustic prominence. In stressed syllables, Thessalian Greek vowels consistently had greater intensity than the unstressed vowels. Unlike Cypriot Greek, stressed vowels in both Athenian and Thessalian Greek stressed vowels mostly retain their acoustic prominence in spontaneous speech (Loukina, 2008).

The observed co-occurrence of consistent acoustic prominence of stressed vowels and vowel reduction on the one hand and gemination, lenition and relatively weak prominence of stressed vowels on the other agrees with previous typological observations about lenition and vowel reduction as historical processes. Martinet (1952), in his classic article on lenition, links Celtic lenition to phonetically weak accent and presence of gemination. On the other hand, vowel reduction is often associated with strong accent (cf. Van Coetsem, 1996 for discussion and multiple references). It is possible that the frequent co-occurrence of these features may be a result of causal relations between them, but an exact model of such interaction has yet to be developed.

Another factor that might have contributed to spread of one of the phonetic variants is language contact. Vowel reduction similar to the one described for Thessalian Greek has also been reported for eastern Bulgarian (cf. Pettersson & Wood, 1985; Tilkov & Boiadzhiev, 1981; Zhobov, 2004), eastern Macedonian (Sussex & Cubberley, 2006), Aromanian (Beis, 2001; Caragiu-Marioțeanu, 1968; Katsanes & Dinas, 1990; Kramer, 1989; Lazarou, 1986) and possibly Judeo-Spanish (Gabinsky, 1992). There also exists some evidence that Balkan varieties of Turkish display vowel reduction similar to the one found in Northern Greek dialects and some other Balkan languages, but it can not be considered conclusive at this stage (Brendemoen, 2002; Sawicka, 1997). In contrast, studies of Cypriot Arabic, Cypriot Turkish and Armenian do not mention vowel reduction of the type found in Balkan languages (Borg, 1985; Georgiou-Scharlipp & Scharlipp, 1997; Gürkan, 1997; Saracoğlu, 1989; Vaux, 1998).

Similarly, the systems of stop consonants of the contact languages for the three varieties of Greek show a clear division between what can be called ‘Balkan’ languages (Bulgarian, Macedonian, Albanian, Arvanitika, Aromanian and Judeo-Spanish) and ‘South-Eastern’ languages (Turkish, Arabic and Armenian). A voicing contrast is found in all “Balkan” languages, which distinguish between series of voiceless unaspirated plosives [p], [t], [k] and voiced plosives [b], [d], [g], at least in word-medial position. The only exception is Arvanitika, which has lost the opposition of voiced stops and nasal+voiced stop clusters, most probably under the Greek influence (cf. Hamp, 1961; Sasse, 1991). There is some evidence for lenition of stop consonants. According to Zhobov (2004) in

some Bulgarian dialects voiced stops may undergo optional spirantization in intervocalic position. In Judeo-Spanish like in Spanish /d/ in intervocalic position is pronounced as [ð] (Gabinsky, 1992). Noteworthy since the consonants are already voiced, in both cases lenition affects only manner of articulation.

All the contact languages of Cypriot Greek which are still spoken on the island show a contrast which is usually described as geminates vs. singletons, and probably a lack of a distinct voicing opposition for stop consonants. The system of stops of Cypriot Arabic according to Borg (1985) consists of 'voice-indifferent' unaspirated segments. Standard Turkish distinguishes between plain voiced and aspirated voiceless consonants (cf. Kornfilt, 1997). In an experimental study Kallestinova (2004) reported variation in voicing for orthographic voiced and voiceless stops in Istanbul Turkish. For Cypriot Turkish Gerogiou-Scharlipp and Scharlipp (1997) described variation in the voicing of stop consonants, which may also affect loanwords. Notably, in Turkish loanwords into Cypriot Greek Turkish voiceless stops correspond to Cypriot Greek geminates while Turkish voiced stops are represented as Cypriot Greek singletons (Newton, 1968): Cyp. [p^{h}ullin] *'stamp'* < Turk. pul, Cyp. [put^{h}in] '*thigh'* < Turk. but (cf. Standard Modern Greek μπούτι [bˈuti]). Western Armenian distinguishes between voiced plosives and voiceless aspirates (Vaux, 1998), that is lack of voicing is always concomitant with aspiration. In this respect Western Armenian differs from Eastern Armenian which also has voiceless unaspirated plosives.

The similarities between Greek dialects and the neighbouring languages suggest that language contact along with other factors may have contributed to the expansion of one of the variants which was also common to other languages involved in the contact. A similar mechanism was suggested by Friedman (1994) to explain some syntactic similarities between Balkan languages. Therefore the role of languages contacts in the development of Modern Greek dialects and possibly their contact languages was catalytic rather than causal: they enhanced the preference for one of the variants which already existed in the language.

This does not mean that the variation observed in Greek dialects will eventually result in structural changes as it may have happened for example in the case of Celtic lenition. As Kallen (2005) says, "general principles of phonology can at best only define points in the system which are open to change and establish probabilities that change will operate in a particular direction". At the same time it raises the question of the separation of 'phonetic variation' and 'structural' change and phonetics and phonology in general. The variation observed in the three varieties of Greek suggests the gradient nature of linguistic processes and

the importance of finer phonetic details for understanding the sound structure of a language or variety.

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