10th International Conference on Speech Prosody 2020
25-28 May 2020, Tokyo, Japan

Intonation of Greek–Turkish contact: a real-time diachronic study

Mary Baltazani[1], *Joanna Przedlacka*[1], *John Coleman*[1]

[1]Phonetics Laboratory, University of Oxford
mary.baltazani@phon.ox.ac.uk, joanna.przedlacka@phon.ox.ac.uk,
john.coleman@phon.ox.ac.uk

Abstract

In multilingual communities, contact varieties are characterized by a combination of linguistic features from the source languages. Speakers of Asia Minor Greek (AMG) cohabited with Turkish speakers for 800 years until the 1923 Convention Concerning the Exchange of Greek and Turkish Populations which forced a two-way mass migration between Turkey and Greece. This severed AMG speakers' everyday contact with Turkish. Many second- and third-generation heritage speakers of AMG now live in villages in Greece. In this diachronic study we examine the intonation of the continuation rise tune in the speech of two generations of AMG speakers: first-generation speakers born in the Anatolian peninsula and second-generation speakers born and raised in Greece. We examine whether contact effects in intonation persist after contact has ceased, through comparison of the f_0 patterns in the speech of the two AMG generations with those of Athenian Greek and Turkish speakers. Our findings show two patterns in the f_0 curve shape and pitch alignment of the continuation rises, one similar to the Athenian and one similar to the Turkish, indicating code-mixing. In addition, our results reveal that this dual patterning diminishes in the speech of second-generation AMG speakers, indicating intergenerational change towards a more Athenian-like pattern.

Index Terms: intonation, continuation rise tune, historical development, real-time diachronic data, curve fitting, intergenerational change

1. Introduction

There is increasing evidence that *ongoing* language contact results in intonational variation and change in the speech of bilingual speakers in different ways. Contact between some languages may result in prosodic transfer, which can be either phonological or phonetic [1], that is, influence the category of phonological tonal events (pitch accents and edge tones), or affect the way they are phonetically realised. For example, due to long-term contact with Italian, declaratives in Buenos Aires Spanish display the Italian early-peak rather than the Spanish late-peak alignment [2]. Similar findings are reported for peak alignment in Cuzco Spanish contrastive focus which, due to close contact with Quechua, appears later in the utterance than in Lima Spanish which had less contact with Quechua [3], as well as peak alignment in the speech of Dutch non-native speakers of Greek which shows patterns intermediate between the two languages [4]. Contact may also give rise to novel patterns attested in neither contextual language. The accents of Lekeitio Spanish, due to contact with Lekeitio Basque, are reported to blend the phonological pattern of Spanish rises, and not Basque falls, with the early phonetic alignment of Basque [5]. In addition to the above, bilingual speakers have been shown to code-switch. [6] examined the production of several tunes produced by German-Turkish bilinguals. She reports code-switched productions in the polar question tunes: when the Turkish question particle /-mI/ was inserted into a German matrix utterance, the question particle was produced with a falling (H*L) Turkish intonation f_0 contour.

Although it is amply shown that the intonation of bilingual speakers can combine elements from the languages they speak, evidence is still lacking on whether and how long such effects on intonation persist after contact has ceased, as few studies exist on the *diachronic* development of intonation [2; 7].

The study in this paper forms part of a broader project, [8], investigating the effects of historical contact on the diachronic development and cross-dialectal variation of intonation. Here we investigate the diachronic development in the intonation of the continuation rise tune in a variety of Greek originating in the area of Cappadocia in Asia Minor (see 1.1 for details). Specifically, we concentrate on the analysis of this tune as used by first- and second-generation heritage Asia Minor Greek (AMG) speakers in contemporary and archival recordings from the 1930s.

The intonation patterns in these two groups of speakers are compared with their counterparts in Turkish to bring to light any similarities that remain after the end of these speakers' contact with Turkish. In addition, since AMG speakers have been living in Greece for almost a century now, the two generations of AMG speakers are compared with each other and with Standard Modern Greek as spoken in Athens (henceforth Athenian) to detect possible intergenerational change over time.

1.1. Background on Athenian, AMG and Turkish

Athenian is the standard used for public communication, in education, and in the media. The variety of Turkish we describe below is the standard dialect as spoken in Istanbul and throughout Western Anatolia as a result of the levelling influence of the standard used in mass media and the Turkish education system since the 1930s ([9]).

The AMG variety examined here originated in Turkey, in a society where Turkish was the dominant language. AMG and Turkish speakers cohabited for eight centuries until 1923 when under the Convention Concerning the Exchange of Greek and Turkish Populations, two million people were forcibly displaced: 1.5 million Anatolian Greeks to Greece and half a million Hellenic Turks to Turkey. This heritage variety survives in villages in northern Greece.

Currently there are second- and third-generation speakers of AMG (children and grandchildren of refugees expelled to Greece in 1923) who, unlike their grandparents, no longer have everyday contact with Turkish. The sociolinguistic characteristics of these groups are very complex, because the speakers are bi- or multi-dialectal, using AMG alongside local varieties of Greek as well as Athenian as part of their linguistic

10.21437/SpeechProsody.2020-149

repertoire ([10], [11], [12]). First-generation speakers were born in Turkey prior to the 1923 Convention while second-generation speakers were born in Greece. After 1923 neither group had contact with Turkish.

2. Materials and methods

2.1. Data, speakers, and annotation

Unlike most autosegmental-metrical studies of intonation ([13], [14]) which are conducted in controlled experimental, laboratory settings, language contact studies draw on natural speech data because many of the sociolinguistic parameters that drive the behaviour of bilingual speakers are not well understood and cannot be replicated in the laboratory. Here we engage with natural speech corpora containing spontaneous and semi-spontaneous speech. The investigated utterances therefore vary in length, complexity, lexical makeup, syntactic structure and speech style, which includes conversations, interviews, and narratives (for details on the data sources see [15]).

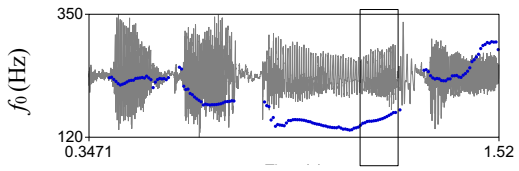
AMG speakers were divided into two groups (first- and second-generation; AMGgen1 and AMGgen2 respectively) based on their date of birth. We used the 1923 Convention on the Exchange of Populations as a reasonable cut-off point for the categorisation, so speakers born in Turkey before it were considered to be first-generation, while those born after it, second-generation. The two generations are therefore also characterized by different socio-linguistic circumstances. The first-generation AMG speech was drawn from archival as well as contemporary field recordings and the informants were born between 1900 and 1920. The second-generation speakers in our sample are close in age, born between 1929 and 1931.

The sample analysed in this study was produced by 24 speakers (Athenian: 3 female, 4 male, μ age = 46.2y; AMGgen1: 3f, 5m; AMGgen2: 1f, 2m; Turkish: 4f, 2m, μ age = 33.7y). It comprises 1127 continuation rise tokens (443 Athenian, 355 AMGgen1, 187 AMGgen2, 142 Turkish).

The sound files were transcribed, segmented and prosodically annotated in Praat [16], according to the principles of the Autosegmental-Metrical framework. The beginning and end of the stressed vowel in the nuclear word were annotated and the vowel start time was used to delimit a region of interest (ROI), stretching from the beginning of the vowel to the utterance end, on which our analysis was carried out (see 2.2).

2.2. Background on the tune

A continuation rise is defined as a phrase marked with an H tone on its right boundary, indicating the speaker has not finished speaking. In the Athenian continuation rise tune an L* nuclear pitch accent typically aligns with the stressed vowel, followed by an H- phrase accent ([17], [18], [19]; Figure 1 top). In the Turkish continuation rise tune a H*+L nuclear pitch accent is followed by a H- phrase accent ([20], [21], [22], [23]; Figure 1 bottom). The f_0 movement in the ROI is a simple rise in Athenian but a rise-fall-rise in Turkish.



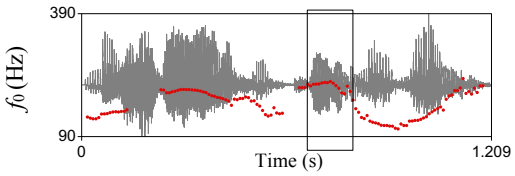


Figure 1: *Representative examples of the continuation rise tune in Athenian (top)* [triˈada ˈatoma muˈ**i**pane] *'Thirty people told me' and Turkish (bottom)* [maˈsaja oˈ**tur**madan] *'Before sitting at the table'. Rectangles indicate the nuclear vowel, transcribed in bold.*

2.3. Comparisons

For all comparisons, we examined the shape of the modelled f_0 curves to find differences in the location of peaks and troughs in the ROI, as well as the alignment of the trough (see 2.4 for details). Two comparisons were made: (a) *Recording date comparison*. First-generation speakers were recorded at different ages, some in their youth (archival recordings), others in their old age (contemporary recordings). Age at recording was considered to be a factor which may have affected their intonation patterns due to a different length of residence in a Greek-dominant society. We compared the archival and the contemporary recordings to determine whether the recording date made a difference to their intonation patterns, because speakers in the contemporary recordings group had been living in a Greek-dominant society for 80 years longer than the 1930s group. (b) *Diachronic comparison*. This was a comparison across the four varieties to determine the similarities of AMGgen1 and AMGgen2 to Turkish and Athenian.

2.4. Modelling of f_0

For each utterance f_0 was measured every 10 ms using ESPS *get_f0*. 10th-order polynomials $\hat{f_0} = \Sigma a_n t^n$ were fitted to f_0 contours using the GNU Octave [24] *polyfit* function; pitch errors were inspected and manually corrected. f_0 maxima and minima were calculated from the roots of the derivative $d\hat{f_0}/dt$.

Across the three language varieties, the same region of interest was defined for the subsequent analysis for maximal comparability. The shape of f_0 contours in the region of interest was modelled using 4th-order orthogonal (Legendre) polynomials (cf. [25]). The five coefficients of the resulting 4th-order polynomials which were fitted to the f_0 contours model their shape characteristics: from lowest to highest, c_0 is the average f_0 height of the contour; c_1 is its slope; c_2 models the shape as a parabola, concave down (or up if the sign is negative); c_3 models the shape as an N-like wave with a peak followed by a trough (or the reverse if the sign is negative); and c_4 as a more complex shape with more than one peak and trough. For the recording date comparison, an independent samples Mann-Whitney test was used to compare the values of the five coefficients, c_0 to c_4, in the archival and contemporary groups of AMGgen1 speakers, as well as the alignment of the polar question trough, which was expressed as the distance of the trough from the end of the nuclear vowel. For the diachronic comparison across the four language varieties, the same variables were tested using Kruskal-Wallis one-way analyses of variance [26].

2.5. Hypotheses

Based on the background for the continuation rise intonation in Athenian and Turkish, we expect any influence of Turkish on AMG to be revealed in the shape of the modelled curves mostly through similarity in the cubic coefficient, c_3, because Turkish displays a rise-fall-rise f_0 movement. In addition, we expect the alignment of the trough in the ROI to be relevant: the nuclear accent in Athenian is typically realized as a trough aligned within the nuclear vowel, while the trough in Turkish realises the trailing tone in the H*+L nuclear pitch accent and typically occurs after the end of the nuclear vowel.

H1, recording date: The influence of Turkish is expected to be greater in the archival than in the contemporary recordings. Turkish influence is expected to diminish in contemporary recordings due to longer contact with Greek (80 years between 1930 and 2011) and absence of contact with Turkish.

H2, diachronic development: The second-generation intonation patterns are expected to diverge more from Turkish than the first-generation ones.

3. Results

Overall, comparisons among the three varieties revealed a complex picture. Most AMG speakers produced continuation rises with both Athenian-like and Turkish-like patterns, as illustrated in the two examples in Figure 2, which were produced by the same speaker. More details of this dual patterning are presented in 3.2.

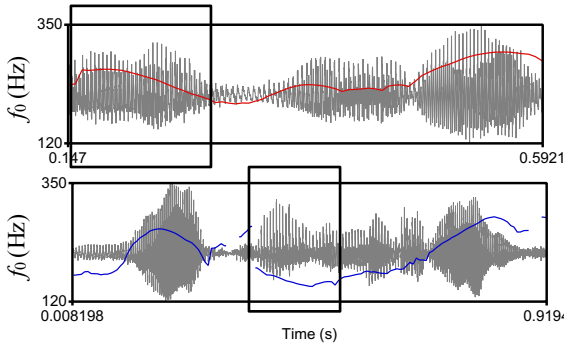


Figure 2: *Examples from the same AMGgen1 speaker producing a Turkish-like (top)* ['**e**fere] *'He brought' and an Athenian-like (bottom)* ['ðjo 'kamares] *'Two rooms' continuation rise. Rectangles indicate the nuclear vowel, transcribed in bold.*

Quantitative results on the recording date comparison are presented in 3.1 and on the diachronic development in 3.2.

3.1. Recording date comparison

Hypothesis 1 was not confirmed. A Mann-Whitney U test revealed no significant difference in the shape characteristics of the curve (e.g., for c_3, U= 13,452, p=.518; for c_2, U= 12,656, p=.129) or in the alignment (U=13,317, p=.427) between archival recordings (mean ranks c_3 = 173, c2 = 166, alignment = 184) and contemporary recordings (mean ranks c_3 = 181, c2 = 184, alignment = 175).

Therefore, all the data on first generation AMG speakers regardless of the recording date are pooled together in the subsequent analysis.

3.2. Diachronic comparison

An initial comparison of the continuation rise trough alignment in the four groups (Athenian, Turkish, AMGgen1, AMGgen2) revealed a distribution with two modes of alignment in the first-generation AMG speakers group (Figure 3, third panel from the top). Note that this bimodal pattern does not relate to date of recording, as is shown in 3.1, where no difference in trough alignment was found between the continuation rises from archival recordings and those from contemporary recordings.

To explore this further, the histograms of trough alignment P(t) in AMG generations 1 and 2 were modelled as a weighted sum of Gaussian probability density functions with means μ and standard deviations σ estimated from the Athenian and Turkish controls, and weights w_1, w_2 i.e.

$$P(t)_{AMG} = w_1\ \text{probdf}(t, \mu_{Ath}, \tfrac{1}{2}\sigma_{Ath}) + w_2\ \text{probdf}(t, \mu_{Tur}, \tfrac{1}{2}\sigma_{Tur})$$

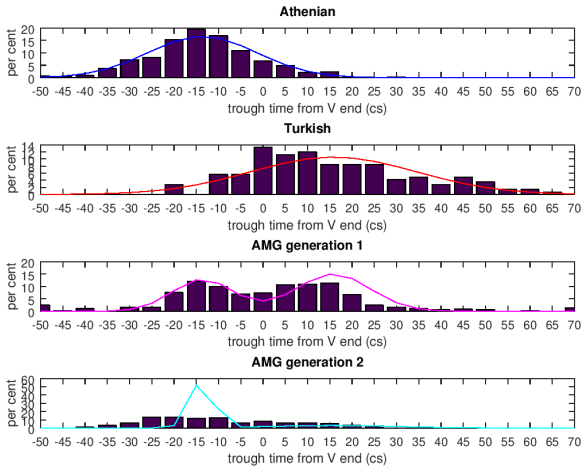


Figure 3: *Distribution of trough time with respect to V end, which is represented as 0 in the x-axis.*

These models are shown as coloured lines in Figure 3. The weights of the Athenian and Turkish components of the AMG histograms are shown in Table 1.

Table 1: *Weights of the Athenian and Turkish components of the AMG histograms.*

	AMGgen1	AMGgen2
w_1 (Athenian)	0.44237	0.78817
w_2 (Turkish)	0.55763	0.21183

This table shows that in AMGgen1 the two components are both strong, whereas in AMGgen2 the "Athenian" component strongly predominates.

In view of this bimodality, we re-ran the diachronic comparison after splitting the first-generation of AMG speakers' group into two subsets: 'early align' for tokens with values less than 0 and 'late align' for the rest. Five groups were compared—Athenian, Turkish, AMGgen1'early align' (AMGgen1E), AMGgen1'late align' (AMGgen1L), and AMGgen2. All six Kruskal-Wallis tests we ran, one for each of the five polynomial coefficients plus one for trough alignment, provided very strong evidence of a difference ($p < 0.001$)

between the mean ranks of at least one pair among the five language groups that were compared. Dunn's pairwise tests were carried out for all pairs of groups and all variables. In the interest of space, we report only on c_3 (see also Figure 4 top) and trough alignment (Figure 4 bottom).

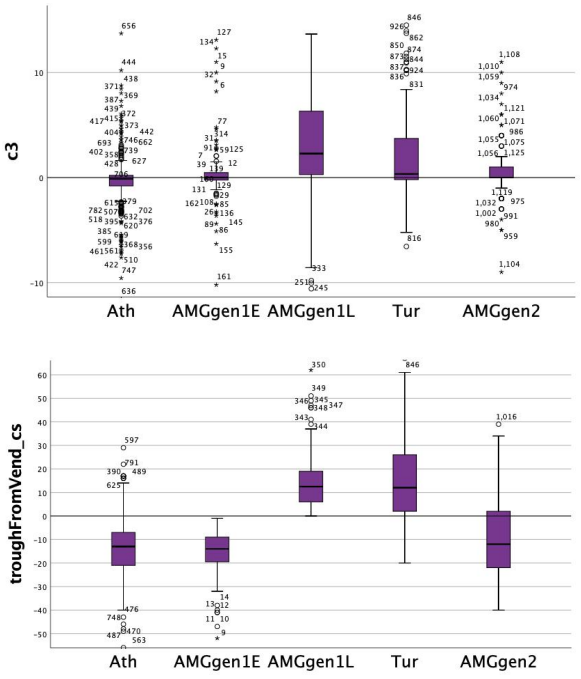


Figure 4: *Comparison of c_3 (top) and trough alignment (bottom) in continuation rises produced by Athenian, Turkish and two generations of AMG speakers. AMGgen1E = the 'early align' AMG first-generation speakers and AMGgen1L = the 'late align' ones.*

For c_3, there was very strong evidence of a difference ($p < 0.000$, adjusted using the Bonferroni correction) between AMGgen1L and all the other groups. There was no evidence of a difference between the other pairs. Each groups' mean and median c_3 values are also important for the interpretation of the results. As mentioned in 2.4, positive c_3 values model the pitch contour shape as a wave with a peak followed by a trough or the reverse if the sign is negative, while c_3 values near zero indicate an f_0 plateau. The mean and median c_3 values for Athenian were –.10 and –.13; for Turkish, 3.15 and .34; for AMGgen1E, .53, and .01; for AMGgen1L, 9.11 and 2.28; for AMGgen2, 2.74 and .00.

The trough alignment comparison provided very strong evidence of a difference ($p < 0.000$, adjusted using the Bonferroni correction) for all pairs except three: AMGgen1E and Athenian, AMGgen2 and Athenian, AMGgen1L and Turkish. Based on these findings, the five language varieties can be divided in two groups: AMGgen1E and AMGgen2 pattern with Athenian (mean alignment, –18.55, –9.19, –13.63 cs respectively), while AMGgen1L patterns with Turkish (mean alignment, 16.60 and 15.80 cs respectively).

4. Discussion

Our analysis showed that the intonation patterns in the continuation rise tunes in the speech of first-generation AMG speakers are different from those of second-generation speakers. The data reveal a pattern of diminishing proportion of Turkish pattern tokens in second-generation speech, and an evident shift towards a higher frequency of Athenian-type variants, suggesting intergenerational change. This change may have arisen due to different linguistic input when the speakers were growing up i.e. languages spoken in their community, their own familiarity with Greek and Turkish or a combination of those factors. The available metadata information for the archival recordings is incomplete, but it suggests that at least some of the first-generation speakers were Turkish bilinguals, although their level of proficiency cannot be established.

Two modes of trough alignment were discovered in the speech of the first-generation AMG speakers—one 'early', Athenian-like pattern within the nuclear vowel, and one 'late', Turkish-like pattern of trough alignment well after the nuclear vowel end. On the other hand, no such bimodality was found for the second-generation speakers, who mostly displayed the 'early' pattern. Modelling the distribution of trough alignment for AMG generations 1 and 2 as a weighted sum of the distributions of the Athenian and Turkish controls, confirmed the asymmetry of Turkish influence in the speech of the two generations. In generation 1 both the Turkish and Athenian components weighed equally, while in generation 2 there was a heavier Athenian component.

Analysis after splitting data by alignment showed that f_0 contours in the two subsets of AMGgen1 utterances had different shapes. The 'early alignment' utterances patterned with Athenian and AMGgen2 in alignment and in f_0 contour shape (esp. the c_3 coefficient). The 'late alignment' ones, on the other hand, patterned with Turkish, indicating that their intonation was heavily influenced by Turkish, with Turkish tune patterns being adopted in Greek utterances. The bimodality also suggests code-mixing, as speakers alternated between the Athenian and the Turkish pattern, illustrated in Figure 2. Strikingly, there is no correspondence between the two modes and the recording date, because alternating between the two patterns seems to be true for every speaker in generation 1.

Contrary to our expectations, hardly any change was detected in the use of the continuation rise patterns between the archival and contemporary recordings, separated by 80 years. Interestingly, the first-generation speakers in the contemporary recordings are not listed as speakers of Turkish, but self-report as familiar with the Standard Athenian variety. Despite this, and their long residence outside Turkey, their speech falls in line with the speakers in the archival recordings, establishing that they are not attriters. At least for the data we analysed here, the robustness of contact effects may be partly attributable to several factors: speakers' interest in keeping their heritage alive, the topics of discussion, or the fact that a member of the language community was an interlocutor.

Finally, the "more Athenian-like" patterns produced by the second-generation AMG speakers are not identical with Athenian variants (cf. Figure 4). Given the prestige of the standard dialect and negative attitudes towards AMG in Greek society, these forms may indicate a transitional stage in the progression towards normative Athenian patterns. To understand more about the nature of these variants, the intonation of later generations needs to be examined. Subsequent generations may show progressively more Athenian-like patterns but it is equally likely that they indicate an establishment of a local variant of the continuation rise tune, somewhat different from the Athenian one.

5. Acknowledgements

We would like to thank Dr. P. Karatsareas for the AMG data. The project is funded by the UK ESRC (ES/R006148/1).

6. References

[1] I. Mennen, "Phonetic and phonological influences in non-native intonation: an overview for language teachers," *Working Papers Queen Margaret University College 9*, pp. 1–18, 2006.

[2] L. Colantoni and J. Gurlekian, "Convergence and intonation: Historical evidence from Buenos Aires Spanish," *Bilingualism: Language and Cognition* 7.2, pp. 107–119, 2004.

[3] E. O'Rourke, "The realization of contrastive focus in Peruvian Spanish intonation," *Lingua* 122(5), pp. 494–510, 2012.

[4] I. Mennen, "Bi-directional interference in the intonation of Dutch speakers of Greek," *Journal of Phonetics* 32, pp. 543–563, 2004.

[5] G. Elordieta and N. Calleja, "Microvariation in Accentual Alignment in Basque Spanish," *Language and Speech*, *48*(4), pp. 397–439, 2005. https://doi.org/10.1177/00238309050480040401

[6] R. Queen, "Turkish-German bilinguals and their intonation: Triangulating evidence about contact induced language change," *Language* 88, 4, pp. 791–816, 2012.

[7] J. Hualde, "Romance intonation from a comparative and diachronic perspective: possibilities and limitations," in J. Auger, J. C. Clements & B. Vance (Eds.) *Contemporary approaches to Romance Linguistics*. Amsterdam: Benjamins, pp. 217–237, 2004.

[8] J. Przedlacka, M. Baltazani and J. Coleman, "Intonational variation and diachrony: Greek contact varieties," in S. Calhoun, P. Escudero, M. Tabain & P. Warren (Eds.) *Proc. 19th International Congress of Phonetic Sciences*, Melbourne, Australia. Canberra, Australia: Australasian Speech Science and Technology Association Inc, pp. 2739-2743, 2019.

[9] G. Campbell, *Turkish. Concise compendium of the world's languages.* London: Routledge. p. 547, 1995.

[10] M. Janse, "Greek-Turkish Language Contact in Asia Minor," in T. Tamis (Ed.) *Etudes Helleniques - Hellenic Studies* 17 (1): pp. 37–54, 2009.

[11] P. Karatsareas, *A study of Cappadocian Greek nominal morphology from a diachronic and dialectological perspective.* PhD dissertation. Cambridge: University of Cambridge, 2011.

[12] N. Vassalou, D. Papazachariou and M. Janse, "The Vowel System of Mišótika Cappadocian," in T. Georgakopoulos, T. Pavlidou (Eds.) *Proc. 12th International Conference on Greek Linguistics*. *2*: pp. 1139–1154. Berlin: Edition Romiosini, 2017.

[13] D. R. Ladd, *Intonational Phonology*. Cambridge: Cambridge University Press, 2008.

[14] J. B. Pierrehumbert, *The phonology and phonetics of English intonation,* PhD dissertation, MIT, 1980.

[15] M. Baltazani, J. Przedlacka and J. Coleman, "Greek in contact: A historical-acoustic investigation of Asia Minor Greek intonational patterns," in I. Kappa & M. Tzakosta (Eds.), *Proc. of the 7th International Conference on Modern Greek Dialects and Linguistic Theory*, Patras: University of Patras: pp. 49-58, 2019.

[16] P. Boersma and D. Weenink, "Praat: doing phonetics by computer" [Computer program]. version 6.0.43, retrieved 8 September 2018 from http://www.praat.org/

[17] A. Arvaniti and M. Baltazani. "Intonational Analysis and Prosodic Annotation of Greek Spoken Corpora," in S-A. Jun, (Ed.) *Prosodic Typology: The Phonology of Intonation and Phrasing*, Oxford: OUP, pp. 84–117, 2005.

[18] M. Baltazani, "Effects of stress on intonational structure in Greek," in R. Hoffmann and H. Mixdorff (Eds.) *Speech Prosody 2006*, Third International Conference, ISCA Archive, http://www.isca-speech.org/archive/sp2006, paper 156.

[19] M. Baltazani and S.-A. Jun, "Topic and focus intonation in Greek," in *Proc. of the XIVth ICPhS*, vol. 2, pp. 1305–1308, 1999.

[20] A. Göksel and C. Kerslake, *Turkish: A comprehensive grammar.* Routledge, 2005.

[21] C. Ipek and S.-A. Jun, "Distinguishing Phrase-Final and Phrase-Medial High Tone on Finally Stressed Words in Turkish," *Proc. 7th Speech Prosody International Conference*, Dublin, Ireland. 2014.

[22] S. Levi, "Limitations on tonal crowding in Turkish intonation," *Proc. Phonologica: 9th international phonology conference*, pp. 1–16, 2002.

[23] U. Özge and C. Bozsahin, "Intonation in the Grammar of Turkish," *Lingua* 120 (1), pp. 132–175, 2010.

[24] Octave community. 2013. GNU Octave 3.7+. Available online at: http://www.gnu.org/software/octave/index.html

[25] E. Grabe, G. Kochanski and J. Coleman, "Connecting intonation labels to mathematical descriptions of fundamental frequency," *Language and Speech* 50(3), pp. 281–310, 2007.

[26] W. H. Kruskal and W. A. Wallis, "Use of ranks in one-criterion variance analysis," *Journal of the American Statistical Association*, 47 (260), pp. 583–621, 1952.