Greek in contact: a historical-acoustic investigation of Asia Minor Greek intonational patterns

MARY BALTAZANI, JOANNA PRZEDLACKA, JOHN COLEMAN
Phonetics Laboratory, University of Oxford

1. Introduction

In ethnically complex societies individual bi- or multilingualism results in the emergence of contact varieties (Sankoff 2001). The effects of contact on the lexical and grammatical aspects of languages have been well documented, e.g. borrowing words, morphemes, syntactic structures or changing the phonetic quality of segments (e.g. Thomason 2001; Clyne 2003). Moreover, the field of historical acoustic phonetic studies has become increasingly popular in the past two decades, with most studies concentrating on segmental aspects of speech, especially vowels (see for example, Harrington *et al*. 2000; Hawkins & Midgley 2005; Wikström 2013). In this paper we present the pilot for a new project that seeks to expand this line of inquiry by examining the diachronic development of intonation, more specifically how long-term contact between ethnic groups shapes the intonation patterns of regional dialects.

The empirical focus in the present paper is Asia Minor Greek (AMG[1]). The morphological, lexical and syntactic diachronic development of AMG has been studied to some extent (e.g., Dawkins 1916; Drettas 1997; Galiotou *et al*. 2014; Janse 1998, 2008, 2009; Karatsareas 2011, 2016, 2017; Mackridge 1987; Michelioudakis & Sitaridou 2016; Ralli 2006, 2012; Revithiadou *et al*. 2006; Revithiadou & Spyropoulos 2012; Sitaridou 2014; Tompaidis, 1988). AMG used to be spoken on the territory of modern Turkey, in a society where Turkish was the dominant language, until the forced migration of most AMG speakers to Greece, following the 1923 Convention Concerning the Exchange of Greek and Turkish Populations. The dialect survives, scattered mainly across northern Greece[2]. It currently has second and third generation speakers (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, with the speakers being bi- or multi-dialectal i.e. using AMG alongside local varieties of Greek and Standard Modern Greek (SMG) as part of their linguistic repertoire (Janse 2009a, 2009b; Karatsareas 2011; Vassalou *et al*. (in press)).

To date, no phonetic or intonational studies of Asia Minor Greek have been conducted, to our knowledge. We focus on a single intonation contour of this variety, that of continuation rises, that is, the melody of phrases in declarative utterances ending in a high pitch, indicating non-finality (see section 2.2 for a detailed description). In the pilot study, we compared the continuation rise patterns of AMG with SMG and Turkish in a small sample of data to test our method. The hypothesis was that AMG intonational patterns will bear resemblance to Turkish ones as its speakers historically interacted with speakers of Turkish.

In what follows, we outline the method of the analysis tested during the pilot stage (section 2) and present some preliminary results in section 3. In section 4 we discuss plans to implement

---

[1] Although AMG is an umbrella term used for a number of geographical sub-varieties hailing from the Asia Minor peninsula (Janse 2009), from the point of view of intonation we refer to it as a single variety because the patterns investigated here are shared across AMG.

[2] But see Sitaridou (2014, 2016) for pockets of Greek speaking populations in Pontus.

a similar analysis in a wider project, with the goal to study the effects of language contact on the intonation of regional varieties over time

2. Method

We present the corpus we compiled during the pilot (2.1), describe the melody we analysed (2.2) and the method of analysis that we developed (2.3).

2.1 Data

The corpus compiled during the pilot comprises 85 hours of speech recordings of 188 speakers of AMG varieties (Cappadocia, Pontus, Istanbul, Smyrna), 66 hrs of SMG and 2½ hrs of Turkish speech[3]. The recordings come from institutional archives (Bibliothèque Nationale de France, Humboldt Universität Lautarchiv, the Academy of Athens digital library, The Committee for Pontian Studies) and field recordings from linguistic projects and individuals[4], made in recent decades in various locations in Greece and Asia Minor. We also collected material from YouTube videos of interviews with AMG speakers.

Due to the varied nature of the sub-corpora, the demographic information pertaining to the interviewees is far from complete. Figure 1 shows the birthplaces of the first generation AMG speakers in Turkey and the locations across Greece where the interviews were conducted with the first, second and third generation informants (markers show number of speakers per location).

Figure 1: *Map of Greece and the Anatolian peninsula. The markers show the AMG speakers' origins or the place the data were collected. Different shades of grey show the number of speakers per location.*

The data we have collected were recorded over the course of the 20th century. The oldest material, obtained from Humboldt Lautarchiv, forms part of the Wilhelm Doegen collection. These are recordings of prisoners of the First World War made in 1917, with the informants' birthdates going back to 1894. The youngest recorded speakers in the corpora acquired were born in the 1990s so the birth dates of the informants span a century. The bulk of the data comes from speakers born between the 1920s and 1940s. A detailed break-up of the speaker birthdates

---

is presented in Figure 2. The recordings vary in length from a few minutes to an hour and the material comprises a variety of speech styles, including short reading passages, word lists and sociolinguistic interviews with one or more informants.
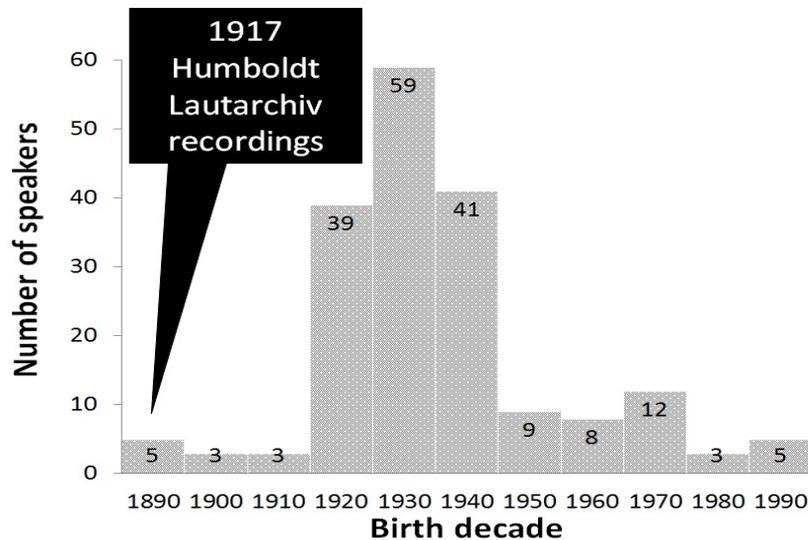
Figure 2: *AMG speakers in our corpus by birth decade.*

All the original sources were acquired as digital data, but they came in a wide variety of file formats (mp3, mp4 and wav; 2-channel or mono), bit rates or sampling rates (44.1 kHz, as for CDs, 22.05 kHz, or 16 kHz). A portion of the data was not immediately suitable for research as some recordings had been made from ¼ inch tape played at different speeds, which required speeding up or slowing down to be intelligible. A small number of recordings ran backwards on one channel. For the purposes of our analysis we converted all the material to 16 kHz, monophonic, uncompressed PCM .wav audio files.

2.2 The target melody

Within the AM model (Pierrehumbert 1980; Ladd 2008), the meaning of utterances is partly regulated by the synchronisation (termed *alignment*) of pitch landmarks like peaks (H tones) or troughs (L), with prosodic units like syllables (the pitch event then termed *pitch accent)* or small clause edges edge (*phrase accent*) or whole utterance edges (*boundary tone*). For example, "really" uttered in English with a high pitch might show surprise, but with a low pitch it might show disbelief. The melody of an utterance consists to a large extent of the sequence of its pitch accents and boundary tones. The description and classification of these landmarks and their contribution to meaning forms a key part of current models of intonation (Bolinger 1989, Hirschberg 2008, Pierrehumbert and Hirschberg 1990).

The melody we investigated is a continuation rise (Figure 3). This term refers in general to a high pitch or a rising tone at a clause boundary to signal a speaker's intention to continue or to hold the floor in a conversation, conveying incompleteness, more-to-come (Bolinger 1989, Hirschberg 2008, Pierrehumbert and Hirschberg 1990).

One of the reasons for choosing this melody is its ubiquitousness and therefore its abundance in natural speech corpora. In addition, intonational analyses of this melody exist both for Standard Greek and Turkish, facilitating the comparisons between AMG and the two other languages: Standard Athenian Greek continuation rises typically have a L* nuclear pitch accent, followed by a H- phrase accent (Arvaniti & Baltazani 2005; Baltazani & Jun 1999;

Baltazani 2006). Turkish continuation rises have been analysed as a sequence of a H*+L pitch accent followed by a H- phrase accent (Levi 2002; Özge & Bozsahin 2010).

The analysis of the corresponding AMG melody, outlined in 3 below, was based on a small sample, therefore it is tentative and it will need to be confirmed by statistical analyses of the whole corpus.

2.3 Method of analysis

The present pilot showcases a novel approach to intonation analysis, combines the insights of the mainstream Autosegmental-Metrical (AM) theory of intonational phonology with acoustic-phonetic comparisons of f_0 curves, whose shapes are mathematically and statistically modelled. The AM method is the first stage in our analysis. It provides the empirical knowledge essential for isolating patterns of discrete elements (like peaks and boundaries) in specific locations in an utterance. An example of this analysis is given in Figure 3 below. The white line shows an estimate of the fundamental frequency of the voice (f_0 trace). Phonological annotations of intonational events follow ToBI conventions.

Our preliminary analysis of the AMG continuation rise melody is a fall (tentatively a H*+L pitch accent) time aligned with the stressed syllable [ri] of the word [istoria] "story", followed by a H tone at the edge of the phrase.
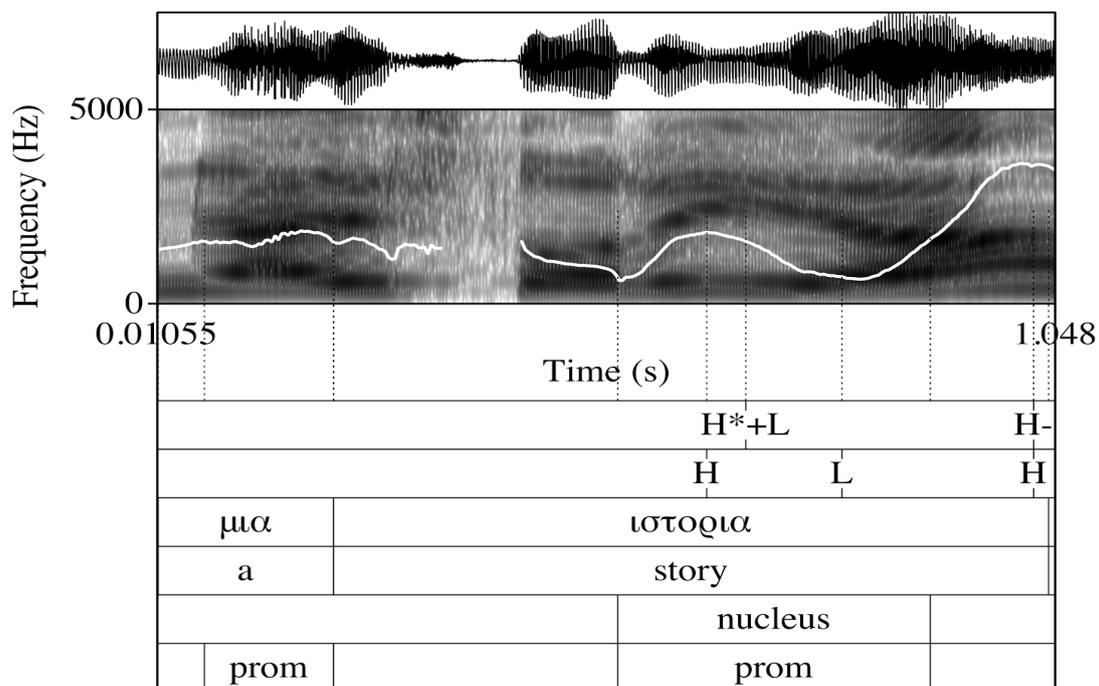
Figure 3: *An example of the AM analysis. Horizontal panels from top to bottom: 1) acoustic waveform of the phrase "μια ιστορία (a story)", uttered by a female AMG speaker; 2) spectrogram of the phrase and superimposed (white line) f_0, an estimate of the fundamental frequency (pitch) of the voice; 3) a phonological transcription of tonal events (H*+L pitch accent and H- phrase accent), time-aligned to the acoustic data; 4) a systematic phonetic transcription of the intonation, made according to the ToBI conventions; 5) a word-by-word transcription in ordinary (Greek) orthography; 6) a word-by-word English translation; 7) annotation showing the location the nucleus; 8) annotation of the location of prominent (stressed) syllables. Time is shown on the horizontal axis in the panel directly under the spectrogram.*

In the next step of analysis, the AM insights are used as a basis for mathematical modelling, applying a technique called Functional Data Analysis (Ramsay, Hooker & Graves 2010). FDA is a collection of statistical methods for analysing continuous data such as curves, signals, or

surfaces in a broad spectrum of disciplines such as physiology (growth curves), demographics (population variables), weather forecasting and more recently speech (Andruski & Costello 2004; Coleman *et al.* 2011). The first step in the analysis is functional data smoothing. This process converts raw discrete data points (in this case measured f_0 values) into a smoothly varying function. It emphasises patterns in the data by minimizing short-term deviation due to measurement errors or inherent system noise. Functional data also allow using information on the derivatives (rates of change) of the curves, which facilitate comparisons across languages, language varieties, gender, generations of speakers and other sociolinguistic or phonetic variables. A significant advantage of the FDA is that it augments the highly abstract and impressionistic AM analysis of intonation with quantitative, empirically testable models of tunes, allowing comparisons of large numbers of pitch curves of either whole utterances or their parts in corpora and also facilitating the study of melodic variability, co-occurrence patterns of tone combinations in melodies and frequency of occurrence. An example of FDA modelling is shown in Figure 4, which also presents our results.

The corpus-based approach (Taylor 2008) we employ also differs from that in most current intonation studies, which perform lab experiments with a small number of participants and controlled material. Instead, we engage with a large natural speech corpus, relying on statistical methods to allow patterns to emerge. Because of the great variability in speech, corpora need to be large enough to find tokens of any one target melody produced by many speakers in more than one speaking style (at least at slow, normal and fast speeds with low, normal, high voice, etc.), if the corpus is intended to reflect some common sources of variability. Despite the expected pattern variability for each melody, the size of our corpus is expected to allow for the most common patterns to be revealed (Zipf's law, Black 2009). The use of natural speech corpora is more ecologically valid than controlled laboratory speech, because data is collected in its natural context, with minimal experimental interference, and the large number of speakers is also more representative of the population studied. A further benefit of this method is that it can be applied to any language, in contrast to language specific controlled laboratory material.

This signal-oriented methodology also offers an improvement over the traditional comparative method of historical linguistics. It advances the scope of inquiry beyond the sound-letter correspondences afforded by written records, an essential step in an investigation of intonation. Importantly, it permits the examination of a primary source, the speakers' voices, freeing the investigation from the interpretation of transcribers, with their concomitant bias and errors.

Furthermore, this methodology will allow us to conduct, in the larger research project, a series of longitudinal studies to chart the course of influence of the donor languages on Greek dialects across time. The end of everyday contact with Turkish for the speakers born in Turkey and their descendants is predicted, in the sociolinguistic literature, to lead to dialect levelling or attrition i.e. the fading of influences for each subsequent generation (Cook 2003; Schmid & Köpke 2007). Evidence of attrition in the morphosyntactic characteristics of AMG has been presented in Vassalou *et al.* (in press). For other dialects, such as Cypriot, where the Greek-Turkish contact is on-going, attrition is not expected.

The longitudinal investigation will depart from the typical apparent-time methods in investigations of language change (Sankoff 2006), i.e. comparing contemporaneous data from different generations. Instead we will compare the Turkish influences across different generations in recordings from the early 1900s, through the mid-1900s and today, to develop a model of diachronic change of intonation and establish patterns of attrition. Especially for AMG, thanks to our extraordinary corpus, we are in a unique position to project real-time change spanning a century and five generations of speakers, something that will enable a dynamic view of the historical development of this variety. The data annotations will include recording date and speakers' age tags so that trends can be revealed, through statistical

processing, about the differences among generations of speakers emerging in the continuum cloud of data-points between two languages.

Finally, one of the goals in our wider research agenda is to investigate whether the intonation of each Greek regional variety will in addition reflect the different chronological and sociolinguistic characteristics of historical contact in the area. For example, the influences of Turkish on the intonation of AMG may differ from those on Cypriot Greek because of the different social nature of the contact. The 1923 relocation of Greeks to monolingual Greek soil severed everyday contact with Turkish for the speakers born in Turkey and their descendants. In contrast, Greek-Turkish contact in Cyprus is on-going, despite the division of the island by the diplomatic conflict for decades and crucially, and the dominant language in Cyprus is Greek.

As part of the larger project, we will compare the Turkish influences on Cypriot Greek and AMG respectively to determine which one is less extensive by correlating the chronological and sociolinguistic characteristics with the amount of intonational variability. Such questions are central to sociolinguistic research on language contact (Sankoff 2001), where socio-historical factors are thought to exert a causal influence in determining language contact outcomes (Thomason & Kaufman 1988; Thomason 2001; Clyne 2003). The corpus approach used in this project to answer them will bring valuable new quantitative evidence to an area of research that either lacks a quantitative perspective or rests on evidence from small corpora (Sankoff 2001).

3. Preliminary results

A small sample of recordings we analysed provides preliminary evidence of Turkish influences on AMG (Figures 4 and 5). AMG shows more similarities to Turkish than to SMG. Given the socio-historical circumstances of AMG, this resemblance is unlikely to be accidental. In future work we intend to confirm this outcome by statistical analyses of the whole corpus.
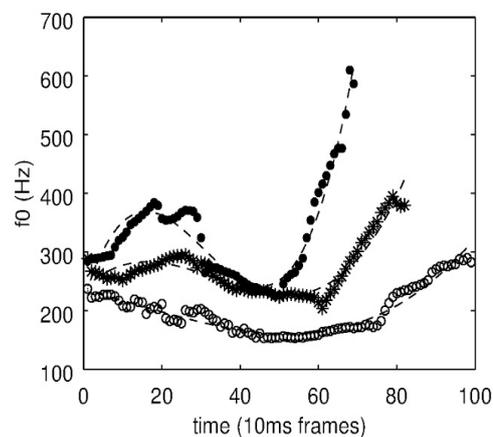
Figure 4: *The shape of sentence-final rising intonation (continuation rises) in the three varieties compared. Going from top to bottom, the black disks show the measured f0 of AMG, asterisks show the measured f0 of Turkish and open circles the measured f0 of SMG. Dashed lines show contours modelled using cubic polynomial basis functions ($y = a_1x^3 + a_2x^2 + a_3x + a_4 + \varepsilon$).*

Figure 4 shows continuation rises in Asia Minor Greek (black disks), Turkish (asterisks) and Standard Modern Greek (open circles). The pitch curve in both AMG and Turkish follows a rise-fall-rise pattern, while SMG lacks the initial rise, patterns that confirm the AM analysis in 2.2 and 2.3. In addition the final rise is shallower in SMG, while in Turkish and AMG the final rise is steeper and faster, with AMG displaying the highest final pitch value. Finally, in AMG the peak is higher and the fall steeper than in Turkish.

The small sample of data (N=41) we analysed demonstrates the success of modelling the shapes of the f_0 contours. Cubic polynomial basis functions (dashed lines) achieve a very good approximation to the observed pitch contours.
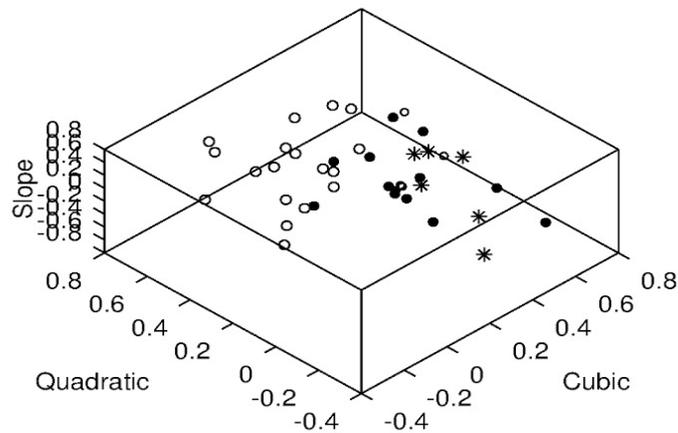
Figure 5: *Shape parameters of sentence-final rising intonation in SMG (open circles) vs. Turkish (asterisks). AMG examples are plotted as black disks, and can be seen to cluster more with Turkish rather than with SMG.*

A statistical analysis of the intonational variation in the shape parameters of the two melodies is shown in Figure 5. AMG sentence-final rising intonation examples (black disks) cluster more with Turkish (asterisks) rather than with SMG (open circles). This approach will be applied to address research questions in the larger project and compare the f_0 curves of the target tunes in each of four regional Greek varieties we intend to investigate with those from monolingual SMG, Turkish and Italian controls respectively.

4. Conclusion and future work

This pilot has investigated how contact between different languages, in our case Greek and Turkish, affects the intonation of a regional dialect (AMG), using archival recordings. Our preliminary results demonstrate the success of cross-variety comparisons of continuation rises, a frequently encountered intonational melody. The fact that the pitch curves of AMG bear a closer resemblance to Turkish than to SMG confirms that contact between different language families (in this case Turkish and Greek) affects regional variation, as predicted.

Applying the same methodology, we plan to extend this enquiry to other contact Greek varieties. We intend to empirically focus on the effects of Italian and Turkish on the development of intonation patterns (target melodies) in four varieties of Greek: Cretan, Asia Minor, Corfiot and Cypriot. These were chosen because their speakers historically interacted with speakers of Italian (Corfiot, Cretan) or Turkish (Asia Minor, Cypriot). SMG (as spoken in Athens) will serve as the basis of comparison. To obtain a more comprehensive picture of how regional intonation may have been affected by language contact, we extend our inquiries to include two further target melodies i.e. (a) declarative utterances ending in low pitch, indicating finality and (b) yes/no questions. We will also continue our research on continuation rises, investigating their shapes in the varieties listed above. These cross-dialectal comparisons form the synchronic aspect of our endeavour. Our project also has a diachronic component, and therefore we will also pursue two further research questions:

1) *How were the intonation changes affected by the temporal and sociolinguistic circumstances of contact with the hypothesised donor languages?* The social and historical circumstances of contact are unique for each of the four recipient Greek dialects chosen for this project. To

address the question, we will compare the extent of influence of each donor language on the two recipient dialects.

2) *To what extent do contact effects weaken with time after contact ceases?* In a series of longitudinal studies, we will compare the intonation patterns in recordings from the 1920s and 1950s with more recent ones for each of the dialects under investigation.

Regarding the diachronic aspects of the analysis, we are in a unique position not only to investigate the differences between the diachronic development of contact varieties, affected by the unalike socio-historical circumstances of the contact, but also to examine the attrition of contact influences (question 2). In the case of AMG, the return of a diaspora speech community to its homeland (paralleled in modern history perhaps only by the movement of around three million diaspora Jews to Israel after its establishment in 1948) constitutes a rare opportunity to study the evolution of a dialect under changing social circumstances, as it gradually converges to the political construction of a modern standard.

While diachronic phonetic changes are a well-known linguistic fact, to date hardly any attention has been paid to the diachronic development of intonation in any language. This omission is unsurprising, given that historical investigations have been relying on *written* evidence, which does not exist for intonation. Intonation is fundamental in human communication (Cutler *et al*. 1997), so it is crucial to understand its mechanisms of change. Unlike traditional diachronic investigations which compare written records or phonetic transcriptions, we focus on the quantitative acoustics of intonation, a pioneering direction in historical linguistics.

We envisage that the knowledge gained through this project will not only advance research on Greek dialectal variation, which is missing, but make important contributions to the broader discipline: The approach employed here will be applicable to other languages and thus expand the field of linguistic research into an exciting new area. Our work offers a novel methodological contribution to both diachronic linguistics and contemporary variationist work. We hope it will contribute to a better understanding of the nature of contact varieties and enhance general principles of linguistic theory regarding the role of language contact in historical change with the view to understanding better the role and weighting of factors contributing to languages changing over time.

Acknowledgements

References

Andruski, J.E. & Costello, J. (2004) Using Polynomial Equations to Model Pitch Contour Shape in Lexical Tones: An Example from Green Mong. *Journal of the International Phonetic Association 34 (2)*: 125-140.

Arvaniti, A. & Baltazani, M. (2005) Intonational Analysis and Prosodic Annotation of Greek Spoken Corpora. In: S.-A. Jun (Ed.), *Prosodic typology: The phonology of intonation and phrasing*. Oxford: OUP, 84-117.

Baltazani, M., & Jun, S.-A. (1999) Focus and Topic Intonation in Greek. *Proceedings of the XIVth International Congress of Phonetic Sciences*, vol. 2. San Francisco, 1305-1308.

Baltazani, M. (2006) Effects of Stress on Intonational Structure in Greek. In R. Hoffmann & H. Mixdorff (Eds.), *Speech Prosody 2006*, Third International Conference, ISCA Archive, http://www.isca-speech.org/archive/sp2006, paper 156.

Black, P.E. (2009) Zipf's Law. In: V. Pieterse & P.E. Black (Eds.), *Dictionary of algorithms and data structures* Available from: https://www.nist.gov/dads/HTML/zipfslaw.html. Accessed 23/06/2017.

Bolinger, D. (1989) *Intonation and its uses: Melody in grammar and discourse*. Stanford, California: Stanford University Press.

Clyne, M. (2003) *Dynamics of language contact. English and immigrant languages*. Cambridge: Cambridge University Press.

Coleman, J., Liberman, M., Kochanski, G., Burnard, L. & Yuan, J. (2011) Mining a Year of Speech. Paper presented at *VLSP 2011: New Tools and Methods for Very-Large-Scale Phonetics Research*, University of Pennsylvania.

Dawkins, R.M. (1916) *Modern Greek in Asia Minor. A study of dialect of Silly, Cappadocia and Pharasa*. Cambridge: C.U.P.

Delveroudi, R. (2000) La Variation Linguistique et la Formation de la Langue Nationale Grecque. In: A.F. Christidis (Ed.), *La langue Grecque et ses dialectes*. Thessaloniki: Centre de la Langue Grecque, 117-126.

Drettas, G. (1997) *Aspects pontiques*. Centre National du Livre. Association de recherches pluridisciplinaires.

Galiotou, E., Karanikolas, N., Manolessou, I., Pantelidis, N., Papazachariou, D. Ralli, A. & Xydopoulos, G. (2014) Asia Minor Greek: Towards a Computational Processing. *Procedia – Social and Behavioral Sciences 147*: 458-466.

Harrington, J., Palethorpe, S. & Watson, C. (2000) Monophthongal Vowel Changes in Received Pronunciation: An Acoustic Analysis of the Queen's Christmas Broadcasts. *Journal of the International Phonetic Association 30 (1-2)*: 63- 78.

Hawkins, S. & Midgley, J. (2005) Formant Frequencies of RP Monophthongs in Four Age Groups of Speakers. *Journal of the International Phonetic Association 35 (2)*: 183-199.

Hirschberg, J. (2008) Pragmatics and Intonation. In: L. Horn & G. Ward (Eds.), *The handbook of pragmatics*. Malden, MA: Blackwell, 515-537.

Janse, M. (1998) Cappadocian Clitics and the Syntax-Morphology Interface. In: B.D. Joseph, G.C. Horrocks & I. Philippaki-Warburton (Eds.), *Themes in Greek Linguistics II*. Amsterdam: Benjamins, 257-281.

Janse, M. (2008) Clitic Doubling from Ancient to Asia Minor Greek. *Clitic Doubling in the Balkan Languages:* 165-202.

Janse, M. (2009a) Greek-Turkish Language Contact in Asia Minor. In: T. Tamis (Ed.), *Etudes Helleniques - Hellenic Studies 17 (1)*: 37-54.

Janse, M. (2009b) The Resurrection of Cappadocian (Asia Minor Greek). *ΑΩ International online magazine 11*, Alexander S. Onassis Public Benefit Foundation: 11-15. http://hdl.handle.net/1854/LU-741991.

Karatsareas, P. (2011) *A study of Cappadocian Greek nominal morphology from a diachronic and dialectological perspective*. Ph.D. thesis. Cambridge: University of Cambridge.

Karatsareas, P. (2016) Convergence in Word Structure: Revisiting Agglutinative Noun Inflection in Cappadocian Greek. *Diachronica 33 (1)*: 31-66.

Karatsareas, P. (2017) The Development, Preservation and Loss of Differential Case Marking in Inner Asia Minor Greek. *Journal of Language Contact 10 (3)*. Forthcoming.

Ladd, D.R. (2008) *Intonational Phonology.* 2nd edition. Cambridge: C.U.P.

Levi, S. V. (2002) Limitations on Tonal Crowding in Turkish Intonation. *Proceedings of Phonologica: 9th international phonology conference*, 1-16.

Mackridge, P. (1987) Greek-Speaking Moslems of North-East Turkey: Prolegomena to Study of the Ophitic Sub-Dialect of Pontic. *Byzantine and Modern Greek Studies 11*: 115-137.

Michelioudakis, D. & Sitaridou, I. (2016) Recasting the Multiple-wh Typology: Evidence from Pontic Greek Varieties. *Glossa 1 (1)*: 1-33.

Özge, U. & Bozsahin, C. (2010) Intonation in the Grammar of Turkish. *Lingua 120 (1)*: 132-175.

Pierrehumbert, J. (1980) *The phonology and phonetics of English intonation*. Ph.D. thesis. Cambridge, MA: MIT.

Pierrehumbert, J. & Hirschberg, J. (1990) The Meaning of Intonation in the Interpretation of Discourse. In: P. Cohen, J. Morgan & M. Pollack (Eds.), *Intentions in communication*. Cambridge MA: MIT Press, 271-311.

Ralli, A. (2006) Allomorphy in Inflection: Evidence from the Dialects of Lesvos, Kydonies and Moschonisia. In: A. Ralli, B.D. Joseph & M. Janse (Eds.), *Proceedings of the Second International Conference of Modern Greek Dialects and Linguistic Theory*. Patras: University of Patras, 329-349.

Ralli, A. (2012) Morphology in Language Contact: Verbal Loan Blend Formation in Asia Minor Greek. In: M. Vanhove, T. Stolz, A. Urdze & H. Otsuka (Eds.), *Morphologies in contact*. Berlin: Akademie Verlag, 185-201.

Ramsay, J.O., Hooker, G & Graves, S. (2010) *Functional data analysis with R and Matlab*. New York: Springer.

Revithiadou, A., Van Oostendorp, M., Nikolou, K. & Tiliopoulou, M.-A. (2006) Vowel Harmony in Contact-Induced Systems: The Case of Cappadocian and Silly. In: M. Janse, B.D. Joseph & A. Ralli (Eds.), *Proceedings of the 2nd International Conference on Modern Greek Dialects and Linguistic Theory*. Patras: University of Patras, 350-365.

Revithiadou, A. & Spyropoulos, V. (2012) *Ofitika pontic: aspects of the grammatical structure of a pontic dialect*. Kyriakidis Publishers, Thessaloniki.

Sitaridou, I. (2016). Reframing the Phylogeny of Asia Minor Greek: The View from Pontic Greek. *CHS Research Bulletin 4 (1)*: 1-17.

Sitaridou, I. (2014) The Romeyka Infinitive: Continuity, Contact and Change in the Hellenic Varieties of Pontus. *Diachronica 31 (1)*: 23-73.

Sankoff, G. (2001) Linguistic Outcomes of Language Contact. In: P. Trudgill, J. Chambers & N. Schilling-Estes (Eds.), *Handbook of sociolinguistics*. Oxford: Blackwell, 638-668.

Sankoff, G. (2006) Age: Apparent Time and Real Time. *Elsevier Encyclopedia of Language and Linguistics,* 2nd edition.

Taylor, C. (2008) What is Corpus Linguistics? What the Data Says. *ICAME Journal 32*: 179-200.

Thomason, S. (2001) *Language contact.* Edinburgh: Edinburgh University Press.

Tompaidis, D.E. (1988) *The Pontic dialect.* Archeion Pontou.

Tzitzilis, C. (2000) Dialectes et Dialectologie du Grec Moderne. In: A.F. Christidis (Ed.), *La langue Grecque et ses dialectes.* Thessaloniki: Centre de la Langue Grecque, 83-90.

Vassalou, N., Papazachariou, D. & Janse, M. (in press) The Vowel System of Mišótika Cappadocian. In: T. Georgakopoulos & T. Pavlidou (Eds.), *Proceedings of the 12th International Conference on Greek Linguistics*.

Wikström, J. (2013) An Acoustic Study of the RP English LOT and THOUGHT Vowels. *Journal of the International Phonetic Association 43 (1)*: 37-47.