

## Cross-Linguistic Experiment on Prosodic Perception: Interrogative and Declarative Sentences in AMPER Madrid Corpus

MARÍA DOLORES RAMÍREZ VERDUGO  
LUISA ASTRUC-AGUILERA  
MARÍA BERTA MORÁN  
*AMPER-Madrid*

### Abstract

SP-ToBI (Beckman et al., 2002) has been used to a large extent as a unique and consensual system in many Spanish intonation studies (Kimura 2006, Sahyang, Andruski, Casielles, Nathan & Work 2006, Velázquez 2006, etc.). However, recent studies point out the existence of further pitch accent tonal sequences and alignments than those proposed in SP-ToBI (Prieto & Torreira 2004, Ramírez Verdugo 2005, Toledo, 2006). In fact, Face & Prieto (2006) claim for the need of revision of Beckman's preliminary system to allow for a wider and more realistic inventory of Spanish pitch accents. In this respect, Face and Prieto survey data on rising accents in Castilian Spanish to propose a three-way contrast rather than the assumed two-way contrast in rising accents. They even challenge the manner in which starredness has been commonly assigned to bitonal accents and propose an analysis based on the secondary association of pitch accent tones. To validate their theory, Face and Prieto (2006) call for experiments which examine speakers' perception degree of strong or weak saliency regarding rising accents. Such experiments could contribute to decide on whether such variation and contrast corresponds to different phonetic realizations or, on the contrary, it may refer to distinct phonological categories. Taking this background into account, this paper aims to bring some light to this dichotomy. The study explores the findings obtained in an experimental study on Spanish versus British speakers' perception of interrogative and declarative sentences in AMPER-Madrid Corpus. These research results reveal interesting cross-linguistic differences and similarities that will be explained under the light of previous studies on prosodic cues and theoretical foundations.

**Keywords:** Prosodic perception, interrogatives, declaratives, Spanish versus English cross-linguistic study.

## 1. Introduction

AMPER-Madrid project investigates the main prosodic features of the geolinguistic variety of Madrid Spanish focusing on its intonation structure and on the parameters of duration and intensity. Earlier studies were devoted to the prosodic description of speech production by male and female Madrid native speakers. The outcome of those surveys allowed us to classify tonal sequences and alignment into a preliminary taxonomy. (cf. Ramírez Verdugo, 2005; Ramírez Verdugo, Astruc & Morán, 2006; Ramírez Verdugo & Astruc, 2007a, 2007b). The analyses undertaken revealed that the realization of pre-nuclear and nuclear pitch accents displayed a wider prosodic variety than that postulated in prior studies (Quilis 1993, 1997; Sosa 1999 y Face 2003). Sosa, for instance, describes the tonal sequence in prenuclear accents as L\*H; and as L\*H% in nuclear accents in interrogative sentences. In declaratives, Sosa postulates the sequence L\*+H both for nuclear and prenuclear pitch accents. In our data, by contrast, the sequences L\*+H and H\*+L were commonly found in both pre-nuclear and nuclear Madrid pitch accents. The examination of this data suggests that the metrical structure of tonic syllables could also affect pitch accent tonal structures. This assumption was confirmed by results on tonal alignment and sequence postulated by earlier and recent studies (Toledo 2001 and 2003; Prieto & Torreira, 2004; Face & Prieto, 2006).

However, as Face & Prieto (2006: 20) recognize, in order to examine in detail this issue on diversity and on the nature of rising accents, a rigorous experimental research on speakers' perception needs to be conducted. Findings, it is hypothesised, will help us decide whether the nature of such variation is a matter of different phonetic realizations; or, on the contrary, it responds to distinct phonological representations. In this respect, recent studies on prosodic cues suggest that native speakers might be able to distinguish the mood of distinctive sentences by listening just to part of an intonation unit (cf. Cruz-Ferreira, 1987; Anderson-Hsieh, Johnson and Koehler, 1992; Guenther and Gjaja, 1996; Derwing and Munro, 1997; D'Imperio and House, 1997; Gussenhoven and Rietveld, 1997; Granström, House and Lundeberg, 1999; Nibert, 2000; Grabe, Rosner, García-Albea and Zhou, 2003; Schouten, Gerrits and von Hessen, 2003; Dorta and Hernández, 2004; Kochanski, Grabe, Coleman and Rosner, 2005; Martínez-Celdrán, Fernández Planas, van Oosterzee and Carrera-Sabaté, 2005; Boersma and Weenink, 2006; Brown, Kochanski, Grabe and Rosner, 2006; Estevas-Villaplan, 2006; Face and Prieto, 2006; Ramírez Verdugo, Astruc and Morán, 2006; Díaz Campos y R. Ronquest, 2007; Fernández Planas, 2007; Gauthier, Shi and Xu, 2007; Xu and Liu, 2007; Liu and Xu, 2007, etc.).

Taking this theoretical and empirical background into account, in the present experiment we were interested in examining the extent to which native Madrid speakers and non-native (Southern British) learners of Spanish were able to perceive and identify declarative out of interrogative contours being provided just with pre-nuclear prosodic cues. We assumed that if Madrid native speakers could distinguish the tone alignment in this initial accent scaling, it could indicate that declarative and interrogative pre-nuclear variation in scaling must correspond to a contrastive phonological category and not simply to a difference in its phonetic realization. Fig. 1 displays an example of declarative Madrid sentence while Fig. 2 shows a sample of an interrogative one. Specific details on research design and results obtained are presented in the following sections. We conclude this paper pointing out some hints for future research on the scope of Spanish intonation within the field of Romance languages.

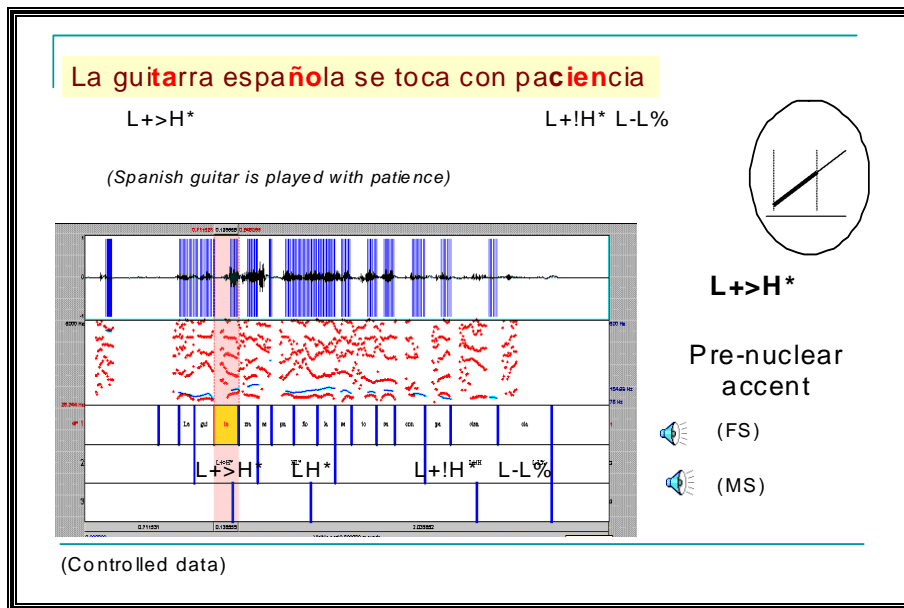


Figure 1. Example of declarative sentence from Amper-Madrid Corpus

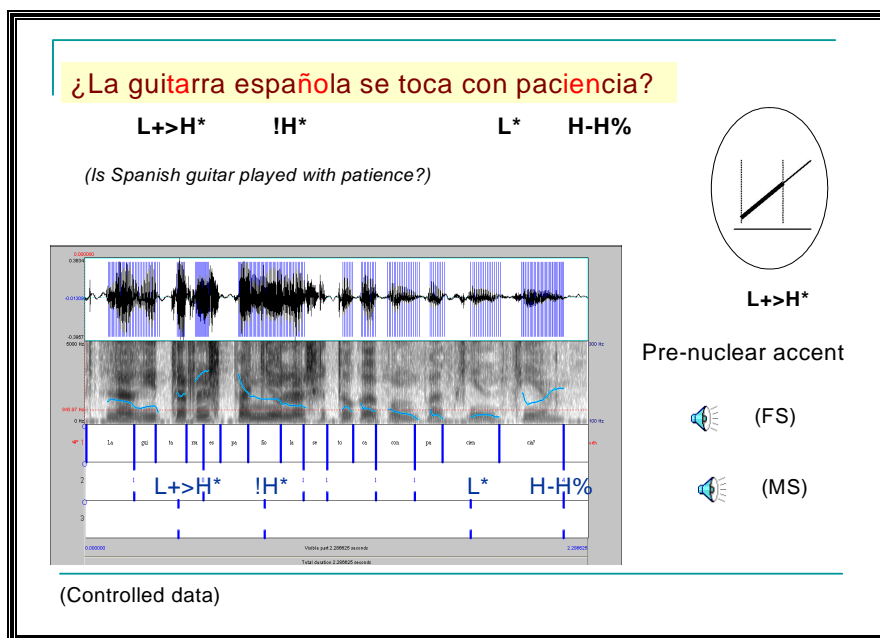


Figure 2. Example of interrogative sentence from Amper-Madrid Corpus

## 2. Research Design

As mentioned in the introduction, the present study belongs to AMPER-Madrid research project within AMPER matrix framework. The language variety under inspection is Madrid Spanish, a more reduced and narrowly Peninsular Central Castelian variety. The corpus for this first experiment corresponds to controlled acoustic data from Amper-Madrid produced by one male and one female Madrid native speakers. The acoustic input, hence, includes contours of declarative and interrogative sentences without extension and with extension both in the noun and verbal phrase. Table 1 illustrates part of the corpus used in this study.

Amper-Madrid Corpus	
Syntactic Structure	Declarative & Interrogative Sentences
N2 V N2	La guitarra se toca con paciencia
N2 Adj2 V N2	La guitarra española se toca con paciencia
N2 V N2 Adj2	La guitarra se toca con paciencia finita

Table 1. Sample sentences from Amper-Madrid corpus

for experimental study on prosodic perception.

### 2.1. Subjects participating in the perceptual experiment

A total of 34 subjects participated in this experimental study: 17 Madrid Spanish native and 17 British learners of Spanish. Table 3 reflects the homogeneity in sociolinguistic features of both language user groups. The experiment, as mentioned above, aimed at investigating Spanish native and non-native speakers' perception of Madrid Spanish declarative and interrogative sentences. Participants were told to listen to 12 input samples. Once they had heard the corresponding input (just the phrase '*la guitarra*'), subjects were requested to decide (by clicking on the option selected) whether the sample belonged to a declarative or an interrogative sentence.

Participants	
17 Madrid Spanish Speakers	Age: 20-40
	Sociolinguistic data: middle-class university students
17 Cambridge British learners of Spanish	Age: 20-40
	Sociolinguistic data: middle-class university students
	Advanced level of Spanish as a FL

**Table 3.** Participants in cross-linguistic experiment on prosodic perception

Our working hypotheses for this study on perception are listed below:

- Hypothesis 1: Native Madrid speakers are able to identify declarative out of interrogative contours based just on pre-nuclear tonal information.
- Hypothesis 2: Non-native (Southern British) learners of Spanish are able to identify declarative out of interrogative contours providing just pre-nuclear tonal information.
- Hypothesis 3: If H1 is validated, pre-nuclear tone scaling is phonological and not simply a phonetic feature. In other words, native speakers perceive pre-nuclear tones as phonologically relevant & contrastive.

Results, we hypothesized, would reveal whether these two language user groups perceived similar or differently declarative and interrogative specific prosodic cues. More specifically in this case, pre-nuclear pitch accent tonal sequence and tonal alignment. Table 4 displays a summary of Madrid Spanish acoustic taxonomy regarding pitch accents found in previous studies (Ramírez-Verdugo, 2005; Ramírez-Verdugo, Astruc & Morán, 2006; Ramírez-Verdugo & Astruc, 2007).

Tone Sequences in Madrid Spanish				
		Prenuclear	Nuclear	Edge Tones
Declaratives		<b>L+&gt;H*</b>	<b>(H-)L+!H*</b>	<b>L-L%</b>
Interrogatives (Polar Questions)		<b>L*+H</b>	<b>L*</b>	<b>H-H%</b>
		<b>L+&gt;H*</b>	<b>L+&gt;H*</b>	<b>H-H%</b>
	With sustained contour		<b>L+H*</b>	<b>L-L%</b>
			<b>L+H*</b>	<b>H-!H%</b>

**Table 4.** Madrid Spanish Prosodic Taxonomy: A summary of earlier studies on Amper-Madrid (Ramírez-Verdugo, 2005; Ramírez-Verdugo, Astruc & Morán, 2006; Ramírez-Verdugo & Astruc, 2007)

## 2.2. Statistical Analyses

In order to compare Madrid Spanish versus British learners of Spanish's perception several statistical analyses were conducted. One-way ANOVA technique was used to compare means of the two language user groups' perception. In order to control reliability, assumptions on distribution, independence and were considered and positively checked (Fisher's F-distribution): Responses were normally distributed; samples were independent; and finally, variances of populations were as part of the test of statistical significance. These statistical analyses were conducted with the support of SPSS software. The following section presents the results obtained.

## 3. Results

The analysis of the data indicates that there is a significant difference between Madrid Speakers' and British learners' of Spanish identification and distinction of declarative out of interrogative sentences ( $p = 0.08$ ). In other words, their ability to identify differences in pre-nuclear scaling seems to indicate that the differences in declarative and interrogative tonal alignment are perceived as

contrastive by native speakers to a higher degree than British learners. Table 5 presents results from descriptive statistics on the two language user groups' mean score and standard deviation.

**Descriptive Statistics**

Dependent Variable: Grade

Language	Mean	Std. Deviation	N
Spanish	86.2747	13.15712	17
English	75.9794	16.37351	17
Total	81.1271	15.53117	34

**Table 5** Spanish speakers vs. British learners' mean scores and standard deviation.

Table 6 displays the results on Fisher's F-distribution test. It shows that responses were normally distributed, samples were independent and variances of populations were as part of the test of statistical significance. Table 7 presents the results obtained in one-way ANOVA. Finally, Table 8 shows data on reliability tests performed.

**Tests of Between-Subjects Effects**

Dependent Variable: Grade

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	900.941 <sup>a</sup>	1	900.941	4.084	.052	.113
Intercept	223774.389	1	223774.389	1014.386	.000	.969
Language	900.941	1	900.941	4.084	.052	.113
Error	7059.226	32	220.601			
Total	231734.556	34				
Corrected Total	7960.167	33				

<sup>a</sup>. R Squared = .113 (Adjusted R Squared = .085)

**Table 6.** Data on reliability tests (F- distribution)

Dependent Variab	(I)Nat.	(J)Nat	Mean Diff.(I-J)	Std. Error	Sig (a)	95% Confidence Interval for Difference(a)	
						Lower B	Upper B
Time	Eng	Span	.31	.94	.74	-1.62	2.25
		Eng	-.31	.94	.743	-2.25	1.623
Grade	Eng	Span	-15.82	5.53	.008	-27.19	-4.44
		Span	15.82	5.53	.008	4.44	27.19

**Table 7.** Madrid speakers' v. British learners' Comparisons

Interestingly, a difference was detected between upper-intermediate and advanced British learners of Spanish in their perceptual experiment mean scores. In fact, advanced level learners were able to approximate Madrid speakers' rating to a large degree. This would mean that the higher the linguistic knowledge speakers may have the better perception of meaningful contrast they have. For upper-intermediate learners of Spanish the prenuclear tonal alignment corresponds simply to phonetic variation. Madrid speakers and advanced Spanish learners, by contrast, do distinguish such variation as belonging to different phonological categories.

RESULTS		Grade	Nationality	Time-taken
Grade	Pearson Correlation	1	.506(**)	.177
	Sig. (2-tailed)		.005	.368
	N	29	29	28
Nationality	Pearson Correlation	.506	1	-.065
	Sig. (2-tailed)	.005		.743
	N	29	29	28
Time-taken	Pearson Correlation	.177	-.065	1
	Sig. (2-tailed)	.368	.743	
	N	28	28	28

**Table 8.** Data on Pearson test analysis

#### 4. Discussion & Conclusion

In this experiment we intended to check whether Madrid Spanish speakers and British learners of Spanish were able to identify similarly different sentence moods being provided only with pre-nuclear tonal information. The results obtained reveal that Madrid Spanish speakers are able to identify declarative out of interrogative contours to a significantly larger extent than the group of British learners of Spanish participating in the study.

These research results reveal interesting cross-linguistic differences and similarities that could be explained under the light of previous studies on prosodic cues, as mentioned above, and theoretical foundations which support this research outcome (cf. Nespor & Vogel, 1986; Pierrehumbert & Steele, 1989; Pierrehumbert & Hirschberg, 1990; Ladd, 1996; Brazil, 1997; Hirst & Di Cristo, 1998; Snow, 1998; Beckman et al., 2002; Face, 2004;



Gussenhoven, 2004; Hirschberg, 2004; Jun, 2005; Face & Prieto, 2006; Prieto et al., 2007; etc.).

The findings obtained would imply that the variation in the pitch accent scaling must be phonological rather than phonetic, as it seems to be in other languages such as English. In order to check this hypothesis, an experiment on native and non-native speakers' perception was carried out. However, to be able to raise a solid conclusion on this issue, further research is needed. Future acoustic and experimental studies will, first, contribute to a complementary analysis of Madrid Spanish, and secondly, we hope, advance in SP-ToBI description and taxonomy. That investigation would help draw a more complete picture of the prosody of Romance languages, a field where much research is still needed.

## 5. References

- ANDERSON-HSIEH, J., JOHNSON, R. & KOEHLER, K. (1992) "The relationship between native speakers' judgements of non-native pronunciation and deviance in segmental, prosody and syllable structure". *Language Learning* 42, 529-555.
- ASTRUC-AGUILERA, L. & NOLAN, F. (2007) "Variation in the intonation of extra-sentential elements". Editado por P. Prieto, J. Mascaró, y M.J. Solé (eds.) *Segmental and suprasegmental issues in Romance*. John Benjamin, 85-107.
- BECKMAN, M.; DÍAZ-CAMPOS, M.; MCGORY, J.T.; MORGAN, T.A. (2002) "Intonation across Spanish, in the Tones and Break Indices framework". *Probus* 14, 9-36.
- BECKMAN, M. & HIRSCHBERG, J. (1994) *The ToBI Annotation Conventions*. Ohio State University.  
[http://www.ling.ohiostate.edu/~tobi/annotation\\_conventions.html](http://www.ling.ohiostate.edu/~tobi/annotation_conventions.html).
- BRAZIL, D. (1997). *The communicative value of intonation in English*. Cambridge: Cambridge University Press.
- BRAUN, B. KOCHANSKI, G., GRABE, E. & ROSNER, B. (2006) "Evidence for attractors in English intonation". *The Journal of the Acoustical Society of America*, Vol. 119 86), 4006-4015.
- CRUTTENDEN, A. (1997) *Intonation*. Cambridge: Cambridge University Press.
- CRUZ-FERREIRA, M. (1987) "Non-native interpretative strategies for intonational meaning". En James, A. y J. Leather (eds.), *Sound patterns in Second Language Acquisition*. Dordrecht: Foris Publications, 103-120.
- DÍAZ-CAMPOS, M. & RONQUEST, R. (2007) "La percepción de acentos tonales en enunciados afirmativos". *Estudios de Fonética Experimental*, XVI, 81-98. Barcelona: Universitat de Barcelona.
- D'IMPERIO, M.A & HOUSE, D. (1997). "Perception of questions and statements in Neapolitan Italian". In *Proceedings of Eurospeech 97*, 251-254, Rhodes, Greece.

- DORTA, J. & HERNÁNDEZ, B. (2005) "Análisis prosódico de un corpus de habla experimental: interrogativas absolutas con expansión en el objeto vs. sin expansión". *Estudios de Fonética Experimental*, XIV, 67-123. Barcelona: Universitat de Barcelona.
- GRANSTRÖM B, HOUSE D & LUNDEBERG M (1999). "Prosodic Cues in Multimodal Speech Perception". In *Proceedings of the International Congress of Phonetic Sciences (ICPhS99)*, 655-658, San Francisco, USA.
- GRANSTRÖM B, HOUSE D & SWERTS M G (2002). "Multimodal feedback cues in human-machine interactions". In Bel, B. and Marlien I. (eds.), *Proceedings of the Speech Prosody 2002 Conference*, 347-350, Aix-en-Provence, France.
- GRICE, M. & SAVINO, M. (2003) "Map Tasks in Bari Italian: asking questions about given, accessible and new information". *Catalan Journal of Linguistics* 2, pp. 153-180.
- DERWING, T. & MUNRO, M. (1997) "Accent, intelligibility and comprehensibility: Evidence from four L1s". *Studies in Second Language Acquisition*, 19 (1), 1-16.
- ESTEBAS-VILAPLANA, E. (2000) *The use and realisation of accentual focus in Catalan with a comparison to English*. Tesis doctoral. University College London.
- FACE, T. (2003): "Un análisis fonológico del acento nuclear en el español de Madrid", en Esther Herrera y Pedro Martín Butragueño (Eds.) *La Tonía: Dimensiones fonéticas y fonológicas*, pp. 221-243. Méjico: Colegio de Méjico.
- FACE, T. (2004) "The intonation of absolute interrogatives in Castilian Spanish". *Southwest Journal of Linguistics* 23 (2), 65-79.
- FACE, T. & PRIETO, P. (2006) *Rising Accents in Castilian Spanish: A Revision of Sp\_ToBI*. Universidad de Barcelona.  
<http://seneca.uab.es/ggt/Reports/GGT-06-17.pdf>.
- FERNÁNDEZ PLANAS, A.M. & MARTÍNEZ CELDRÁN, E. (2003) "El tono fundamental y la duración: dos aspectos de la taxonomía prosódica en dos modalidades de habla (enunciativa e interrogativa) del español". *Estudios de Fonética Experimental* XII, 165-200. Barcelona: Universitat de Barcelona.
- FERNÁNDEZ PLANAS, A.M., CARRERA, J. ROMÁN, D. & MARTÍNEZ CELDRÁN, E. (2006) *Declarativas e interrogativas en Tortosa y Lleida. "Comparación de su entonación"*. *Estudios de Fonética Experimental* XV, 163-209. Barcelona: Universitat de Barcelona.
- GUSSENHOVEN, C. (2004) *The Phonology of Tone and Intonation*. Cambridge: Cambridge University Press.
- HIRSCHBERG, J. (2004) "Pragmatics and intonation". In: Horn, L.R., Ward, G.L. (eds.), *The Handbook of Pragmatics*. Oxford: Blackwell, 515-537.
- HIRST, D. & DI CRISTO, A. (1998) *Intonation systems. A survey of twenty languages*. Cambridge: Cambridge University Press.
- HUALDE, J.I: (2002). "Intonation in Spanish and the other Ibero-Romance languages: Overview and status quaestionis". In Wiltshire, C. and Camps, J. (eds.), *Romance Phonology and Variation. Selected Papers from the 30<sup>th</sup> Linguistic Symposium on Romance Languages*, 101-116. Amsterdam: John Benjamins.

- KELM, O. (1995) "Acoustic measurement of Spanish and English pitch contours: native and non-native speakers". *Hispanic Linguistics* 6/7, 435-448.
- LADD, D.R. (1996) *Intonational phonology*. Cambridge: Cambridge University Press.
- LIU, F. & XU, Y. "Question intonation as affected by word stress and focus in English". *Proceedings of the 16th International Congress of Phonetic Sciences*. Saarbrücken, Germany, 1189-1192.
- MARTÍNEZ-CELDRÁN, E., FERNÁNDEZ PLANAS, A.M., VAN OOSTERZEE, C. & J. CARRERA-SABATÉ (2005) "Intonational description of the interrogative sentences with initial unstressed "que" in four Catalan dialects", *Phonetics and Phonology in Iberia* (PaPI).
- NIBERT, HOLLY (2000). *Phonetic and Phonological Evidence for Intermediate Phrasing in Spanish Intonation*. PhD Thesis. University of Illinois at Urbana-Champaign.
- PIERREHUMBERT, J. & HIRSCHBERG, J. (1990) "The meaning of intonation contours in the interpretation of discourse". In Cohen, Morgan, P.R., J. and Polack, M.E. (eds.), *Intention in Communication*. Cambridge and Massachusetts: MIT press, 371-411.
- RAMÍREZ VERDUGO, M.D. (2005a) "Análisis contrastivo de los sistemas entonativos del inglés en la interlengua de hablantes no nativos. Implicación en la organización de la información desde la perspectiva funcional. Estudio basado en un corpus computerizado de aprendices españoles de lengua inglesa". En *Premios Nacionales de Investigación 2003*. CIDE-MEC (2005), 385-422.
- RAMÍREZ VERDUGO, M.D. (2005b) "Aproximación a la prosodia del habla de Madrid". *Estudios en Fonética Experimental XIV*: 309-326. Barcelona: Universidad de Barcelona.
- RAMÍREZ VERDUGO, M.D. & ASTRUC-AGUILERA, L. (2006) "The universality of intonation: some common and language specific patterns in interrogative intonation." Paper presented at 39th annual meeting of the Societas Linguistica Europaea (SLE), Relativism and Universalism in Linguistics. Universität Bremen (Germany).
- RAMÍREZ VERDUGO, M.D., ASTRUC-AGUILERA, L. & MORÁN, B. (2006) "Entonación interrogativa en español e inglés". *III Jornadas Científicas del Proyecto Amper*. Tenerife: Universidad de la Laguna.
- RAMÍREZ VERDUGO, M.D. & ASTRUC-AGUILERA, L. (2007) "Sp\_ToBI at the workshop on Transcription of Intonation in the Ibero-Romance Languages". Paper presented at Phonetics and Phonology in Iberia Conference. Universidade do Minho (Portugal).
- SNOW, D. & BALOG, H. (2002) "Do children produce the melody before the words? A review of developmental intonation research". *Lingua* 112, 1025-1058.
- TOLEDO, A.G. (2001): "Acentos en el español: un corpus de conversación", *Estudios de Fonética Experimental*, XI. Barcelona: Laboratori de Fonètica de la UB, pp.121-142.

- TOLEDO, A.G. (2003): “Modelo autosegmental y entonación: Los corpus DIES-RTVP”, *Estudios de Fonética Experimental*, XII. Barcelona: Laboratori de Fonètica de la UB, pp.143-163.
- TOLEDO, G. (2006) “Tonos estrellados: una argumentación”, *Estudios de Fonética Experimental* 15: 99-131.
- TOLEDO, G. & RAMÍREZ VERDUGO, M.D. (2007): “Spanish phrasing: Secondary association of T\* in face of intermediate phrase edge tone H- (laboratory data)”, *Phonetics and Phonology in Iberia (PaPI) 2007*, Braga, Portugal.
- XU, Y. AND LIU, F. (2007) “Determining the temporal interval of segments with the help of F0 contours”. *Journal of Phonetics*, 35, 398-420.