A contrastive study of Catalan and Spanish declarative intonation: Focus on Majorcan dialects

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Abstract

The goal of the present paper is to identify some of the differences in the intonation of Catalan and Spanish as spoken in Majorca. The tonal features we investigated were: (1) utterance-final pitch accents in broad focus declaratives, and (2) local contrastive focus pitch accents. Previous research, mostly on related varieties, such as Central Catalan and Castilian Spanish, had indirectly suggested that potential differences could arise with regards to these specific configurations (Estebas 2003a,c; Face 2002a, 2004). The Majorcan dialects of Catalan and Spanish were found to fundamentally differ in the shape and alignment patterns of their utterance-final pitch accents (of broad focus declaratives) in that Catalan displayed low or falling pitch accents while Spanish presented small rising-falling pitch accents. On the other hand, statistical differences were found with respect to the alignment of pitch valleys culminating rising-falling pitch contours in contrastive focus accents. Overall, the findings reported here add to our knowledge of the intonational differences and similarities between Romance languages by comparing two contact languages using similar materials and under identical experimental conditions. These findings are relevant for comparative-historical purposes and future language contact studies.

1. Introduction

Our understanding of the principles underscoring intonational variation and change is not nearly as detailed as the one we have for segmental variation (Labov 1994, 2001). If we intend to significantly extend that knowledge, detailed descriptions of the intonation of a greater number of language varieties are needed. Furthermore, specific contrastive studies should be undertaken in

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order to gain insight into the nature of the potential intonational differences and similarities across languages and language varieties (Atterer & Ladd 2004; Beckman et al. 2002; Elordieta & Calleja 2005; van Leyden 2004; van Leyden & van Heuven 2006; Muecke et al. 2009; McGory & Díaz 2002). In the present paper, we report on the results of two experiments aimed to capture some of the differences between the intonation of Catalan and Spanish, as spoken in the Western Mediterranean island of Majorca.

Detailed, explicit comparative intonational research is useful on several grounds. First, this type of research may allow us to develop some postulates regarding the diachrony of the intonation of the Romance languages. Hualde (2003) points out that there is no good reason to believe that the reconstruction of Proto-Romance intonation is not possible, provided that detailed descriptions of "enough" languages and dialects are available. Much recent work has been devoted to the study of the prosody of several Romance languages. However, it would appear that a deeper holistic knowledge than the one we presently have would arise from explicit comparative studies, since they may reveal important cross-language systematic differences that had remained unnoticed in non-comparative studies, as well as show that some previously-noticed differences do not hold when subjected to an explicit comparative scrutiny using fundamentally equivalent methods. Comparative intonational research would likely be more reliable if explicit cross-language and cross-dialectal contrastive research using similar materials would be undertaken, rather than comparing findings coming from different experimental designs.

Recently, several research projects have aimed at mapping the geographical distribution of some of the features of the intonation of various Romance languages. For instance, ongoing work at the Universitat Autònoma of Barcelona is currently dedicated to creating two on-line dialectal Atlases mapping the intonational characteristics of the main regional varieties of Catalan, on the one hand, and Occitan, on the other: the *Atles interactiu de l'entonació del català* (Prieto & Cabré 2008) and the *Atlás interactiu de l'intonacion de l'occitan* (Prieto & Sichel-Bazin 2008). A similar project is that of the *Atlas Multimédia Prosodique de l'Espace Roman* (AMPER), hosted at the Université Stendhal of Grenoble (Romano et al. 2001-2008; Fernández-Planas et al. 2004; Carrera-Sabaté et al. 2004; Martínez-Celdrán et al. 2005, 2006; Fernández-Planas et al. 2006). Explicit reference to geographical location of intonational features may prove to be extremely useful for our understanding of the diachrony of Romance prosody (Simonet 2009).

A second reason why detailed comparative research is useful derives from the fact that, within the Romance linguistic area, many of the languages find themselves in a societal language contact situation: e.g., Catalan and Spanish, Galician and Spanish, Catalan and French, Occitan and French, Occitan and Italian, Sardinian and Italian, Portuguese and Spanish, etc. If we were to study

contact-induced variation and change in these situations (Alvord 2005; Colantoni & Gurlekian 2004; Elordieta & Calleja 2005; O'Rourke 2005; Simonet 2008), we would need a careful descriptive assessment of the two or more languages in contact. This would be needed prior to carrying out any type of sociolinguistic, contact study.

A third reason why this type of research may be useful comes from the fact that it may come to significantly inform phonological theory at a general level. Atterer & Ladd (2004) and Muecke et al. (2009), for instance, addressed this issue in their explicit comparison of alignment patterns in two dialects of German, Southern and Northern standard German. It was found that Northern and Southern German speakers use slightly different alignment patterns for a type of intonational rise that is better understood as being "the same" across these two dialects. Furthermore, Atterer & Ladd (2004) also found that German speakers of English transfer their variety-specific alignment patterns from their first to their second language, further suggesting that German-English bilinguals identified as belonging to "the same" phonological category two patterns that are acoustically different. The main point in Atterer & Ladd (2004) is that some cross-linguistic differences in pitch alignment that had been previously labeled differently (that is, with different "phonological" labels such as L+H* vs. L*+H) are better understood as low-level phonetic differences, instead of categorical ones, due to the fact that there seems to be no evidence to assume that these patterns are contrastive within the languages under discussion and that the cross-linguistic differences are too small in order for them to merit different labels or phonological notations. The insight of Atterer & Ladd (2004) is that they reveal that many of the proposed intonational Autosegmental-Metrical labels have a wrongly-understood "crypto-phonetic" nature instead of the abstract, phonological nature they were intended to originally have (Pierrehumbert 1980). In recent work on the characteristics of the intonation of several Spanish dialects, the observation that is emerging is that dialectal comparisons are needed so as to be able to state more convincingly what acoustic characteristics are common to most dialects and what aspects are subject to regional or sociolectal variation (Elordieta & Calleja 2005; Willis 2003). A detailed understanding of the similarities and differences between Spanish dialects may come to inform our knowledge regarding what may constitute the intonational phonology of Spanish and what may merely be allophonic and/or regional variation (Elordieta & Calleja 2005). At the same time, comparing different Romance languages may also be relevant on the same grounds. Thus, even though it is true that Catalan and Spanish, for instance, are two different languages, they do not differ arbitrarily, since they are genetically related.

The experiments reported in the present paper contribute to our knowledge of intonational variation in Romance. We compare some basic contours of the traditional Majorcan variety of Catalan with related ones in the developing

Majorcan variety of Spanish. We make these explicit comparisons based on the premise that, since they derive from a common ancestor (Proto-Hispano-Romance), the intonational characteristics of the two languages were identical at some point in the distant past. First, the results of the experiments reported here are believed to be relevant from a historical, comparative Romance perspective on intonational variation. Second, since the two studied varieties are in an extensive and intensive contact situation, we believe that this investigation will allow us to set up the stage for research on the effects of contact on the intonation of the Majorcan varieties, or in the whole Catalan-Spanish contact area.

During the last two decades, a great deal of attention has been dedicated to studying the sources of variation in tonal alignment, i.e., the timing of tonal events with respect to other events in the speech chain (Arvaniti et al. 1998, 2000; D'Imperio 2001; Caspers & van Heuven 1993; Ladd 2008; Ladd et al. 1999, 2000; Pierrehumbert 1980; Pierrehumbert & Steele 1989; Prieto et al. 1995; Prieto & Torreira 2007; Xu 1998; Xu & Wang 2001; Xu & Xu 2005). Most studies have focused on the position of pitch valleys or peaks with respect to segmental or syllabic boundaries, as well as other pitch events, in rising pitch movements. Importantly, it has been reported that pitch events have a tendency to align with specific segmental or syllabic landmarks (i.e., "anchors"), rather than other pitch events, and that this is unaffected by the number of segments intervening between the two anchors as well as changes in speech rate (Caspers & van Heuven 1993; Ladd et al. 1999, 2000; Prieto & Torreira 2007; Xu 1998). Regarding syllable structure, for instance, Prieto & Torreira (2007) found later peaks in rising pitch movements in closed syllables (CVC) than in open ones (CV), while valleys where aligned with consonantal onsets in both CV and CVC syllables. Effects of accent status have also been reported. For instance, Prieto et al. (1995) found earlier peaks in rising pitch movements in nuclear (i.e., utterance-final) than in prenuclear (i.e. non-utterance-final) pitch accents. Interestingly, as explained above, tonal alignment patterns may vary as a function of language variety as well (Atterer & Ladd 2004; Elordieta & Calleja 2005; Muecke et al. 2009; van Leyden & van Heuven 2006). In sum, most recent research on the intonation of Romance has focused on the study of alignment. Consequently, the present paper will examine the alignment patterns of several of the pitch events constituting the analyzed contours and it will pay attention to the differences as well as similarities in this regard between Catalan and Spanish.

The present paper is concerned exclusively with declarative intonation. For Experiment 1, speakers were recorded while reading a list of declarative sentences with a broad focus pronunciation. In Experiment 2, we study the production of declarative sentences that contain one word receiving a contrastive focus pronunciation. For the purposes of the present paper, we are exclusively

concerned with (1) the shape and alignment of utterance-final pitch accents in declaratives (Experiment 1), and (2) the shape and alignment of local contours in contrastive focus declaratives (Experiment 2). The reasons why we focused our efforts in these two pitch gesture types come from the findings of previous research on the Peninsular dialects of both Catalan and Spanish. A discussion of the relevant previous literature is included separately under the introductory sections dedicated to each one of the experiments. The experimental methods of each experiment are also explained in the corresponding sections below. A general Method section precedes the sections dedicated to Experiments 1 and 2. The last two sections offer an overall discussion of the findings of both experiments and general conclusions.

2. General Method

2.1. Participants

Majorca is a bilingual speech community in which the linguistic market is shared by Spanish and Catalan (Alomar 1995; Bibiloni 1991; Blas Arroyo 2007; Joan 1997; Melià 1997; Miralles 1989; Pieras 1999; Salvà 2005; Segura 2005; Villaverde 2005). Consequently, in order to make inferences about (Majorcan) Catalan, on the one hand, and (Majorcan) Spanish, on the other, it was deemed important to minimize the potential effect of individual bilingualism in our contrastive data. Catalan-speaking monolinguals are fundamentally non-existent in Majorca. Spanish-speaking monolinguals, at least amongst those who were born in Majorca, are also rare. We were interested in recruiting speakers that would be on the two extremes of the language contact continuum but who would have been brought up in the island; that is, speakers who, although being bilingual and thus representative of the speech community, would show a relatively minimal effect of contact (at least as compared with other natives of Majorca who may be more 'balanced' bilinguals).

A language background questionnaire (LBQ) was administered to a pool of potential participants. The participants were asked questions that allowed for the gathering of demographic information such as gender, age (year of birth), time spend outside of Majorca, and place of birth. The questionnaire was administered in the language of choice of the participants, either Catalan or Spanish. They were asked the following language-background questions: (1) Which language do you consider to be your native language? (2) Which language did you use to speak at home, as a child, with your family? (3) Which language do you use more frequently in your daily life? (4) Rate the percentage of use of Catalan and Spanish in your daily life: (i) with family (ii) with friends (iii) at work/school (iv) while shopping (v) with strangers.

On the one hand, the participants were classified as Catalan speakers if they answered "Catalan" to the first three questions and had significantly higher percentages of use of Catalan than Spanish in all of the communicative settings about which the questionnaire inquired. The opposite was true for the speakers who were classified as speakers of Spanish.

A total of twelve (12) speakers were recruited. All of the selected participants were born in Majorca and had lived locally throughout their lives. They came from different towns in the island. Balanced numbers of males and females were asked to participate: 6 males and 6 females. The ages of the participants were comparable: they were mostly born between the late 1960s and early 1980s. The recordings took place in the year 2006.

Most of the recruited Catalan speakers reside in small rural towns, where the most frequently used language is Catalan, while the recruited Spanish speakers reside mostly in larger towns, where Spanish is widely used. All the Spanish subjects were born and grew up in the island's capital city, Palma, but four of them recently moved to other relatively large towns (Inca and Son Ferrer, Calvià), due to a phenomenon of counter-urbanization. However, at the time of the recordings, they still used to commute every day to Palma, where they work, and their friends and families still reside. Commuting to the capital city is not as common for the Catalan group. Their families and most of their friends live in their home towns, where they also spend most of their spare time. This situation is representative of the current overall sociolinguistic fabric of the island of Majorca (Villaverde 2005).

2.2. Recordings

Subjects were recorded individually. All the data gathered from each participant were collected in one experimental session, with a short break between the two experiments that inform the present paper, which involved similar tasks. Individual sessions took place in a quiet room, either in the subject's own house or in their work place, and lasted about 30 to 45 minutes, including instruction time.

Speech was recorded onto a solid-state digital voice recorder (Marantz PMD660) and through a head-worn dynamic microphone (Shure SM10A). The signal was digitized at 44.1 kHz and 16-bit quantization. Sound files were transferred to a computer's disk for acoustic analysis. Individual target sentences were divided into individual sound files. The signal was down-sampled at 22.05 kHz in order to reduce disk space. All acoustic analyses were carried out with the Praat digital signal-processing software (Boersma & Weenink 2008).

3. Experiment 1

3.1. Background

Central Catalan utterance-final pitch gestures have been described as showing a descending trajectory that occurs in the middle of a progressive fall starting at the peak of the penultimate pitch accent and continuing to the end of the utterance (Astruc 2005; Estebas 2003a; Prieto 2002).

The phonological characterization of utterance-final pitch accents has been a matter of some debate in the literature. On the one hand, Prieto (2002) proposed to label final pitch accents in Catalan as L* due to the fact that they have a progressively falling trajectory and rarely display a peak or a rise of any sort. Estebas (2003a) argued, on the other hand, for a downstepped H* based on the argument that a L* phonological analysis would predict a low elbow on the last accented syllable and a flat pitch track from there to the end of the sentence. It should be added that, in Estebas (2003a)'s data, 24 % of the final pitch accents produced by the only recorded informant were realized with a peak or a non-falling trajectory. In all other occasions (76 %), the informant in the study simply realized a progressively falling trajectory. Finally, Astruc (2005) proposed to analyze Central Catalan utterance-final pitch accents as H+L*. According to Astruc (2005), the exact alignment of the L* tone in the H+L* accent may vary. It may align with the stressed syllable, in which case there occurs a low elbow by the final stressed syllable, or with the end of the word/sentence, in which case there is no obvious low elbow before the end of the utterance.

Simonet (2009) specifically addressed this issue with data from the Majorcan dialect of Catalan. Simonet found that the pitch fall between the midpoint of the pre-stressed, utterance-final syllable and that of the subsequent stressed syllable was significantly greater than the pitch fall between the stressed syllable and the utterance-final, post-stressed one. This was shown in utterances such as *Sa paella és salada* 'The paella is salty', in which pitch values were extracted from the midpoint of the three syllables constituting the paroxytonic, utterance-final word *salada* 'salty.' This effect was interpreted to indicate that Majorcan Catalan utterance-final pitch accents show evidence for the existence of a L* tone associated with the utterance-final stressed syllable. Additionally, Simonet (2009) found that the higher tone found on utterance-final, pre-stressed syllables resulted from the existence of a local H on that syllable (for at least 4 out of 10 speakers) rather than from a linear interpolation between the preceding prenuclear pitch accent and the utterance-final L*. These findings were interpreted to indicate that there is evidence for a bi-tonal H+L* pitch accent, at least for some speakers of Majorcan Catalan. It is unlikely, though not impossible, that the higher tone preceding the utterance-final stressed sylla-

ble in Simonet (2009)'s data results from the existence of a H- boundary tone. The reason is that boundary tones have not been found to occur consistently between verbs and objects in Romance (D'Imperio et al. 2005; Elordieta et al. 2005) and thus accepting that all high tones in Simonet (2009) result from preceding boundary tones would be more unlikely than accepting that they result from bi-tonal pitch accents. However, Simonet (2009) did not address the alignment patterns of H and L tones in these bi-tonal utterance-final accents. The present paper looks at alignment patterns in Majorcan Catalan utterance-final accents using similar (but different) materials and different speakers than in Simonet (2009). Here, the position is assumed that high and low pitch values occurring in or near the utterance-final stressed syllable are manifestations of a bi-tonal utterance-final pitch accent. (The reader is referred to Simonet (2009) for further data).

As for Spanish, Face (2002a) studied in detail the shape and alignment of final pitch gestures in a corpus of read-aloud, broad focus declaratives of the Castilian (Madrid) dialect. Utterance-final pitch accents in this dialect were found to display small, downstepped rising-falling trajectories, with Ls timed with respect to stressed-syllable onsets and Hs occurring within the bounds of stressed syllables (Face 2002a; Elordieta & Calleja 2005). Additionally, Face (2002a) found that 60 % of utterance-final pitch accents in his corpus showed a clear rise-fall and therefore a pitch peak while the other 40 % of the utterance-final pitch accents presented no clearly-observable rise, but a mid-level sustained pitch trajectory and a gradual fall occurring on the post-stressed syllable. Both types of gestures were analyzed as L+H* pitch accents, with peakless gestures being thought of as reduced or down-stepped. It is unlikely that these non-falling pitch gestures could be interpreted as simply deaccented (i.e., as if the L+H* pitch accent had been completely deleted) because the complete lack of accent would hypothetically trigger a falling slope with a similar or equal steepness in the stressed and post-stressed syllable(s), which does not agree with the findings.

In summary, there seems to be a difference between Catalan and Spanish in the overall shape of the pitch gestures associated with utterance-final stressed syllables. On the one hand, while Catalan (including Majorcan Catalan) seems to show a preference for falling accents, Spanish shows one for rising-falling or mid-sustained accents. While this has been shown for dialects that are not in an immediate contact with each other (i.e., Central and Majorcan Catalan and, on the other hand, Madrid Spanish), the present paper addresses the question of whether these differences arise in a speech community where the two languages are in immediate proximity. Furthermore, the present paper investigates the patterns of relative alignment of pitch events with prosodic landmarks with the goal of establishing the potential phonological and phonetic differences between the two contact language varieties.

Table 1. *Materials for Experiment 1: SVO (subject + verb + object), S^2VO (branching subject + verb + object), $SVO^{2/3}$ (subject + verb + branching object). All lexically-stressed syllables have an accent mark.*

Language	Sentence	Structure
Catalan	*Sa germána caminá̀va per Bunyóla*	SVO
	En Manólo sa menjá̀va s'arengáda	SVO
	Sa germána de'n Manólo caminá̀va per Bunyóla	S^2VO
	En Manólo i sa germána menjáven arengádes	S^2VO
	Ses germánes anáven a sa balláda de Bunyóla	SVO^2
	En Manólo se menjá̀va s'arengáda saláda	SVO^2
	Sa germána se menjá̀va s'arengáda saláda amb vinágre	SVO^3
	En Manólo se menjá̀va s'arengáda amb llimóna geláda	SVO^3
Spanish	*Su hermána caminába por Barcelóna*	SVO
	Manólo se tomába la limonáda	SVO
	La hermána de Manólo caminába por Barcelóna	S^2VO
	Manólo y su hermána se tomában la limonáda	S^2VO
	Su hermána se tomába la limonáda y el heládo	SVO^2
	El móno pelába a banána de Canárias	SVO^2
	Su hermána se tomába la limonáda con heládo de banána	SVO^3
	Manólo se tomába la banána venezolána con heládo	SVO^3

3.2. Method

3.2.1. Materials. In order to elicit comparable data across the two languages, read-aloud (rather than spontaneous) speech was investigated. No contexts for the sentences were provided to the speakers. The participants read aloud 10 sentences (3 iterations) from a printed list ($10 \times 3 = 30$ sentences per speaker). The sentences contained different numbers of prosodic words and had different syntactic structures in order to avoid repetitive intonation. The last two sentences of the list were not analyzed because many were read with a list, enumeration intonation. Therefore, the analysis of declarative read speech was based on a total of 288 sentences (8 sentences $\times$ 3 repetitions $\times$ 6 subjects $\times$ 2 languages $=$ 288 total). The materials controlled for: (1) Lexical-stress configuration (only paroxytones); (2) quality of the stressed vowel (only /a/ or /o/); (3) surrounding consonants (only voiced consonants); (4) number of intervening unstressed syllables between the stressed syllables corresponding to adjacent prosodic words (always two or more). The materials are presented in Table 1.

The effects of lexical-stress configuration and number of intervening unstressed syllables between prosodic words have been studied in depth in prenuclear pitch accents in both Catalan and Spanish (Elordieta & Calleja 2005;

Face 2002a; Prieto et al. 1995; Prieto 2006). Our intention here was to explicitly compare the acoustic characteristics of utterance-final pitch accents in Majorcan Catalan and Majorcan Spanish rather than provide a full phonetic and phonological characterization of these pitch accents in the two languages. Ideally, a full phonological analysis of utterance-final pitch accents would need to orthogonally vary the number of intervening unstressed syllables, syllable structures and speech rates and analyze the patterns of alignment under all these conditions (Arvaniti et al. 1998, 2000; D'Imperio 2001; Caspers & van Heuven 1993; Ladd 2008; Ladd et al. 1999, 2000; Pierrehumbert 1980; Pierrehumbert & Steele 1989; Prieto et al. 1995; Prieto & Torreira 2007; Xu 1998; Xu & Wang 2001; Xu & Xu 2005). However, since the relevant differences between the two languages may be observed under a simpler experimental design, the decision was made to simply control for these factors in acknowledgement of the fact that they tend to affect the alignment of pitch events.

3.2.2. Metrics. The last word in each utterance was segmented with the help of time-aligned spectrographic and sound wave displays generated by Praat (Boersma & Weenink 2008). In particular, the following prosodic landmarks were hand-located: (1) *Onset*: Onset of the utterance-final stressed syllable; (2) *Offset*: Offset of the utterance-final stressed syllable; (3) *Word Edge*: Right-hand word edge, i.e., offset of the absolute final syllable.

Utterance-final pitch gestures were classified as belonging to three classes: (1) rises (a rise in pitch from the pre-stressed to the stressed syllable), (2) falls (a fall in pitch from the pre-stressed to the post-stressed syllable), and (3) flat contours. This step was taken as a first approximation to the overall shape of pitch trajectories in the utterance-final region (Simonet 2009). This classification was carried out with an automatic procedure using Praat (Simonet 2008).

Subsequently, as is standard procedure in intonational research, important pitch events were isolated (extracted) from continuous pitch tracks. The acoustic analysis was focused on an investigation of the patterns of alignment (relative timing) of pitch events with respect to several prosodic landmarks. The target pitch events were visually inspected using pitch tracks generated by Praat. Standard segmentation procedures were followed.

On the one hand, for visible pitch rises (or rise-falls), the isolated pitch events were a valley (i.e., onset of pitch rise) and a peak (i.e., offset of pitch rise). On the other hand, for visible pitch falls, the extracted events were a peak (i.e., onset of pitch fall) and a valley (i.e., offset of pitch fall). It is important to note that "peaks" in falling pitch accents did not generally consist of f0 maxima, but f0 turning points in which a slightly falling or flat contour became steeper in its falling trajectory. Notice that, even though the two types of events are very similar, the sequence of events is different in pitch rises (valley

+ peak) than in pitch falls (peak + valley). Peaks and valleys were hand-located following standard procedures as generally applied in pitch alignment investigations (Elordieta & Calleja 2005; Face 2002a; Prieto et al. 1995). Both types of events were seemingly associated with utterance-final stressed syllables as the first of the two events occurred by the onset of the syllable and the second one, somewhere within its bounds (Face 2002a).

3.3. Results

The classification of Catalan and Spanish pitch gestures in three classes provided the following results:

– Spanish: Out of 143 pitch contours, there were 86 rises (60 %), 38 flat contours (26 %), 19 falls (13 %).
– Catalan: Out of 144 pitch contours, there were 133 falls (93 %), 11 flat contours (7 %), 0 rises.

One Spanish sentence was excluded due to clipping (digitization error). In order to be able to study the phonetics of final pitch gestures in both languages, the tokens were divided into two subgroups, which were then explored independently: (1) rising gestures in Spanish, and (2) falling gestures in Catalan. The analysis consisted of an investigation of the timing characteristics of the relevant pitch events with respect to several prosodic landmarks. The patterns of alignment were investigated by comparing different linear regression models, which investigated the relative stability of pitch pivot points with respect to prosodic landmarks, such as syllable offsets and right-hand word edges (Prieto et al. 1995). Linear regression models were calculated with the least squares method (Xu & Wang 2001). The power of a linear regression analysis would be heightened if the data would orthogonally vary as a function of factors such as lexical-stress configuration, number of intervening unstressed syllables, syllable structure or segmental composition. However, since data from several speakers and repetitions are pooled together, the amount of variation is arguably sufficient to perform reliable regression analyses. Examples of Catalan utterance-final pitch falls and Spanish utterance-final pitch rises may be observed in Figures 1 and 2.

3.3.1. Rising pitch accents in Spanish. The Spanish pitch gestures examined in the present section comprised a total of 86 tokens, 50 from male speakers and 36 from female speakers. All non-rising pitch gestures were excluded from further investigation. Data from all the participants were pooled.

In the linear models, the dependent variable was the distance between the stressed-syllable onset and the peak (*peak delay*) (Prieto et al. 1995). Three competing predictor variables were considered: (1) stressed-syllable duration,

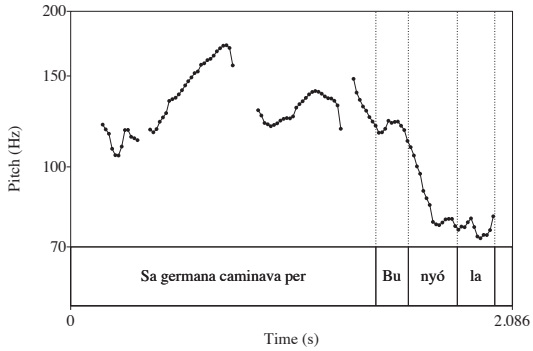

Figure 1. *Catalan sentence* Sa germana caminava per Bunyola *'Her sister was walking around Bunyola'. Notice the pitch contour on the utterance-final word.*

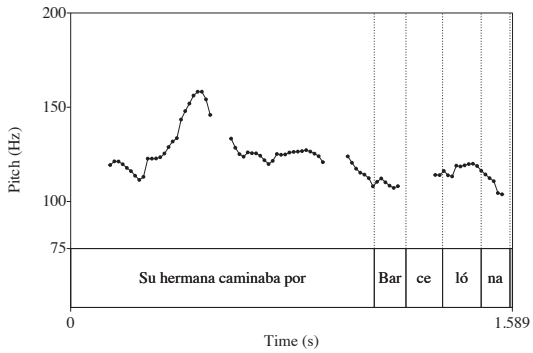

Figure 2. *Spanish sentence* Su hermana caminaba per Barcelona *'Her sister was walking around Barcelona'. Notice the pitch contour on the utterance-final word.*

(2) distance between stressed-syllable onset and right-hand word edge (this distance resulted from the sum of the durations of the stressed and the post-stressed syllables in each utterance-final word), (3) position of preceding valley, calculated as the distance between the valley and the stressed-syllable onset. The predictions were as follows:

– If peaks align with respect to stressed syllables, model 1 is expected to outperform the other two competing models.
– If peaks are placed according to word edges (Estebas 2003b; Prieto 2006; Simonet 2006), model 2 should be a better predictor of peak delay than the other two models.

– If peaks are timed with respect to preceding valleys (that is, rises have a stable duration), model 3 should outperform the other two models. (See Xu & Wang (2001) and Simonet (2007) for the rationale behind these analytic assumptions.)

The results of the linear regression models revealed that the linear model in which the sum of the durations of both the stressed and the post-stressed syllables (i.e., the distance between the onset of the stressed syllable and the right-hand word edge) was the predictor was more successful [$F(1,84) = 80.27$; $p < .001$; $R^2 = 0.488$] than the one in which the predictor variable was the duration of the stressed syllable [$F(1,84) = 46.96$; $p < .001$; $R^2 = 0.358$] and much more than the one in which peak placement was predicted with the help of the location of the preceding valley [$F(1,84) = 4.89$; $p < .05$; $R^2 = 0.05$]. Models 1 and 2 are relatively similar in their predictive power, as shown by the R^2 values.

In summary, peaks appear to move in synchrony with right-hand word edges and, less robustly, with stressed-syllable offsets. This finding may be caused by the fact that the two most powerful predictors are likely correlated with each other. This could result from individual differences in speech rate (i.e., the longer the stressed syllable, the longer the post-stressed one if an individual is speaking slowly). In the present case, these similarities would be caused by the fact that we only examined paroxytonic words (Prieto 2006; Simonet 2006). However, the fact that model 1 was slightly more successful than model 2 suggests that the duration of the post-stressed syllable has an effect, together with that of the stressed syllable, in the placement of the pitch peak in the Spanish rising pitch accents described here. This is similar to what occurs with prenuclear pitch accents in Majorcan Catalan (Simonet 2007). In all cases, it is interesting to highlight that peaks were placed within the bounds of stressed syllables (Face 2002a).

3.3.2. Falling pitch accents in Catalan. The subset of utterance-final falling pitch gestures in Catalan comprised a total of 133 tokens, 63 from female speakers and 70 from male speakers. Data from all the participants were pooled.

The dependent variable was, in all cases, the distance between the stressed-syllable onset and the valley (*valley delay*). Three competing predictor variables were considered: (1) stressed-syllable duration, (2) distance between stressed-syllable onset and right-hand word edge (the sum of the duration of the stressed and post-stressed syllables), and (3) position of the preceding peak or fall onset (calculated as the distance between the onset of the fall and the stressed-syllable onset). As with peaks in the Spanish rising utterance-final pitch gestures, the following predictions apply:

– If valleys align with respect to stressed syllables, model 1 will be found to outperform the other two competing models.

– If valleys are placed according to word edges (Prieto 2006; Simonet 2007), model 2 should be a better predictor of valley delay than the other two models.
– If valleys are timed with respect to the preceding peak (that is, falls have a consistent duration), model 3 should outperform the other two models.

The results of the linear regression models revealed that the only model that reached significance was model 3 (models 1 and 2: $F < 1$), in which the location of valleys was predicted by the location of the preceding peak or fall onset [$F(1, 131) = 33.89$; $p < .001$; $R^2 = 0.20$]. These findings suggest that valleys in Catalan utterance-final, falling pitch gestures are associated with fall onsets, and not prosodic landmarks such as syllable offsets or word-edges, and therefore have a somewhat consistent duration. In other words, there is evidence suggesting that the length of the fall in these pitch gestures is stable. This is an unexpected finding. The findings of the present investigation do not agree with previous findings on falling nuclear pitch accents in Central and Majorcan Catalan interrogatives (Prieto 2009; del Mar Vanrell 2006).

3.4. Discussion

The focus of the present experiment was to confirm the existence of systematic differences in the realization of utterance-final pitch accents in read-aloud, broad focus declaratives between the Majorcan dialects of Catalan and Spanish. Previous research on Peninsular varieties of both languages had indirectly suggested that there existed differences in the shape of these pitch accents between at least two of the dialects of the two languages: Central Catalan (Barcelona) and Castilian Spanish (Madrid). We aimed to investigate whether these differences would hold in an explicit comparison of two dialects that are spoken in the same speech community, Majorca.

The results of the present experiment confirm that Majorcan Catalan and Majorcan Spanish present fundamentally different patterns for the realization of utterance-final pitch accents in read-aloud declaratives. Majorcan Catalan utterance-final pitch accents were found to display a falling trajectory while speakers of the Majorcan variety of Spanish tended to use rising-falling contours.

The description of the Majorcan Catalan utterance-final pitch gestures offered here is not identical to the one provided in Prieto (2002) and Estebas (2003a) for Central Catalan. While in Central Catalan the pitch track follows a progressively descending trajectory from the peak of the penultimate pitch accent to the end of the utterance, in Majorcan Catalan, according to our data, the falling trajectory is accelerated (steeper) during the last stressed syllable in the sentence. Astruc (2005) found that a few utterance-final pitch accents in

her corpus of Central Catalan speech also received this type of pronunciation. In Majorcan Catalan, this steeply falling trajectory seems to be systematic (Simonet 2009). In our opinion, our data support an analysis according to which utterance-final pitch accents in Majorcan Catalan have a L* tone associated with the utterance-final stressed syllable. The acoustic analysis carried out in the present study did not allow for a direct investigation of whether utterance-final pitch gestures in Majorcan Catalan broad focus declaratives consist of a monotonal L* or a bi-tonal H+L*. Simonet (2009) explicitly addressed this question by investigating similar contours (using different materials) with a different analytical procedure. The evidence presented in Simonet (2009) suggested that there was evidence for the existence of bi-tonal H+L* gestures. Following the evidence presented in Simonet (2009), we assumed that Majorcan Catalan utterance-final pitch gestures are indeed bi-tonal and that the "peaks" and "valleys" identified in these pitch gestures are phonetic realizations of the two tones. Since Simonet (2009) did not investigate the patterns of relative alignment of the valleys and peaks that presumably correspond to the H and L tones in H+L* pitch gestures, one of the goals of the present experiment was to investigate these. Importantly, the results of the investigation of the patterns of relative timing of Majorcan Catalan utterance-final pitch gestures revealed that valleys seemed to be timed with respect to fall onsets (i.e., peaks) and not with respect to non-tonal prosodic landmarks, such as syllabic or word edges. This finding further supports the bi-tonal H+L* analysis, in that it shows that falls have relatively stable durations and thus H tones are leading tones in the original Pierrehumbertian sense (Pierrehumbert 1980). Evidently, this is not the only possible interpretation of bi-tonality. For example, it has been shown that while, in Portuguese, targets in bi-tonal H+L* accents are aligned independently, in H*+L accents the alignment of the valley depends on the alignment of the previous peak (Frota 2002b). In sum, we believe that while the results in Simonet (2009) suggest that Majorcan Catalan utterance-final falls are bi-tonal, our present findings suggest that the specific type of bi-tonality involved is one in which the two tones are aligned with respect to each other. This was, however, an unexpected finding, since it differs from recent discoveries regarding the behavior of valleys in falling interrogatives in Central Catalan (Prieto 2009).

On the other hand, Majorcan Spanish utterance-final pitch gestures mostly displayed a rising (rising-falling) or flat contour. Peaks were found to move in synchrony with right-hand word edges (and stressed-syllable offsets) and to occur within the bounds of stressed syllables. In sum, Majorcan Spanish utterance-final pitch gestures were found to be similar to those of Madrid Spanish (Face 2002a).

4. Experiment 2

4.1. Background

The shapes and alignment patterns of local pitch contours in sentences that have a contrastive focus pronunciation on one word have been analyzed in detail in recent research in both Central Catalan and Castilian Spanish. For instance, Estebas (2000) and Estebas (2003c) studied the timing characteristics of peaks and valleys in focal pitch gestures in Central Catalan, and compared them with those in British English. In Catalan, local pitch contours in contrastive focus words were found to display complex rising-falling trajectories. Pitch peaks in focused words were found to be systematically placed within the bounds of stressed syllables, unlike those in broad focus words, which were systematically delayed to post-stressed syllables (Estebas 2003b,c). This timing difference has generated some debate in the literature, regarding whether it is part of the phonology or rather falls from independent phonetic effects (Estebas 2003b; Prieto 2006; Prieto et al. 2005). (See below for a more detailed account of a similar debate in Spanish.) Additionally, Estebas (2003c) compared the behavior of post-focal valleys in Central Catalan and English. Post-focal valleys were defined as the tonal minima or low elbows culminating the falling trajectories that follow pitch peaks in focused words. Estebas (2003c) tested the validity of two competing phonological accounts: (1) a post-focal valley may be said to arise from the presence of a post-focal boundary tone (L-), or (2) it may be claimed to represent a trailing tone (i.e., it might be a part of the focal pitch accent per se: L+H+L* or L+H*+L). The prediction of the first analysis is that valleys will be found to align with respect to word edges, since boundary tones associate with prosodic boundaries. The prediction of the second analysis is that valleys will align with respect to pitch peaks; that is, they will follow peaks at a constant distance. For instance, the falling focus pitch accent H*+L of European Portuguese consists of a valley aligned with respect to the preceding peak (Frota 2002b). Interestingly, Estebas (2003c) found that valleys followed the preceding pitch peaks at a systematic, invariable distance in British English, but aligned with respect to word edges in Central Catalan. The main point we wish to highlight here is that post-focal valleys were systematically present in Estebas (2003c)'s corpus of Central Catalan and that they moved in synchrony with word edges, thus suggesting an H*...L- analysis.

For Spanish, several acoustic parameters that may be used to mark contrastive focus have been investigated. For instance, Toledo (1989) investigated features such as the height of pitch peaks, the duration and intensity of stressed syllables in focused words and the occurrence of following pauses. Toledo (1989) found no significant differences in duration between words in broad and narrow focus, nor were pauses frequently used to mark focus. On the other

hand, pitch peaks were indeed found to be significantly higher in words in narrow focus than in those in broad focus. Intensity also appeared to be used by speakers to mark narrow focus. On the other hand, de la Mota (1997) found differences between narrow and broad focus words on three parameters: height of pitch peaks, duration of stressed syllables and timing of pitch peaks with respect to segmental landmarks. Regarding the timing differences, it was found that, in words with narrow focus, pitch peaks occurred within the bounds of the corresponding stressed syllable, while they were delayed to post-stressed syllables in broad focus words. Finally, Face (2000) found that, in a corpus of Castilian (Madrid) Spanish, intensity and pitch peak height did not contribute to the distinction between words in narrow and broad focus, while pitch peak timing and stressed-syllable duration did.

The peak timing difference between narrow and broad focus in Spanish has generated some debate in the phonological literature (Face 2001, 2002a,b; Hualde 2000; Nibert 2000; Face & Prieto 2006; Sosa 1999). Three analyses have been put forward. On the one hand, Nibert (2000) and Hualde (2000) considered differences in the alignment of peaks to arise from the interaction of peaks with adjacent L boundary tones (L-). According to Nibert (2000) and Hualde (2000) the presence of a L- tone may trigger the retraction of the preceding pitch peak. On the other hand, Face (2000), Face (2001), Face (2002a) and Face (2002b) proposed an analysis according to which peak timing becomes an integral part of the phonological and phonetic description of narrow and broad focus pitch gestures. Face argued that delayed, broad focus pitch gestures should be analyzed as L*+H, while focus pitch gestures should be analyzed as L+H*. The star marks the primary association of tones with stressed syllables. In other words, according to Face, in narrow focus pitch accents H tones are associated with stressed syllables while the preceding L tone is a leading tone. On the other hand, Face & Prieto (2006) argued that the L*+H notation is not the appropriate labeling of broad focus pitch gestures, since this label is needed to describe a different type of pitch accent that exists in some Spanish dialects. According to Face & Prieto (2006), peak delay differences between broad and narrow focus words are captured by formal secondary associations since they are both analyzed as primarily consisting of the same bitonal structure (L+H*). The difference, the argument continues, arises from the fact that high tones have a secondary association with stressed-syllable offsets in non-delayed accents, while they are either not associated with any prosodic landmark or associated with right-hand word edges in delayed accents. Regardless of the phonological analysis of these pitch gestures, the point we wish to highlight here is that focus words in Castilian Spanish seem to present a systematic lack of pitch peak delay.

Regarding the timing or alignment of post-focal valleys or low pivot points, the two competing analyses of Hualde (2000) and Face (2001) seem to make

two different predictions. In Hualde (2000)'s analysis, the presence of a post-focal boundary L tone blocks or minimizes peak delay. In such a case, the presence of a clear low pitch pivot point after the peak is necessary. Otherwise, peak delay would occur. In Face (2001)'s and Face & Prieto (2006)'s analyses, the absence of peak delay in focus pitch gestures is triggered by the phonology of the focal pitch gesture per se, and thus does not depend on the presence of a following L- tone. Face (2001) and Face (2002b) tested the predictions of both proposals. Some support for both analyses was found. It was found that some focal pitch gestures were realized with a following L tone (i.e., a clear low elbow). Others, on the other hand, did not display any clear trough in pitch; that is, the next pitch valley was the one associated with the following prenuclear pitch accent and not a L- tone systematically associated to the right-hand of the focused constituent. Since Estebas (2003c) systematically found post-focal valleys in her corpus of Central Catalan sentences, the presence of post-focal valleys may differentiate between Catalan and Spanish focal pitch contours.

In sum, according to research carried out to date, Central Catalan and Castilian Spanish seem to present very similar contrastive focus local pitch contours: complex rising-falling trajectories with the peak within the bounds of the corresponding stressed syllable. Differences may arise with respect to the timing of post-focal valleys. In Central Catalan post-focal valleys seem to be associated with right-hand word-edges (Estebas 2003c). In Castilian Spanish, there seem to be two different, optional contours. In one of the two contours, a post-focal valley occurs during the focused word and thus closely follows focal pitch gestures. In the other one, there is no immediately following valley (Face 2002b).

The present experiment is concerned with declarative sentences in scripted speech in which one of the words in the utterance receives a contrastive focus pronunciation. Instrumental analyses will be specifically concerned with focal pitch contours, while overall phenomena affecting prosodic words to the right or left of focal pitch gestures will be ignored.

4.2. Method

4.2.1. Materials. The twelve (12) subjects were recorded while reading aloud a list of sentences aimed at eliciting declaratives in which one of the words received a contrastive focus intonation. Unlike in Experiment 1, speakers were provided with a meaningful context or communicative situation for each sentence in order to gather naturally-sounding melodic contours. In the paper sheet that contained the sentence list provided to the participants, the word that was supposed to receive a contrastive focus intonation was written in capital letters. The subjects were asked to first read the sentence silently. The researcher would then ask a question, which provided the context, and the par-

Table 2. *Materials for Experiment 2: SVO (subject + verb + object), S^2VO (branching subject + verb + object), $SVO^{2/3}$ (subject + verb + branching object). All lexically-stressed syllables have accent mark.*

Language	Sentence	Structure
Catalan	*No, sa GERMANA caminàva per Bunyóla*	SVO
	No, sa germána CAMINAVA per Bunyóla	SVO
	No, sa germána caminàva per BUNYOLA	SVO
	No, sa GERMANA de'n Manólo caminàva per Bunyóla	S^2VO
	No, sa germána de'n MANOLO caminàva per Bunyóla	S^2VO
	No, sa germána anàva a sa BALLADA de Bunyóla	SVO^2
	No, sa germána anàva a sa balláda de BUNYOLA	SVO^2
	No, sa germána se menjáva s'ARANGADA saláda amb llimóna	SVO^3
	No, sa germána se menjáva s'arangáda SALADA amb llimóna	SVO^3
	No, sa germána se menjáva s'arangáda saláda amb LLIMONA	SVO^3
Spanish	*No, MANOLO se tomába la limonáda*	SVO
	No, Manólo se TOMABA la limonáda	SVO
	No, Manálo se tomába la LIMONADA	SVO
	No, la HERMANA de Manólo se tomába la limonáda	S^2VO
	No, la hermána de MANOLO se tomába la limonáda	S^2VO
	No, Manólo se tomába el HELADO de banána	SVO^2
	No, Manólo se tomába el heládo de BANANA	SVO^2
	No, Manólo se tomába el HELADO de banána con limonáda	SVO^3
	No, Manólo se tomába el heládo de BANANA con limonáda	SVO^3
	No, Manólo se tomába el heládo de banána con LIMONADA	SVO^3

ticipants were expected to read the answer audibly. For instance, the researcher would ask a question such as *Qui caminava per Bunyola, sa germana de'n Joan?* 'Who was walking around Bunyola, Joan's sister?' Following the question, the participant would say *No, sa germana de'n MANOLO caminava per Bunyola* 'No, MANOLO's sister was walking around Bunyola'.

The list included a total of 10 sentences, which were read twice by the participants. Thus, a total of 240 sentences were elicited (20 sentences $\times$ 12 speaker $=$ 240 total). The sentences varied in the number of prosodic words and their syntactic structure. The selected sentences were retrieved from the list used for Experiment 1. The materials are presented in Table 2. Factors such as stressed vowel, surrounding consonants and lexical-stress configuration were controlled for, as in Experiment 1 (see above).

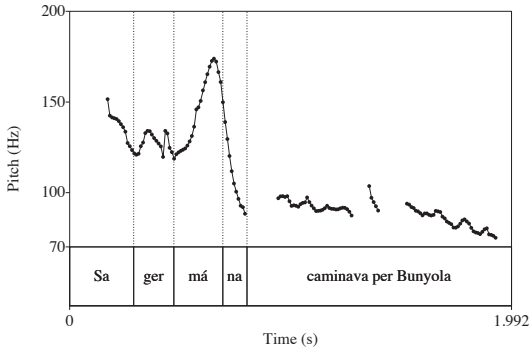

Figure 3. *Catalan sentence* Sa germana caminava per Bunyola *'Her sister was walking around Bunyola' with contrastive focus on* germana *'sister.'*

4.2.2. Metrics. Cursory examination of the data, with the use of time-aligned spectrograms, waveforms and pitch tracks revealed the existence of the following pitch patterns:

1. A steep rise followed by a steep fall, with the pitch peak occurring within the bounds of the corresponding stressed syllable.
2. A rising gesture with the peak on the post-stressed syllable. In this pattern, subsequent valleys did not occur until well into the following prosodic word.
3. A falling gesture throughout the stressed syllable with no clear preceding rise.
4. Words with a flat, low pitch.

The acoustic investigation of focal pitch gestures was concerned exclusively with the first type (i.e., rising-falling), since they constituted the vast majority of gestures that were found in both languages. There was a total of 176 rising-falling pitch gestures, 89 in Catalan and 87 in Spanish, out of the 240 total tokens (73 %). Notice that the most common shape for focal pitch gestures in both languages consisted of a rising-falling configuration that would seem to provide evidence for the systematic presence of L- boundary tones following focal rises in both languages.

In order to investigate the alignment patterns of rising-falling contours, three pitch events were identified: (1) pre-peak valley (onset of pitch rise), (2) peak (f0 maxima), and (3) post-peak valley (offset of pitch fall). Three prosodic landmarks were hand-segmented: (1) onset of stressed syllable corresponding to the focused word, (2) offset of stressed syllable, and (3) right-hand word edge of the focused word. Figures 3 and 4 display examples of rising-falling contours in Catalan and Spanish.

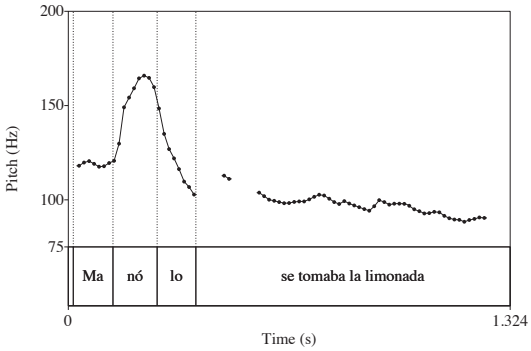

Figure 4. *Spanish sentence* Manolo se tomaba la limonada *'Manolo was having the lemonade' with contrastive focus on* Manolo *'proper name.'*

The examination of relative alignment patterns was carried out in two steps: (1) relative measures of pitch timing were compared across the two languages, and (2) absolute timing measures were submitted to linear models to examine their potential patterns of stability.

The selected timing measure to carry out the explicit contrastive examination was *relative timing* (i.e., the time distance between the stressed-syllable onset and each specific pitch event divided by stressed-syllable duration). This measure provides values that are between 0 and 1 if the target pitch event occurs between the onset and the offset of the stressed syllable (0 being the onset and 1, the offset), smaller than 0 if the pitch event precedes the syllable onset, and greater than 1 if it follows the syllable offset. Notice that this measure assumes that there is some sort of theoretical relationship between pitch events and lexically-stressed syllables. This is indeed what other investigators have found (Prieto & Torreira 2007). For instance, Face (2002a) measured the distance between valleys and stressed-syllable onsets and peaks and stressed-syllable offsets. These measures, although different than the ones used here, implicitly assumed that pitch events are timed with respect to stressed syllables. Due to potential differences in speech rate across speakers, we opted for the use of relative measures of pitch timing. That is, in order to avoid speech rate to interact with our analyses of pitch timing, the decision was made not to use absolute measures of timing, such as milliseconds. This is especially important here because between-speaker comparisons are fundamental in our analysis.

4.3. Results

Timing data were submitted to three separate t-tests, one for each dependent variable: (1) the relative timing of pre-peak valleys, (2) the relative timing of peaks, and (3) the relative timing of post-peak valleys. In each of the three t-test, the fixed factor was *Language* (Catalan vs. Spanish). The results of the first t-test revealed no significant effects of *Language* on the timing of the pre-peak valley [$t(165.78) = -0.107$; *ns*]. The second t-test also revealed no significant effects of *Language* on the relative timing of peaks with respect to syllable boundaries [$t(172.58) = -0.444$; *ns*]. Finally, the third t-test revealed significant effects of *language* on the relative timing of post-peak valleys [$t(173.05) = -3.061$; $p = 0.002$]. In sum, the inferential statistics revealed that post-peak valleys occur earlier in Majorcan Catalan [*mean* = 1.47, *sd* = 0.28] (i.e., closer to stressed-syllable offsets) than in Spanish [*mean* = 1.60, *sd* = 0.30].

Finally, the investigation of alignment patterns of pitch pivot points in Spanish and Catalan was completed with the analysis of potential stability patterns of two of the pitch pivot points. Stability patterns were examined with the use of linear regression models using the least squares method. Two predictor variables were selected: (1) the duration of the stressed syllable (*SyllDur*), and (2) the sum of the durations of the stressed and post-stressed syllable (*FootDur*), i.e., the time distance between the onset of the stressed syllable and the right-hand word edge (Estebas 2003b; Prieto 2006; Silverman & Pierrehumbert 1990). The two dependent variables that were examined were: (1) time lag between the onset of the stressed syllable the pitch peak (*peak delay*), and (2) time lag between the onset of the stressed syllable and the post-peak valley (*valley delay*). The data were divided into two subsets: (1) Catalan and (2) Spanish utterances.

In the Catalan data subset, neither stressed-syllable duration (*SyllDur*) nor foot duration (*FootDur*) were strong predictors of peak alignment. Of the two predictors, *SyllDur* [$F(1,88) = 22.64$; $p < .001$; $R^2 = 0.20$] was slightly better than *FootDur* [$F(1,88) = 17.09$; $p < .001$; $R^2 = 0.16$]. Regarding the timing of post-peak valleys, *SyllDur* [$F(1,88) = 20.68$; $p < .001$; $R^2 = 0.19$] was slightly worse than *FootDur* [$F(1,88) = 27.05$; $p < .001$; $R^2 = 0.23$]. These results agree with Estebas (2003c)'s findings for Central Catalan in that post-peak valleys seem to move somewhat in synchrony with right-hand word edges in Catalan.

For Spanish, the timing of peaks was similarly predicted by both variables: *SyllDur* [$F(1,85) = 48.58$; $p < .001$; $R^2 = 0.36$] and *FootDur* [$F(1,85) = 54.08$; $p < .001$; $R^2 = 0.38$]. Regarding the alignment of post-peak valleys, *FootDur* [$F(1,85) = 73.02$; $p < .001$; $R^2 = 0.46$] was stronger of a predictor than *SyllDur* [$F(1,85) = 47.97$; $p < .001$; $R^2 = 0.36$]. In sum, there seem to

be no major differences regarding the stability patterns of Catalan and Spanish. Differences in the timing of pivot points, specifically post-peak valleys, were found. On the one hand, it seems that post-peak valleys in both languages, when present, move somewhat in synchrony with right-hand word edges even though they do not need to strongly align with them. On the other hand, notice that *FootDur* is a much stronger predictor in Spanish than in Catalan. The presence of post-peak valleys, although optional, seems to be largely preferred in both languages.

4.4. Discussion

Experiment 2 was concerned with the signaling of contrastive focus in Majorcan Catalan and Majorcan Spanish. The focus of the analysis was on local intonational contours; that is, on words receiving the contrastive focus pronunciation. The most common intonational pattern in both languages consists of a complex rising-falling configuration in which pre-peak valleys occur by the onset stressed syllables and pitch peaks are placed within the bounds of stressed syllables. In agreement with previous findings for related dialects (Estebas 2003c; Face 2002b), rises not followed by clear post-peak valleys were slightly more common in Spanish than in Catalan. However, the two languages use fundamentally the same kind of pitch contour, a rising-falling contour.

For the rising-falling patterns, acoustic differences were found between the two languages with respect to the relative alignment of post-peak valleys exclusively. No relevant differences were found with respect to the relative timing of peaks, which occur within the bounds of the stressed syllable in both languages. In both languages, post-peak valleys seem to move somewhat in synchrony with right-hand word edges, as evidenced by the results of the regression models. However, valleys were found to occur earlier, with respect to the duration of stressed syllables, in Catalan than in Spanish. Additionally, although *FootDur* was a significant predictor in both languages, the R^2 values show that it was a stronger predictor in Spanish than in Catalan. This alignment difference does not come completely as a surprise, since it is known that languages and dialects present different patterns of alignment even for pitch accents that are highly similar, such as rising-falling accents in this case (Atterer & Ladd 2004; Muecke et al. 2009; Elordieta & Calleja 2005). On the other hand, the data reported here would be congruent with the following interpretation: (1) Majorcan Catalan contrastive focus pitch accents consist of a multi-tonal contour (L)+H*+L, while (2) Spanish focus accents consist of a pitch accent ((L)+H*) followed by an obligatory L boundary tone (L-).

5. General Discussion

The present paper has reported on two experiments aimed at investigating some of the differences and similarities between Catalan and Spanish, as spoken in the island of Majorca, with respect to the configuration of some of their intonational contours. In Experiment 1, broad focus read-aloud declaratives were analyzed in detail. More specifically, the experiment was concerned with the shape and alignment patterns of utterance-final pitch gestures. In Experiment 2, contrastive focus read-aloud declaratives were studied. The focus of the analysis was on the acoustic characteristics of local pitch movements in words receiving a focus pronunciation. Different patterns were described and their frequency of occurrence was reported. Additionally, accurate acoustic analyses were carried out on the patterns of relative timing of pitch points, such as valleys and peaks with respect to several prosodic landmarks, such as stressed-syllable offsets and right-hand word-edges.

Regarding the case of utterance-final pitch gestures, Majorcan Catalan accents were found to display an overall falling trajectory starting by the end of the pre-stressed syllable and finishing towards the end of the stressed syllable. The description of this pitch gesture is not equivalent to the one provided in Prieto (2002) and Estebas (2003a) for Central Catalan, because in Majorcan Catalan the falling trajectory seems to be accelerated (steeper) during the last stressed syllable in the sentence. Astruc (2005), in her corpus of Central Catalan data, described a pattern similar to the one we have found for Majorcan Catalan but it was not the most common pattern attested. Simonet (2009) found a very similar pattern in the production of 10 speakers of the dialect investigated here, Majorcan Catalan. Simonet (2009), however, used different speakers and different materials to the ones used in the present study. Furthermore, Simonet (2009) did not investigate the relative patterns of alignment of pitch peaks and valleys, as a different analytical method was used: one based exclusively on investigating the size of pitch excursions of pitch contours. We do not know what is the nature of the difference between Central and Majorcan Catalan. We wish to highlight, at this juncture, that an utterance-final pitch accent very similar to the one reported here and in Simonet (2009) for Majorcan Catalan has been previously described for other Romance varieties: Portuguese (Frota 2002b,a), Italian dialects (Grice 1995; D'Imperio 1997), and some American dialects of Spanish (Sosa 1999). Simonet (2009) develops the idea that falling utterance-final pitch accents are a conservative feature of Romance (and Ibero-Romance) while the type of rising-falling pitch accent found in Madrid Spanish (Face 2002a) is a more recent development (see Simonet (2009) for the full discussion.)

Finally, regarding Majorcan Spanish utterance-final pitch gestures, it was found that these mostly displayed either a rising-falling or a low-pitched flat

contour. Valleys, or rise onsets, were found to be timed with respect to stressed-syllable onsets while peaks or rise offsets were found to move in synchrony with right-hand word edges. Peaks were found to be placed within the bounds of stressed syllables. Thus, Majorcan Spanish utterance-final pitch gestures were found to be similar to those of Madrid Spanish (Face 2002a).

The initial hypothesis regarding the differences in the overall shape of utterance-final pitch gestures between the two languages was largely confirmed. In fact, due to the fact that potential differences seem to have been found between Central (as described in Prieto (2002); Estebas (2003a); Astruc (2005)) and Majorcan (as described here) Catalan in that Majorcan Catalan utterance-final pitch gestures present evidence of a clear L tone associated with the stressed syllable, the attested differences between Majorcan Catalan and Majorcan Spanish were even greater or more robust than anticipated.

At a general level, we believe that it could be affirmed that the attested differences with respect to the shape of utterance-final pitch gestures between the two languages are fundamental; that is, they pertain to the domain of the phonology of the two languages. It seems reasonable to assume that Spanish and Catalan speakers *intend* to reach different tonal *targets* in their production of utterance-final stressed syllables; that is, Spanish speakers intend to reach a H tone while Catalan speakers intend to reach a L tone. Variably, the Spanish H tone may be deaccented. In Catalan, the H+L* utterance-final accent we have described would seem to be in contrast with the preutterance-final rising L+H* accent, while the Spanish L+H* utterance-final accents may or may not be in contrast with Spanish L+H* preutterance-final accents. In Spanish, there is a systematic alignment difference between the two rising pitch gestures used in prenuclear and utterance-final positions, but their phonological status has been a matter of some debate in the literature (Face 2002a; Face & Prieto 2006; Hualde 2000).

Regarding the phonological analysis of Majorcan Catalan utterance-final accents, our data seem to support an analysis according to which utterance-final pitch gestures consist of two associated tones, (e.g., H+L*), since there appear to be a clear H and a clear L in most productions. Importantly, in Experiment 1 valleys (L) were found to be timed with respect to fall onsets (H) and not with respect to prosodic landmarks. This is different from what is usually found for rising accents in Spanish and other languages; that is, that rise offsets (H) are not timed with respect to onsets (L) but with respect to prosodic landmarks and are less robustly aligned with those than rise onsets (L) (Prieto & Torreira 2007). On the other hand, regarding the Majorcan Spanish rising-falling utterance-final pitch gestures, peaks or rise offsets were found to move in synchrony with right-hand word edges (or, less clearly, with stressed-syllable offsets). Peaks or rise offsets occurred within the bounds of stressed syllables. This seems to call for a L+H* analysis in which the relationship between the

two tones is less stable than that between the two ones of the Majorcan Catalan falling (H+L*) accents.

In summary, the data presented here seem to suggest that Majorcan Spanish utterance-final accents could be described as L+H* or H* (Face 2002a; Face & Prieto 2006; Hualde 2000), while Majorcan Catalan accents could be described as H+L* (Astruc 2005). The question remains, however, as to whether this very systematic difference in production is accompanied by a systematic difference in perception. That is, the question remains as to whether Catalan and Spanish listeners are able to recognize these specific melodic patterns as characteristic of their own language (van Leyden & van Heuven 2006). Another question that arises is whether balanced bilingual speakers will transfer the shape of the utterance-final pitch gestures in their dominant language to their non-dominant, second language (Atterer & Ladd 2004; Mennen 2004; Simonet 2008). These questions are left for future research.

Experiment 2 was concerned with the signaling of contrastive focus in the two languages under investigation. The focus of the analysis was on local intonational contours; that is, on words receiving the contrastive focus pronunciation. Intonational phenomena potentially marking contrastive focus outside of the focused word itself were not analyzed. The most common intonational pattern in both languages for words receiving a contrastive focus pronunciation consisted of a complex rising-falling configuration in which pre-peak valleys occur by the onset of stressed syllables and pitch peaks are placed within their bounds. The timing characteristics of peaks in focus pitch gestures clearly distinguishes them from those of prenuclear broad focus accents. This is true for both languages, based on research on the shape of prenuclear pitch gestures in the two varieties under investigation (Simonet 2006, 2007). Significant acoustic differences, however, were found between the two languages with respect to the alignment of post-peak valleys. In both languages, post-peak valleys seem to move somewhat in synchrony with right-hand word edges. However, valleys were found to occur earlier, with respect to the duration of stressed syllables, in Catalan than in Spanish. Importantly, however, post-peak valleys were found to occur systematically in both languages, contra previous findings for related dialects of the two languages (Estebas 2003c; Face 2002a).

The nature of the difference in the timing of post-peak valleys deserves further investigation. A possibility is that falls may be a defining characteristic of focus pitch gestures in Catalan, but not in Spanish. We believe that this interpretation would agree somewhat with the findings in Estebas (2003c) for Catalan and in Face (2002b) for Spanish. Recall that Estebas (2003c) found that post-peak valleys systematically occurred by right-hand word edges in Catalan, while Face (2002b) showed they were optional in that position in Spanish. Perception experiments would be useful for disentangling the nature of this difference. In paticular, this possible analysis would consider post-peak valleys in

contrastive focus pitch accents as the realization of a L associated with the pitch accent in the focused word (...H*+L) in Majorcan Catalan while it would be the realization of a L- boundary tone in Majorcan Spanish. In support of this explanation, it could be argued that alignment differences were found between the two languages (in post-peak valleys only) and that word- or syllable-edge effects were much stronger for Spanish than for Catalan.

Alternatively, the differences might be a question of low-level alignment characteristics of the two language varieties; that is, a phonetic rather than a phonological difference (Atterer & Ladd 2004; Elordieta & Calleja 2005). Recall that post-peak valleys were found, in both languages, to move in synchrony with right-hand word edges, which suggests some type of primary or secondary association between post-peak valleys and word edges (Atterer & Ladd 2004; Prieto et al. 2005; Face & Prieto 2006). In our opinion, this attests to the fact that their phonological nature is fundamentally identical. This would especially be the case if we were to assume that post-peak valleys arise, in both languages, from low boundary tones (L+H* … L-) that may be associated with the right-hand word-edge (Estebas 2003c).

6. Conclusion

The goal of the present paper was to find specific similarities and differences in the intonation of Catalan and Spanish as spoken in Majorca. The melodic configurations we investigated were: (1) utterance-final pitch accents in broad focus declaratives, and (2) local contrastive focus pitch accents. Previous research, mostly on related varieties, such as Central Catalan and Peninsular Spanish, had indirectly suggested that potential differences could arise with regards to these specific configurations (Estebas 2003a,c; Face 2002a, 2004). Overall, the hypotheses were confirmed by the data analyzed in experiments 1 and 2.

The important difference in the shape and alignment of utterance-final pitch accents in broad focus read-aloud declaratives between the two languages suggested that this difference is a categorical one. On the one hand, utterance-final pitch gestures in Majorcan Catalan were found to display a steep falling trajectory, which was steeper during the last stressed syllable in the sentence than during the pre-stressed and the post-stressed (H+L* … L%). Importantly, valleys were found to move in synchrony with the preceding peaks in this language variety. This supported an interpretation according to which the preceding high tone is a leading tone in a bi-tonal H+L* pitch accent. On the other hand, Majorcan Spanish pitch gestures were found to be better represented by rising-falling or mid-sustained pitch trajectories (L+H* … L%).

Regarding contrastive focus pitch gestures, no differences were apparent with regards to overall shape (rising-falling in both cases) and peak alignment.

However, for these pitch accents, the timing of post-peak valleys statistically distinguished Catalan from Spanish. These statistical characteristics, however, might not be random, but an inherent part of the sound structure of Catalan and Spanish, and one that native speakers of both languages need to learn. Two alternative explanations were put forward: (1) the difference might be phonological, with post-peak valleys being the realization of a L tone that is part of the focus pitch accent in Catalan and the realization of a L- boundary tone in Spanish, or (2) the difference might be due to a variable phonetic interpretation of an identical phonological configuration. The two alternative explanations are fully consistent with the data. The existence of language-specific phonetic interpretations of equivalent intonational phonological categories is well-known in the literature (Atterer & Ladd 2004; Elordieta & Calleja 2005).

Finally, we would like to add some remarks about how can the findings reported here inform an investigation into the intonational behavior of bilingual speakers. According to Flege's Speech Learning Model (Flege 1995), when second language learners need to acquire a "new", substantially different category (inexistent in their native language), they tend to be more successful in doing so than when they need to learn a slightly different *statistical* distribution that fundamentally corresponds to an "equivalent" category (existent in their native language) (Flege 1987). For instance, English learners of French experience lesser difficulties acquiring a native-like acoustic distribution of French /y/, which differs drastically from English /ʊ/, than for French /u/, which closely resembles it. In the present case, the prediction seems to follow that Spanish speakers learning Catalan as a second language (or Spanish-dominant Spanish-Catalan bilinguals) will be more successful in learning the Catalan H+L* utterance-final pitch accent (very different from Spanish) than the acoustic characteristics of the Catalan L+H*+L or L+H* … L- focus pitch accent (closely similar to Spanish). This is left for future research.

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