# MELODIC ALTERNATIONS IN SPANISH

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## ABSTRACT

This article describes how the tonal elements of two common Spanish intonation contours –the falling statement and the low-rising-falling request– align with the segmental string in broad-focus utterances differing in number of prosodic words. Using an imitation-and-completion task, we show that (i) the last stressed syllable of the utterance, traditionally viewed as carrying the 'nuclear' accent, associates with either a high or a low tonal element depending on phrase length (ii) that certain tonal elements can be realized or omitted depending on the availability of specific metrical positions in their intonational phrase, and (iii) that the high tonal element of the request contour associates with either a stressed syllable or an intonational phrase edge depending on phrase length. On the basis of these facts, and in contrast to previous descriptions of Spanish intonation relying on obligatory and constant nuclear contours (e.g., L* L% for all neutral statements), we argue for a less constrained intonational morphology involving tonal units linked to the segmental string via contour-specific principles.

**Keywords:** Intonation, tonal association, Spanish.

## 1. INTRODUCTION

This article presents the first data from a project aimed at investigating how the tonal elements of a variety of intonation contour types align with the segmental string in European Spanish. In particular, it presents acoustic data in graphical and auditory form for two intonation contours that feature interesting patterns of tune-text association: the falling statement, and the low-rising-falling request.

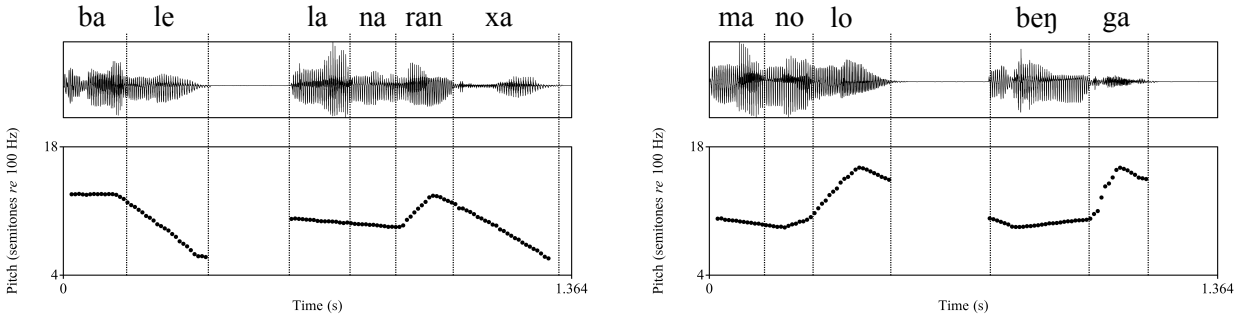
The falling statement contour has been described in [2] as having a low nuclear accent preceded by an optional number of prenuclear rising accents with delayed tonal peaks. However, when produced in an intonational phrase (IP) of only one prosodic word (PW), this contour seems to present a high rather than a low tone in the only stressed syllable of the utterance. The low-rising-falling request contour, which can be commonly observed in conversational settings, also appears to exhibit a melodic alternation in its final PW depending on IP length. Whereas in IPs of only one PW the only stressed syllable of the IP carries a low tone followed in by a terminal rise-fall in the postaccentual syllable(s), in IPs of more than one PW the last stressed syllable seems to carry a prominent high tone (followed by a terminal fall in the post accentual syllables). These patterns of tune-text association, which are reminiscent of those described by [4] for several Catalan contours, suggest that tonal association in Spanish is less straightforward than implied in recent descriptions of the intonation system of this language [2], in which different contour types are understood as consisting of an obligatory and constant nuclear component at its right edge (e.g. L* L% for all neutral statements), preceded by optional prenuclear accents in utterances containing more than one PW (i.e. more than one lexically stressed syllable [3]).

This study addresses two issues: (a) whether the melodic alternations sketched above on the basis of introspection and impressionistic observation can be elicited in a controlled experiment, and, more generally, (b) how Spanish intonation contour types are best represented in phonological terms.

## 2. METHOD

Four female participants from three different parts of Spain (speaker 1 from Oviedo, in northern Spain, speakers 2 and 4 from Madrid, in central Spain, and speaker 3 from Seville, in southern Spain), took part in an imitation-and-completion production task aimed at eliciting the two target intonation contours (i.e. falling statements and rising-falling requests) in broad-focus utterances differing in length (PW). In the training phase of the experiment, participants were asked to read and imitate a series of linguistic items corresponding to either a statement (i.e. *Vale. La naranja.* 'OK. The orange.') or a request (i.e. *Manolo. Venga.* 'Manolo. Come on.'). Each item was presented first in written form, and then also auditorily in a synthetic realization produced with a Nuance Vocalizer$^{TM}$ European Spanish voice. The pitch of the synthetic speech was manipulated in Praat [1] so that the utterances would feature either a falling statement or a low-rising-falling request con-

**Figure 1:** Illustration of the pitch contours of resynthesized utterances used in the training phase of the experiment. The sounds can be played in Adobe Acrobat Reader™ by clicking on the images.




two pitch patterns used, modeled after natural productions by a native speaker, are illustrated in Fig. 1. Note that the resynthesized sounds illustrated in this figure can be played in Adobe Acrobat Reader™ (but not necessarily with similar software) by clicking on the images.

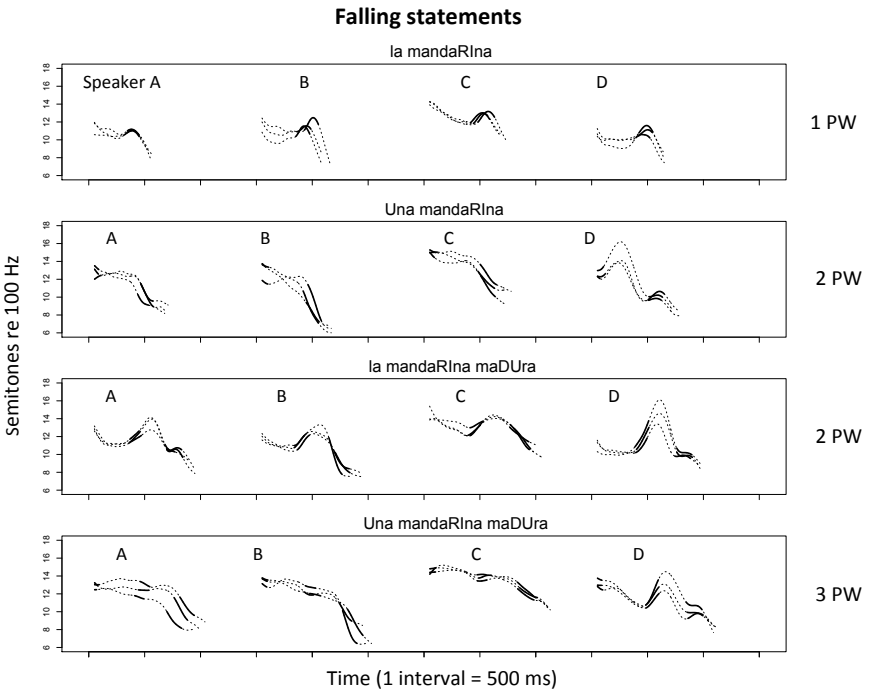
In the test phase of the experiment, participants encountered stimuli similar to the ones presented in the training phase, but differing in their number of PWs (see Table 1 in the Appendix). This time, only the initial word of each item (i.e. *vale* 'OK' in statements, or a proper name in requests) were presented both in auditory and written form, but the rest of the item was presented in written form only. Crucially, participants were asked to *complete* the utterances as naturally as possible. The pool of items was presented to each participant three times, each time with a randomized item order. Pitch contours were extracted from the recorded materials using the auto-correlation pitch detection function in Praat [1] in st re 100 Hz, and were smoothed via the smooth.spline() function in R [5] with a smoothing parameter of 0.7. We then annotated the start and end of each target utterance, and the start and end of all lexically stressed syllables using time-aligned waveforms and spectrograms.

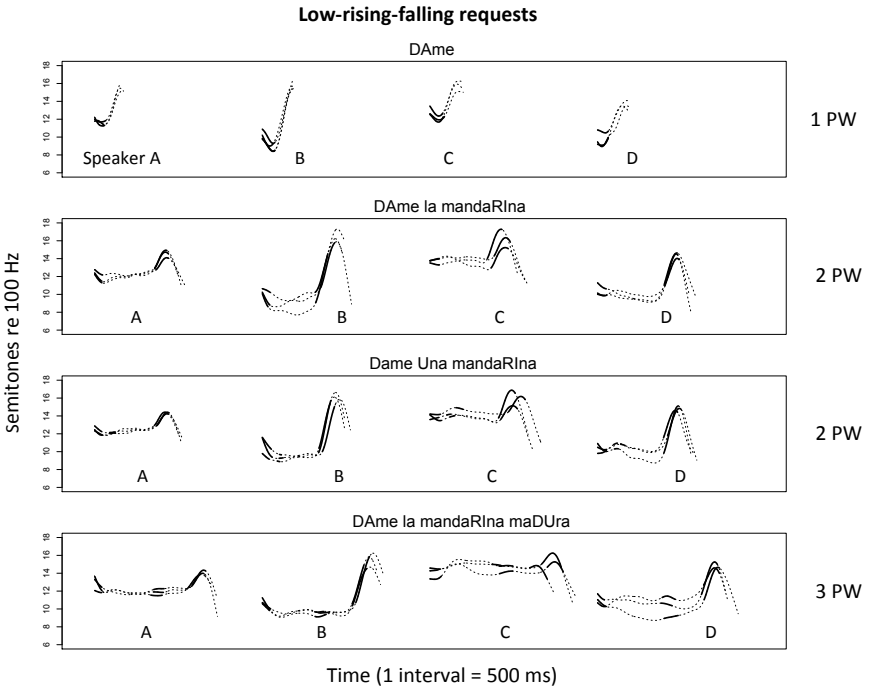
## 3. RESULTS

Fig. 2 shows the pitch contours produced by each speaker, overlaid and grouped by contour type and item (three repetitions per speaker). The parts of the contours corresponding to stressed syllables are drawn in thick lines. Note that the corresponding recorded utterances can be played in Adobe Reader (but not necessarily in other similar software) by clicking on the images.

The top panel in Fig. 2 shows that all falling statements in utterances consisting of only one PW were produced with a tonal peak on the stressed syllable *ri* of the word *mandarina*, and a low tone at the end of the utterance (note that the utterances illustrated in the figure can be played in Adobe Acrobat Reader™ by clicking on the different panels). On the other hand, in most utterances containing two or three PWs (in 24 out of the 36 tokens), the last stressed syllable of the utterance featured a falling tone. Exceptions to this pattern were found in speaker D's utterances, and in speaker A's realizations of the sentence *la mandarina madura* 'the ripe mandarin'. In these cases, the last stressed syllable of the utterance exhibited a sudden upward change in the otherwise falling pitch trajectory, resulting in a S-shaped falling pattern throughout the last word of the utterance. To investigate to what extent these cases differed statistically from those featuring a simple fall, we fitted first-order linear models to the pitch trajectories of the last stressed syllables, and visualized the distribution of their slope coefficients in a density plot in R. The data exhibited a clearly bimodal distribution, with no overlap between the two groups previously identified on the basis of visual inspection. The cases previously labelled as simple falls had slopes ranging between -29.03 and -7.75 st/s and a mean of -17.11 st/s, whereas those of the S-shaped group had slopes ranging between -3.85 and 6.76 st/s and a mean of 0.79 st/s. Assuming that the slopes of the simple falls were normally distributed, the probability of observing values of -3.85 or higher in their population is extremely low ($p < .0001$). Another striking difference between the two tonal patterns is that many of the S-shaped cases were also characterized by a prominent tonal peak located roughly towards the end of the penultimate PW of the utterance. All of this suggests that the long utterances were produced following two

**Figure 2:** Pitch contours in semitones (re 100 Hz) as produced by each speaker, for each contour type, and item. Stressed syllables are capitalized in the text, and drawn in thick lines in the plots. The utterances illustrated in each panel can be played in Adobe Reader by clicking on the figure.



tonal patterns (i.e. a final fall vs. a final rise-fall).

The top panel of Fig. 2 also shows an interesting melodic alternation in the first stressed syllable of the falling statements between cases starting with a series of unstressed syllables (i.e. *la mandarina*, *la mandarina madura*), which feature a falling or flat stretch of low pitch before an accentual pitch rise, and cases beginning with a stressed syllable (e.g. *una mandarina*, *una mandarina madura*). In the latter, the initial parts of the utterances tend to start with a high tone, and are mostly followed by a flat or slightly falling tone rather than a rise culminating in the post-tonic syllable.

Regarding the low-rising-falling requests, the bottom panel of Fig. 2 shows that they exhibited two main tonal patterns. In short utterances of one PW, the only stressed syllable of the utterance exhibited a slightly falling or low tone, followed by a rise to a high tone, and sometimes a slight terminal drop in pitch. In longer utterances containing two or more PWs, it was the first, rather than the last, stressed syllable of the utterance that exhibited a falling or low tone. This low tonal point was generally followed by a stretch of flat pitch (in 32 out of the 36 tokens), ending in a sudden pitch rise leading to a prominent tonal peak towards the end of the last stressed syllable, and a terminal fall to a mid or low tone.

## 4. DISCUSSION AND CONCLUSION

As we hypothesized, the number of PWs in the utterance conditioned the use of different tonal patterns for both falling statements and rising-falling requests. For falling statements, we found three main melodic patterns. First, utterances consisting of one PW consistently exhibited a tonal peak in their only stressed syllable. The second pattern, found in the majority of the longer statements, had falling pitch throughout the final stressed syllable of the utterance. Interestingly, this melodic alternation, here elicited experimentally, is similar to that described for Catalan declaratives in [4] on the basis of introspection. The third melodic pattern, mostly found in the long statements of speaker D, had two tonal peaks clearly differing in scaling and alignment, with the higher first peak realized towards the end of the first PW, and the second within the stressed syllable of the last PW. In our view, a plausible analysis of this pattern is that a) it consists of two units of intonational phrasing, b) that the first unit ends in a high edge tone, c) that the second and final unit has only one PW, and d) that this PW receives a high rather than a falling accent, as the word *mandarina* in the short utterance *la mandarina*.

Regarding the low-rising-falling requests, we observed two main melodic patterns. In short utterances consisting of only one PW, the only stressed syllable featured a low tonal target followed by a rise to a high tonal target in the final syllable, and, in some cases, a slight terminal fall. In the longer utterances, the initial low tonal point appeared to be realised in the first stressed syllable of the utterance, rather than the last one, which featured a very salient rise with a tonal peak located close to its end, followed a final a fall to a mid or low tone.

In light of these findings, one can wonder what kinds of tune-text association principles are followed by Spanish speakers when uttering the two studied contour types. First, a common feature of both contour types is that the first stressed syllable of the utterances in which they occur has stable tonal characteristics (i.e. high tones in statements, low tones in requests) regardless of phrase length. Second, in both contour types, certain tonal elements are realized *only* if certain metrical positions are available in the utterance: statements feature a final low accent only in IPs of more than one PW, and they exhibit initial accentual rises from an initial low target only when they start with one or more unstressed syllables. Third, an interesting feature of the low-rising-falling request is that its high tonal element appears to associate with different types of metrical position (i.e. a stressed syllable vs. a phrase edge) depending on the number of PWs in the IP. At the underlying level, therefore, this high tone does not appear to be specified in terms of a precise metrical role (i.e. it is neither a pitch accent nor a boundary tone).

The three observations above imply that Spanish intonation contour types (or at least the two contour types studied here) are composed of obligatory and optional tonal elements that get assigned to specific metrical locations (e.g. first or last stressed syllable of the phrase, right phrase edge) according to contour-specific principles of tonal association. Clearly, this is an important characteristic of Spanish prosody that should be addressed by intonational models of this language. In this respect, it should be noted that models relying on a set of constant final contours (e.g. L* L% for all statements regardless of IP length [2]; falling pitch throughout the last stressed syllable of all statements in text-to-speech systems) fail to generate the melodic alternations described here. Therefore, models supporting a less constrained tonal morphology and contour-specific principles of tune-text association such as the ones discussed here will be required to overcome this fundamental problem.

## 5. ACKNOWLEDGEMENTS

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## 7. APPENDIX

**Table 1:** Target utterances used in the test part of the experiment, and English translations. Syllables with lexical stress are indicated in bold and underlined. Falling statements were always preceded by the word *Vale* 'OK'. Low-rising-falling requests were always preceded by a person's name, such as *Manolo* or *Pedro*.

| | | | |
|---|---|---|---|
| Falling statements: | | | |
| | 1 PW | La manda**ri**na. | 'The mandarin.' |
| | 2 PW | **U**na manda**ri**na. | 'A mandarin.' |
| | 2 PW | La manda**ri**na ma**du**ra. | 'The ripe mandarin.' |
| | 3 PW | **U**na manda**ri**na ma**du**ra. | 'A ripe mandarin.' |
| Low-rising-falling requests: | | | |
| | 1 PW | **Da**me. | 'Give (some) to me.' |
| | 2 PW | **Da**me la manda**ri**na. | 'Give me the mandarin.' |
| | 3 PW | **Da**me una mandarina. | 'Give me a mandarin.' |
| | 3 PW | **Da**me la manda**ri**na ma**du**ra. | 'Give me the ripe mandarin.' |