Prosodic Patterns in Castilian Spanish Short Declarative Sentences

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Abstract

An utterance is normally divided into two or more intonation groups. Each intonation group has its intonation pattern. Pitch movement of Spanish utterance is basically determined by a combination of two factors: position of the stressed syllables and the intonation pattern.

The pitch of a syllable can be affected by that of preceding syllables. This is rather a physiological effect than a phonological one.

1 Introduction

While Spanish has traditionally been considered a "stress-accent" language, recent studies show that the fundamental frequency (f_0) is a more crucial physical cue than intensity and duration, for the perception of stress in Spanish. (See, for example, Quilis (1980).)

However, the stressed syllables do not always show higher f_0 values than the unstressed ones, as can be seen in Fig. 1 and Fig. 2. The "Normalized Log FF" values in the axis of ordinate are calculated by normalizing (or standardizing, in the statistical sense) the mean values in the vowel part of each syllable, of natural logarithms of f_0, as follows.

$$F_{ij} = \frac{1}{K_{ij}} \sum_{k=1}^{K_{ij}} F_{ijk}$$

where

$$F_{ijk} = \frac{\log_e f_{ijk} - m}{s} \quad , \qquad m = \frac{1}{N} \sum_{i=1}^{I} \sum_{j=1}^{J_i} \sum_{k=1}^{K_{ij}} \log_e f_{ijk} \quad , \qquad N = \sum_{i=1}^{I} \sum_{j=1}^{J_i} K_{ij} \quad ,$$

$$s = \sqrt{\frac{1}{N} \sum_{i=1}^{I} \sum_{j=1}^{J_i} \sum_{k=1}^{K_{ij}} (\log_e f_{ijk} - m)^2}$$

F_{ij}: Normalized Log FF of the j-th syllable of the i-th intonation group
    (The notion "intonation group" will be defined below in Section 2.3)

K_{ij}: Number of measured points in the j-th syllable of the i-th intonation group
    (f_0 was measured every 10 miliseconds)

f_{ijk}: Fundamental frequency (in Hz) at the k-th measured point of the j-th syllable of

the i-th intonation group

I: Number of intonation groups in the utterance

J_i: Number of syllables in the i-th intonation group.

This mathematical processing allows to compare f_0 movements of speakers who have different voice ranges.

Fig. 1 denotes the Normalized Log FF values of all the syllables constituting the sentence *ROsa y NaOmi SON aMIgas.* ("Rosa and Naomi are friends.", Capital letters indicate stressed syllables.) read by two Spanish speakers. Note that the last word *aMIgas* is pronounced in two different ways. The stressed syllable *MI* is pronounced with the highest pitch in the word in the utterance of Speaker 1, but not in that of Speaker 2.

Fig. 2, based on an utterance in a TV news, shows a curious phenomenon. The sentence, which could be translated as "The selections of Spain and Portugal confronted each other in Castellón in a football game for friendship, where the powers of the two teams were shown to be similar, judging from the final result.", when read by the announcer, was divided by short pauses into four parts, each of which is represented by a line in the graph. In the graph, the last syllable of the word *PortuGAL* is arbitrarily divided into *GA* and *L*. It should be noted that, in the last word of the first three parts, the third syllable counting back from the stressed one (the syllable *Por* of *PortuGAL*, for example) is pronounced with a strikingly high pitch. This phenomenon, widely observed in Spanish formal speech, is named "pseudoaccent" in Kimura (1992), where many similar examples are given.

These examples suggest the complexity of the relation between stress and f_0. This paper proposes a new hypothesis about the stress-f_0 relation in Castilian Spanish, paying special attention to the last word of a declarative sentence. Section 2 will introduce the hypothesis with some new notions, which will be applied to some simple utterances in the sections that follow.

2   Hypothesis and Definition of the Terms

For reasons of space, only the outline of the hypothesis will be given here. For more details, see Kimura (1996).

2.1   Stress

Stress is an abstract mark assigned to the specific syllable of each word in the lexicon. A stress, in itself, does not trigger any f_0 movement. The f_0 movement in Spanish should rather be regarded as a combination of stress pattern and intonation pattern, two notions to be defined below.

2.2   Sentence Melody

A *sentence melody* is defined as a simplified pitch movement in an utterance, constituted by the Normalized Log FF values of the syllables in the utterance. For example, Fig. 1 shows two different sentence melodies of one sentence. A sentence melody, calculated in this way,

carries no information about pitch movements within a syllable. But this does not cause any serious problem here, because the pitch does not rise nor fall sharply within a syllable in normal utterance of a declarative sentence in Castilian Spanish, except when the final syllable of the last word is stressed, in which case the pitch falls steeply in the last stressed syllable. This type of sentence is deliberately excluded from discussion in this paper. See Kimura (1996), pp.152-153 for a possible solution of this problem.

2.3 Intonation Group

Intonation groups (henceforth, "IG")are basic prosodic units, into which an utterance is divided. An extremely short utterance can consist of only one IG. In this paper, an IG is provisionally defined as a sentence constituent that contains one and only one stressed syllable. For example, the sentence *La moREna me miRAba.* ("The dark-complexioned woman was looking at me.") consists of two IGs, *la moREna* and *me miRAba.* See Fig. 3.

2.4 Stress Pattern

Stress pattern is a pattern that every IG has, as determined by the number of syllables it contains and by the position of the stressed syllable. For example, the stress pattern of the IG *la moREna* is 4_2, where the first number denotes that this IG consists of four syllables, while the subscript number indicates that the second syllable counting from the end bears the stress. Similarly, the IG *mi maMÁ* is of the stress pattern 3_1. *La moREna me miRAba* in Fig. 3 can therefore be said to be a $4_2 + 4_2$ type sentence.

2.5 Intergroup Configuration and Intragroup Melody

When an utterance consists of two or more IGs, the pitch ranges of the IGs form the *intergroup configuration* of the utterance. See the "INTER-group configuration" sections of Fig. 3 and Fig. 4.

The *intragroup melody* of an IG is made of the relative heights of the syllables within the pitch range of the IG. See the "INTRA-group melodies" sections of Fig. 3 and Fig. 4.

2.6 Intonation Pattern

Fig. 5 and Fig. 6 show the intragroup melody of *moliNEro* ("miller") and that of *la moREna* ("the dark-complexioned woman"), respectively, each pronounced in isolation (i.e., in citation form). These utterances can be considered as very short declarative sentences, consisting of only one IG. Note that the two melodies are very much alike, the stressed syllable being the highest, the last syllable the lowest, and the first two syllables located in between.

The intragroup melody of the first IG *la moREna* in Fig. 3 is noticeably different, in spite of having the same stress pattern (4_2). Here the first two syllables are pronounced very low, and the last (unstressed) syllable is the highest. The first IG in Fig. 4 shows a similar intragroup melody.

.This fact is another evidence that the stress pattern alone does not determine the intragroup melody. In other words, the intragroup melody is determined by a combination of the stress

pattern and another factor. And it seems reasonable to call this factor *the intonation pattern* of the IG. Fig. 5 and Fig. 6 have *the falling intonation pattern type 1*, while *the rising intonation pattern type 1* is present in the first half of Fig. 3 and of Fig. 4. On the second half of these figures, see Section 3.2.

3 Experiment on the Effect of the Preceding Pitch

3.1 Method

A male speaker from Salamanca and a female speaker from Madrid read 19 test sentences. In total, 38 utterances were analyzed. All the sentences consist of one or two IGs. All the syllables are of CV type. In case of only one IG, the stress pattern is either 3_2 or 4_2. In case of two IGs, length of the first IG ranges from one syllable to four syllables, covering all the possible stress patterns in Spanish, and the second IG is limited to stress patterns 3_2 and 4_2. In case of two IGs, the intragroup melodies of the first IGs are ignored in the following analysis, because our attention is here concentrated on the falling intonation pattern.

After measuring the f_0's and calculating the Normalized Log FF of each syllable, a further mathematical operation was done to obtain the "Secondary Normalized Log FF" (henceforth, "SN Log FF") values, in the following manner.

$$F'_{ij} = \frac{F_{ij} - F_{iJ_i}}{F_{ik} - F_{iJ_i}} \times 2 - 1 \, ,$$

where

F'_{ij}: SN Log FF of the j-th syllable of the i-th IG

F_{ij}: Normalized Log FF of the j-th syllable of the i-th IG

F_{ik}: Normalized Log FF of the stressed syllable of the i-th IG

F_{iJ_i}: Normalized Log FF of the J_i-th (i.e., the last) syllable of the i-th IG

That is to say, the value for the stressed syllable is fixed to $+1$, and that for the last syllable, to -1.

3.2 Results

Fig. 7 and Fig. 8 show the SN Log FF values of the syllables that precede the stressed syllable (pre-stress syllables), in relation to the distance from the stressed syllable of the preceding IG. Remember that the pitch of the stressed syllable (of the observed IG) is $+1$.

In the utterances of an isolated IG, the SN Log FFs of the pre-stress syllables are near zero.

When there is a preceding IG, the nearer the stressed syllable of the preceding IG is, the higher the pre-stress syllables are pronounced.

But this tendency is of little phonological interest, because this is obviously due to a physiological factor: after a high pitch with which the preceding stressed syllable is pronounced, it is impossible to make an immediate fall to the desired level.

Therefore, we can be fairly certain that the second IG of Fig. 3 and that of Fig. 4 have the falling intonation pattern type 1, just like Fig. 5 and Fig. 6, in spite of the apparent difference.

References

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    Hispánica, **36**, 76–88.

Kimura, Takuya (1996), "A Proposition of a New Method of Analysis of Spanish Prosody (in
    Japanese)", *Homenaje al profesor Makoto Hara — trabajos reunidos con motivo de la
    jubilación universitaria*, Tokyo, 137–160.

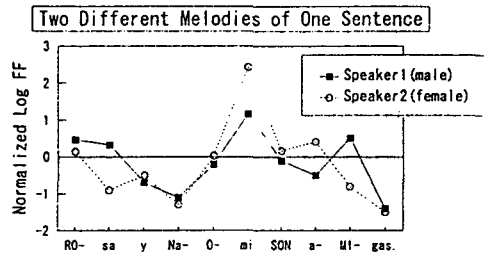Quilis, Antonio (1980), *Fonética acústica de la lengua española*, Gredos, Madrid.
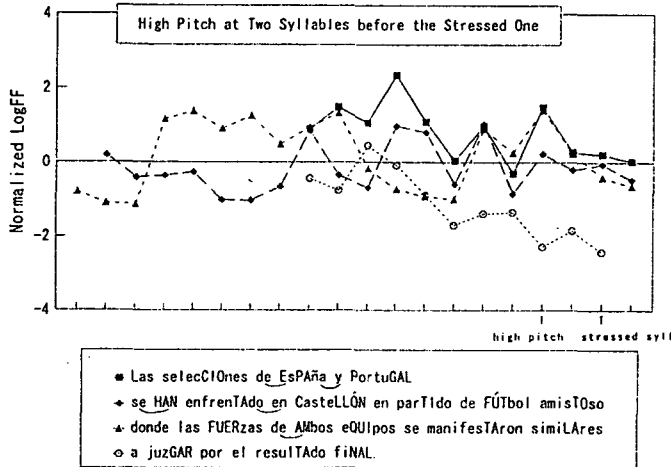
Fig. 1   From *NHK Radio Spanish Course*, April 1992, lección 6.

Fig. 2   From *España al día*, No.142,
January 28, 1991, Televisión Española.
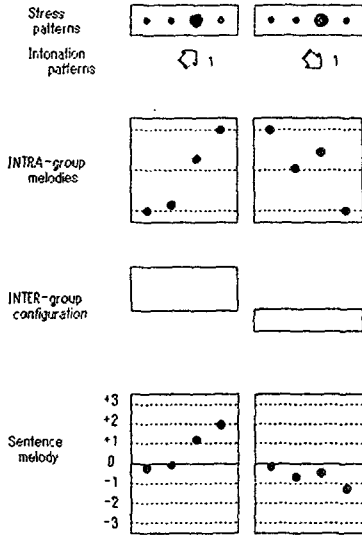
Fig. 3   "La moREna me miRAba."
by the male speaker from Salamanca
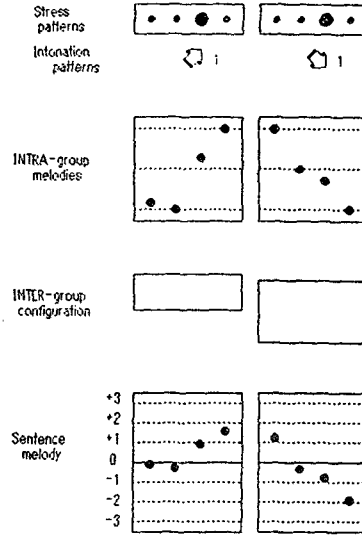
Fig. 4   "Me miRAba la moREna."
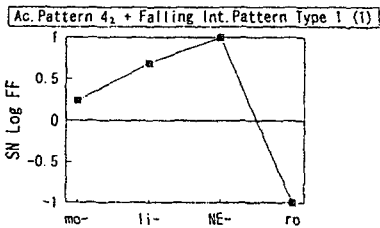by the female speaker from Madrid

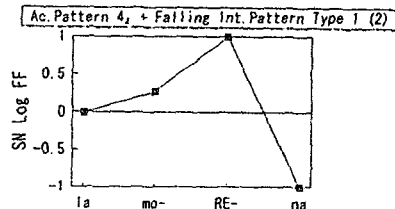Fig. 5   "MoliNEro."
by the female speaker from Madrid

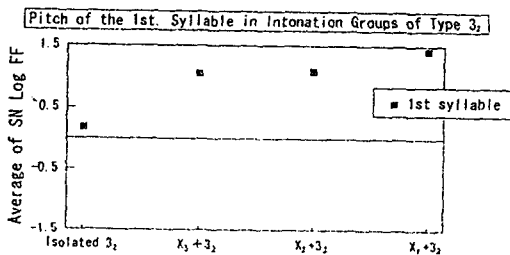Fig. 6   "La moREna."
by the female speaker from Madrid

Fig. 7

Fig. 8