Sorting out the phonetics and phonology of intonation: typological and acquisition data

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Abstract

The Autosegmental Metrical (AM) model of intonation offers several constructs for describing intonation. On the basis of data on language typology and language acquisition, this paper tries to sort out those constructs that because of their added semantic import should be characterized as phonemic, from the phonetic ones, which being language-specific as well, lead to variation without added semantic import. Phonetic constructs of intonation can be discerned when comparing languages that share similar "targets", but which show otherwise unmotivated differences. These are acquired later in L1, and tend to be persistent in L2.

Index Terms: alignment, boundary tones, phrase boundaries, pitch accents, scaling

1. Introduction

Intonation studies have been well established in the last thirty years. Studies of intonation in certain linguistic traditions and for certain specific languages are much older. However, never before had intonation flourished as in recent years, since the formulation of the AM-model, by means of which the intonation of many western languages has been described with much detail and depth. Among them, Spanish and German have often been submitted to analysis, and their pitch accents and boundary tones have been formalized by means of the so-called ToBI (see [1] and [2] for Spanish, and [3] for German).

However, there are still aspects that have not received as much detailed treatment. The AM-model tries to establish the intonation targets of a language, i.e. the Hs and Ls combined in pitch accents and boundary tones. Targets, though, come aligned to segments and/or to syllables. Moreover, there is downstep, upstep, and scaling. All these notions are interrelated and contribute to the specific make-up of the intonation of a language. And yet, are all of them of equal value? That is, should all these notions be represented as part of the intonation targets of a certain sentence type? One could be tempted to claim that **pitch accents** and **boundary tones (BT)** are the real targets, the phonemic units so to say, whereas the rest is only phonetic, i.e. a matter of detail. However, as we will see below, things are not as clear-cut, and they need careful inspection. In this paper we will focus two sentence types, declaratives and *yes/no* interrogatives in two languages, Spanish and German. The choice is based on many similarities and some differences in the intonation of these two sentence-types across the two languages.

After briefly describing these similarities and differences as typological data (section 2), acquisition data mainly from L1 but also from L2 will be presented (section 3). A discussion of the evidence leading to a characterization of what can be considered phonetic vs. phonemic will be presented in section 4, followed by some conclusions in section 5.

2. Aspects of Spanish and German intonation in comparison

Spanish and German are good representatives of the two language families, Germanic and Romance, and thus have numerous differences at the segmental and prosodic level. And yet in the area of intonation they show many similarities. These two languages have been selected for a comparative study, based on the different typology that they belong to and on the availability of acquisition data. L1 phenomena as well as some L2 phenomena will be considered, in order to try and characterize what elements of intonation have phonemic import and what elements are only phonetic, i.e. language specific but not distinctive.

2.1. Intonation of declaratives

The contours of declarative sentences can be reduced to a few targets both in Spanish and German, which can be characterized as follows.

Spanish declaratives:

- 1) First peak H appears in the post-tonic if pre-nuclear: L*H
- 2) A rise follows in the pre-nuclear phrase, which is again L*H
- 3) Nuclear-stressed syllable is H*
- 4) Fall from last stress to the end: boundary tone L%

German declaratives:

- 1) First peak H appears in the tonic syllable: H*L
- 2) A rise follows, again H*L also in case of pre-nuclear
- 3) Nuclear-stressed syllable is H*
- 4) Fall from last stress to the end: boundary tone L%

2.2. Intonation of *yes/no* interrogatives

A similar reduction can be undertaken for the contours of interrogative sentences in Spanish and German.

Spanish interrogatives:

- 1) First peak H is in the post-tonic if pre-nuclear, and higher than in declaratives
- 2) A fall of F0 follows, which is said to be unstressed
- 3) Nuclear stressed syllable is L*
- 4) Steep rise to the end: H%

German interrogatives:

- 1) First peak H is in the tonic, at a similar tone level as in declaratives
- 2) A fall of F0 follows
- 3) Nuclear stressed syllable is L*
- 4) Rise to the end: H-^H%

2.3. Some differential elements emerging from the comparison

Sections 2.1 and 2.2 have shown that Spanish and German intonation has much in common: the contours of declaratives and interrogatives are very similar except for the pre-nuclear pitch accent of Spanish. If we assume that the various Hs and Ls are the intonation targets in each sentence type, we have the following situation.

Spanish declaratives and interrogatives:

- 1) Pitch accent L*H of pre-nuclear phrases is typical for broad focus sentences, whereas H*L cues narrow focus ([4], [5], [6]). Scaling is here crucial, too, as a higher F0 contrasts interrogatives to a lower F0 in declaratives [7].
- 2) The following medial rise indicates declarativeness, whereas the absence of a medial rise indicates interrogativeness ([7], [8], [9], [10], [11]).
- 3) Nuclear-stressed syllable is H* in declaratives vs. the L* of *yes/no* interrogatives ([7], [8], [9], [10]).
- 4) The boundary tone L% indicates that the sentence is a declarative [9], whereas H% marks interrogatives [7].

German declaratives and interrogatives:

- 1) The peak H* appears in broad focus sentences, whereas L*H would indicate narrow focus [3]. There does not seem to be any difference between the first peak of interrogatives as compared with declaratives [12].
- 2) As in Spanish, the medial rise is typical for declaratives, whereas the absence of a medial rise indicates interrogativeness [13].
- 3) The nuclear-stressed syllable H* characterizes broad-focus declaratives vs. the L* of the nuclear stressed syllable of *yes/no* questions and vs. L*H of narrow focus [3].
- 4) The boundary tone L% indicates that the sentence is a declarative, whereas H% marks interrogatives [12].

The four targets in each sentence-type are tied to some semantic import: e.g. declarative vs. interrogative, broad focus vs. narrow focus. However, they do not all convey the same amount of information. For instance, as Face ([7], [14]) has shown, the final boundary H% tone of interrogatives in Spanish tends to be redundant, because Spanish hearers already know that the sentence is interrogative after the first or at most the second target. But the final H% may be crucial in the case of ambiguity between a declarative and an interrogative, as in Spanish both sentence-types may occur with the same word order.

An overview of the abundant literature on intonation reveals that there is more to intonation than just targets. Several studies on the intonation of each respective language have pointed out the following differences.

Additional differences:

- 1) The final fall of declaratives is steeper in Spanish than in German [10].
- 2) The last boundary tone of declaratives is lower in Spanish than in German [10].
- 3) The first peak of interrogatives is higher and appears later in Spanish than in German ([7], [12]).
- 4) The final rising slope of interrogatives is steeper in Spanish than in German ([7], [10]).

What information, if any, is contained in these four characteristics? They stand up when comparing the two languages, but they can be in a way dispensed with, in the sense that their absence does not seem to alter the semantic import of the utterance. As we will see below, children seem to acquire the targets before they acquire the other additional features; bilingual children tend to not make a difference between the two languages as regards such features and to apply one of them to both languages. The same can be observed in the prosody of some L2 speakers.

3. Acquisition of Spanish and German declarative and interrogative intonation

Studies on the acquisition of intonation, both by L1 monolinguals and bilinguals, and by L2 adults, are not numerous. Still, it would go beyond the purpose (and length) of this paper to refer to more than a few examples (see e.g. [15] for L1 and [16] for L2).

In the context of the present research it is crucial to ask whether both sets of prosodic features are acquired at the same time and in the same way by all subjects in a given group, or whether there is some manifest difference between the acquisition of what are normally considered targets and the features that we have called additional.

3.1. Acquisition data: subjects and methodology

The acquisition data reported here stem from studies on L1 acquisition of intonation of Spanish and German ([17], [18], [19]) and on L2 acquisition of Spanish by L1 adult German speakers [20]. All studies were carried out at the University of Hamburg. Some already published studies on L1 have been complemented with further measurements, and the study on L2 constitutes the data-base of an unpublished M.A. Thesis.

The subjects of the L1 studies on declaratives are two to three Spanish and German monolingual children, whose utterances have been selected for analysis at 2;0 and/or at 3;0 years of age, as well as two to three German-Spanish bilinguals of the same age growing up in Germany. For the study on interrogatives, besides two children in each of these groups, two Spanish-German bilinguals of about 3 years of age growing up in Spain were considered.

The studies on declaratives selected 20 broad-focus declarative sentences produced by each child, whose pre-final pitch accents were submitted to the analysis of alignment of tones to syllables: taking the end of the stressed syllable as the null-point, the distance in ms to the peak (H) was measured. Further measurements have included the steepness of the falling final slope (i.e. the distance in semitones between H and the final L% divided by time), as well as the distance in semitones between the mean F0 and the final L%. For the study of interrogatives all produced *yes/no* broad-focus questions were selected (a total of 116 utterances) and the F0 was measured at 4 points: onset of utterance, first F0-peak (H), F0-minimum (L) and final F0-peak (H%). The distance in ms between the onset of the utterance and the first peak (H) was measured, too, as well as the steepness of the final slope, i.e. the distance in semitones between L and the final H% divided by time.

The L2 study was based on declaratives and *yes/no* interrogatives read by four adult native speakers of German and four adult native speakers of Spanish, as controls. The Spanish test sentences were read by four adult German native speakers, who were advanced learners of Spanish. The F0 of the L2 declaratives was measured, in order to establish 1) the steepness of the falling slope, and 2) the difference in semitones between the pre-final peak and the final L%. In interrogatives, the 3) height and distance from the beginning of the utterance to the first H was measured, as well as 4) the steepness of the final rising slope.

3.2. L1 acquisition

In [17] it has been shown that at age 3;0 German and Spanish monolingual children already master declarative intonation, including the L*H pitch accent of pre-nuclear phrases in Spanish. This is not the case at age 2;0, as in [18] it was shown that out of three children only one used the L*H pitch accent of Spanish pre-nuclear phrases. In [17], it was further shown that German-Spanish bilingual children at age 3;0 did not yet master the pitch accent L*H in Spanish and tended to often substitute the German H* for it. Figure 1 shows these results represented by means of alignment: Spanish pre-final L*H, with the peak on the posttonic syllable, should show positive values, whereas German pre-final H*, with the peak on the tonic syllable, should show negative values. These results are only confirmed for the monolinguals. Bilinguals tend to compromise values, i.e. their values show a tendency that coincides with that of the target language, but they also produce negative values in Spanish (H* instead of L*H) and positive values in German (L*H instead of H*).

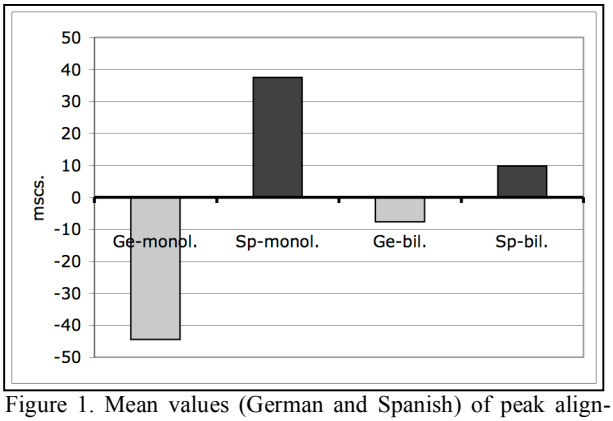

Figure 1. Mean values (German and Spanish) of peak alignment for monolingual and two bilingual children aged 3;0.

Measurements of the two additional features, namely that 1) the final fall of declaratives is steeper in Spanish than in German, and that 2) the last boundary tone of declaratives is lower in Spanish than in German were first performed in relation to the adult data. Results confirmed that: 1) the final slope was steeper in Spanish declaratives as compared with the German ones, and 2) the distance between the mean F0 and the final L% was 2.3 ST larger in Spanish than in German. However, child data at age 3;0 showed unexpected results: 1) the falling slope appears to be steeper in the monolingual German data than in the monolingual Spanish data. 2) Regarding the level of the final boundary tone, there does not seem to be any difference between the monolingual Spanish and the monolingual German child data. In the case of the bilingual data, 1) the final slope is as expected, steeper in Spanish than in German for both children, and 2) the distance between the mean F0 and the final L% is very similar in both languages.

The analysis of *yes/no* interrogatives produced by monolingual and bilingual children has been carried out in [19]. All children, monolinguals as well as bilinguals, already master the targets of *yes/no* questions at age 2;0. However, this is not the case for the two further features, namely that 3) the first peak of interrogatives is higher and appears later in Spanish than in German, and that 4) the final slope of interrogatives is steeper in Spanish than in German. In the case of monolinguals, these features are not completely mastered until 3;0 years of age, whereas at age 2;0, monolingual children only master one of the features, but not both. Bilinguals growing up in Hamburg do not master these features even at age 3;0, as they tend to have similar values in both languages. However, bilinguals growing up in Spain do differentiate the slopes of Spanish and German, producing a clearly steeper rising slope in Spanish; they also differentiate the initial peak in a language-specific fashion. Figure 2 shows the contours of *yes/no* questions produced by two bilingual children (Manuel and Simon) at 3;0 years of age growing up in Germany. Whereas both children produce targets adequately, they do not distinguish the final slope, which is produced as in German (Simon) or as in Spanish (Manuel). Notice that the initial peak is produced higher in Spanish than in German by one bilingual child.

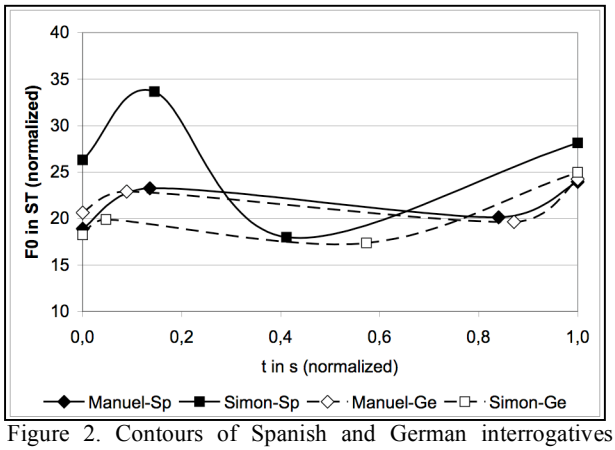

Figure 2. Contours of Spanish and German interrogatives produced by two bilingual children aged 3;0.

3.3. L2 acquisition

According to the results reported in [20], 1) the distance between the pre-final peak and the final L% in declaratives was 1.6 semitones larger in Spanish. This difference is rather minimal, but probably noticeable, according to [21], which shows that this is the minimal tonal difference required by Spanish-speaking listeners to be detected. The time between the pre-final peak and the final L% is shorter in Spanish than in German, which should lead to a steeper fall in Spanish. The results from the four Spanish L2 learners tended to show values that lay in between the German and the Spanish values, due to individual differences: one L2 speaker had values similar to the native Spanish ones, whereas the other three L2 speakers produced values almost identical to those of their L1 German. A further test on the acquisition of the L*H pitch accent of the pre-final phrases of declaratives showed that the L2 learners had already acquired this pitch accent, which the author attributes to the fact that this pitch accent is also present in the L1 German (i.e. in narrow focus). That is, the L2 learners did not have to learn the pitch tone of Spanish pre-final phrases from scratch.

The test related to the *yes/no* questions focused on the acquisition of the initial H, which in Spanish has higher tone values than in declaratives. This is produced with much variation by the L2 learners: whereas one produces the correct values of the L2, another subject produces the values of his L1 German, and the other two have compromise values in between those of the L1 and L2. Regarding the final slope, analyses tend to show that the steep slope of Spanish poses some difficulties to the L2 learners.

4. Discussion

In the present study we have tried to draw a distinction between targets of intonation and some additional features

involving alignment and scaling. Whereas both L1 monolinguals and bilinguals, as well as L2 speakers usually produce all targets of declaratives and interrogatives, the other additional features of intonation pose difficulties both to the L1 learners and the L2 learners. L1 monolingual children do not seem to produce the additional intonation differences of interrogatives at age 2;0, but produce most of them correctly at age 3;0. Bilinguals growing up in Germany have difficulties to produce the additional differences of interrogatives, even at age 3;0, as they only produce one of them in accordance with each language, either the initial peak or the final slope, but not both. Only the bilinguals growing up in Spain are capable of producing both additional features correctly, i.e. the initial peak and the final rise.

In the case of declaratives, monolingual results are contrary to expectations, as German monolinguals produce a steeper fall than Spanish monolinguals at age 3;0. Moreover, the L*H pitch accent of pre-final Spanish phrases poses some difficulty to 3;0-year-old bilinguals growing up in Germany, as they tend to substitute the German H* for it. These two phenomena could be expected to be related: not producing the delayed peak of the L*H pitch accent of Spanish should provide more time to the speaker to produce the end of a declarative, and thus lead to a final slope that is not as steep as in the adult language; however, the bilingual data show that there is not such a relationship, as in spite of missing L*H, the final slope of Spanish declaratives is not as steep as in the adult language. L2 speakers of Spanish do not have difficulty with the L*H pitch accent of Spanish pre-final phrases, but show difficulties producing the initial higher peak of interrogatives in Spanish. Further, the lower tones of Spanish declaratives seem to pose some difficulties both to L1 and to L2 learners, the latter looking for some intermediate or compromise solution.

Considering the overall results thus shows a mixed picture, in the sense that it is not the case that learners acquire the distinctive units before acquiring the non-distinctive ones. It is true that most of the distinctive targets have already been acquired at about 2;0, both by monolingual as well as by bilingual children. However, the additional non-distinctive features tend to require longer time, especially in the case of L2 learners. Bilingual children seem to have difficulties with the L*H pitch accent of Spanish, which even L1 monolingual learners do not generally produce at 2;0. Thus, this target requires more time to be acquired, which is probably due to the rising tone being more marked than falling tones (see e.g. [15]). Besides targets and additional features, other factors must be considered, as e.g. markedness. That is, markedness of rising tones seems to be the reason for the late acquisition of the steep slope of Spanish interrogatives, which is delayed in the acquisition of bilinguals growing up in Germany.

5. Conclusions

The studies on the acquisition of intonation considered here have shown that the various features of intonation can be split into phonemic and phonetic features. The former are acquired very soon both by monolinguals and bilinguals, but they may be delayed if they are marked. The latter require more time to be produced in a language-specific fashion. In the case of L2-learners, markedness does not seem to play such an important role, provided that the marked element also exists in the L1. If these results are confirmed by other studies, we can conclude that children acquire the distinctive aspects of intonation before acquiring the phonetic accompanying features, which do not convey meaning. Finally, L2 learners seem to also have special difficulties in the mastery of some non-distinctive phonetic features.

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