F0 ALIGNMENT AND SCALING: MELODIC CUES TO PROSODIC BOUNDARIES IN CATALAN

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1. INTRODUCTION

AIM OF THE PRESENT STUDY:

- **Exploring the role of melodic cues, i.e. F0 alignment and scaling, in boundary perception in Catalan**

BACKGROUND:

- **Prosodic breaks easier to perceive when they occur at syntactically or semantically congruent locations (Ladd 1996:236)**
- **However, still hard to indentify in some of these cases**
- **For example: the prosodic boundary that follows left-dislocated (LD) elements in languages such as Catalan**
- **In Catalan, LD-boundary most often realized with a high boundary tone (Feldhausen 2010), as shown in Fig.1.**
- **Problem: potential confusion with late prenuclear peaks, causing ambiguity (cf. Fig.2)**

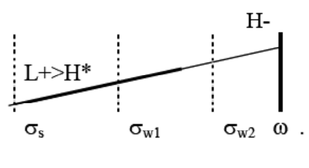

Fig. 1: Schematic diagram of a H- boundary on a proparoxytonic word.

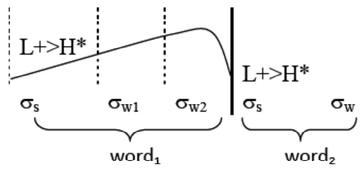

Fig. 2: Schematic diagram of the ambiguity between a late prenuclear peak and H-.

- **Prenuclear peaks are very late in Catalan (see Prieto *et al* 2009; de-la-Mota *et al* 2009), to the point that in proparoxytonic words (SWW), they are often aligned past the boundaries of the posttonic syllable and well into the final syllable of the word.**

QUESTIONS:

- **To what extent do Catalan listeners rely on melodic cues, that is, on F0 scaling and alignment?**
- **Can Catalan listeners reliably discriminate between late prenuclear peaks and high boundary tones?**

2. METHODOLOGY

STIMULI:

- **Same sentence uttered by a trained native speaker phonetician:**
  (a) with a prosodic boundary, as a clitic left-dislocated phrase (1);
  (b) without it, as a declarative (2)

(1)	**[La Bàrbara] vol venir demà.** the B. wants come.INF tomorrow **'Barbara, she wants to come tomorrow.'**	**[CLLD]**
(2)	**[La Bàrbara vol venir demà.]** **'Barbara wants to come tomorrow.'**	

- **Special care was taken in the selection of the base stimuli to exclude rhythmic cues to the prosodic boundary (up to the extent that this is possible in natural speech)**
- **Both base sentences read at the same speech rate**
- **They did not contain: pauses, excessive preboundary lengthening or creakiness at the potential boundary location**
- **Resynthesized stimuli (Fig. 3)**
- **Separate manipulation of F0 scaling and alignment in equidistant steps**

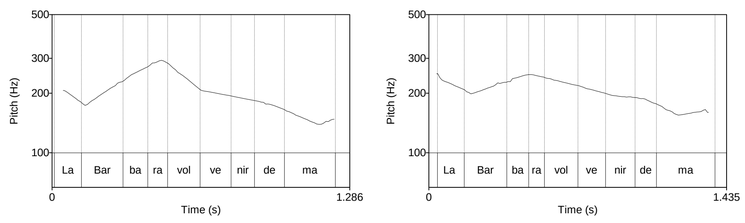

Fig. 3: Pitch contours of stylized material (left panel: CLLD; right panel: broad focus, no boundary).

EXPERIMENTS:

- **<u>First step</u>, *classical categorical identification* experiment (e.g. Liberman *et al* 1957; Repp 1984)**
  => Two original sentences used as base for manipulation of scaling (Exp 1) and alignment (Exp 2)

  (we shifted the scaling and alignment of the rise in five steps, for each of the base sentences until they approximate each other. This yielded no positive results, neither for scaling nor for alignment. <u>For this reason, not longer discussed here</u>)

- **<u>Second step</u>, *extended identification experiment* (e.g. Kuhl 1999; Schneider *et al* 2006)**
  => Original CLLD sentence used as base for manipulation of scaling (Exp 3) and alignment (Exp 4)

- **Following the method in Schneider *et al* (2006)**
- **Just one base stimulus is used, which is shifted in each direction until it becomes unnatural**
- **The scaling test has 23 stimuli (steps of 9Hz), cf. Fig. 4, and the alignment test 19 stimuli (steps of 13ms), cf. Fig. 5.**

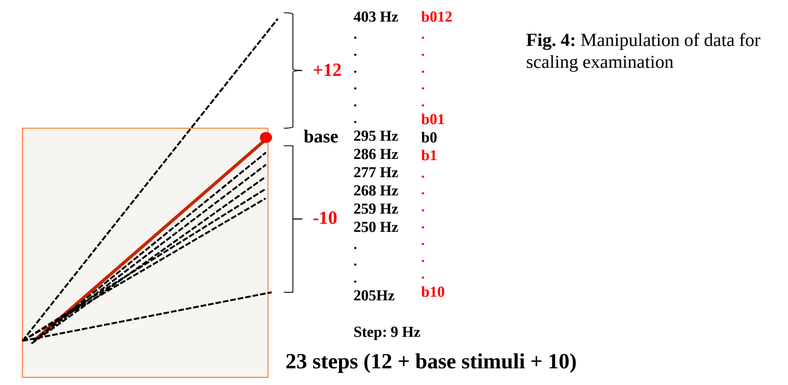

Fig. 4: Manipulation of data for scaling examination

Fig. 5: Manipulation of data for alignment examination

- **16 native speakers of Central Catalan**
- **Experiment presented on computer screen: participants listened to the stimuli and filled a single choice questionnaire (20-30 minutes)**
- **They were instructed to decide as fast as possible whether there was a separation between "La Bàrbara" and "vol venir demà", that is, whether they heard [La Bàrbara] [vol venir demà] or [La Bàrbara vol venir demà].** (Question for subjects: "Do you hear a separation between *Bàrbara* and *vol* as if there were a comma?")

RESULTS:

- **<u>Clear categorical effect for the scaling task</u> (cf. Fig. 6):**
  a) While speakers perceive generally no boundary from stimulus b0 (being the starting point of the manipulation, located at 295Hz) to b12 (being the stimulus with the lowest scaling)
  b) they perceive generally, i.e. in 70% of the cases, a boundary from b01 (being a stimulus close to the starting point) to b012 (being the stimulus with the highest scaling).
- **In contrast, no effect could be detected in the alignment task (cf. Fig. 7); participants appear to be at chance.**
- **Thus, <u>scaling is a more effective cue than alignment</u>**

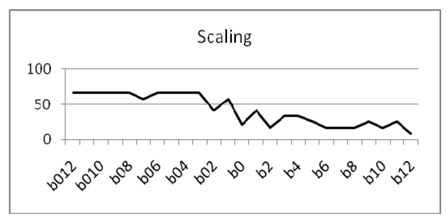

Fig. 6: Percentage of participants that perceived as a prosodic break resynthesized stimuli with varying scaling of the first peak. The starting point of the manipulation is "b0".

Fig. 7: Percentage of participants that perceived as a prosodic break resynthesized stimuli with varying alignment of the first peak. The starting point of the manipulation is "b0".

4. CONCLUSIONS

- **Overall, extended identification experiments seem to be more sensitive than the classical identification tasks.**
- **It is rather scaling than alignment that tells the difference between a sentence-internal prosodic break and a late peak**
- **The exact position of the peak is not important for the perception of a boundary: *If scaling already signals a boundary, the peak can also be located before the word edge***
- **The result that scaling is more robust than alignment is in line with the studies by Vanrell (2007), Savino & Grice (2007), and Vizcaino *et al* (2009).**

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