Raphaël Sichel-Bazin

LEADING TONE ALIGNMENT IN OCCITAN DISAPPROVAL STATEMENTS

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dirigit per Pilar Prieto Vives

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Departament de Filologia Catalana

Universitat Autònoma de Barcelona

ABSTRACT (IN ENGLISH)

The rising-falling nuclear pitch accent of Occitan disapproval statements consists of three tonal targets: LH+L*. Instead of leading the starred tone at a fixed interval in normalized time (Pierrehumbert and Beckman 1989), the two L and H leading tone targets align with specific anchoring points in the segmental stream, namely the left and right edges of the preaccentual syllable, respectively. Grice's (1995b) model for pitch accent structure allows us to account for this alignment pattern since it includes leading tones within a different node that precedes the one that dominates starred and trailing tones.

RESUM (EN CATALÀ)

L'accent nuclear ascendent-descendent de les oracions expressant desacord en occità consta de tres tons: LH+L*. En comptes de precedir el to asterisc ("starred tone") a un interval fix en temps normalitzat (Pierrehumbert & Beckman 1989), els tons menadors ("leading tones") L i H s'alineen amb determinats punts d'ancoratge de la cadena de segments: les fronteres dreta i esquerra de la síl·laba pretònica, respectivament. El model de Grice (1995b) per a l'estructura dels accents tonals permet donar compte d'aquest patró d'alineació incloent els tons menadors en un node diferent que precedeix el que domina to seguidor ("trailing tone") i to asterisc.

Key words: tonal alignment, leading tones, tritonal pitch accent

Paraules clau: alineació tonal, tons menadors (leading tones), accent tritonal

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1. INTRODUCTION

Occitan is a highly threatened Romance language, still spoken in the southern third of France, in the Aran Valley in Catalonia, Spain –where it is co-official with Catalan and Spanish– and in twelve valleys in the Alps of the Piedmont region of Italy. The prosody of this language has been the object of very little work: to our knowledge, only two articles[1] and the interactive atlas of Occitan intonation[2] deal with the prosody of Occitan. The latter is a rich online atlas, which provides data on dialectal intonation patterns of the language, as well as recordings made as part of a systematical intonation survey involving map tasks and video interviews. Of the two articles, Lai (2005) describes intonation patterns found in the Occitan variety spoken in Gap in the Hautes Alpes region of France in terms of the number of words within sentences and sentence type. Hualde (2003) offers a pilot study of Occitan intonation in which he points out that the study of Occitan prosody could greatly facilitate an understanding of the singularity of French prosody within the Romance language family, since Occitan occupies the place of a bridge language between French to the north and Ibero- and Italo-Romance languages to the south.

In fact, Occitan shares prosodic characteristics with both groups of languages. On the one hand, it has conserved a lexically distinctive stress pattern like the Southern Romance languages: though proparoxytones do not exist in Occitan, there are paroxytones and oxytones, and the location of stress may serve to distinguish two different words.

On the other hand, like in French, accented syllables in Occitan are not the only ones that can bear tonal movements. In French, it is well known that the tonal pattern of an

[1] Hualde (2003) and Lai (2005).
[2] Atlàs interactiu de l'intonacion de l'Occitan (2007): http://prosodia.uab.cat/atlasintonacion.

accentual phrase[3] is –at least very often– constituted by two rises: a non-obligatory early rise and an obligatory late rise. Welby (2004 and 2006) describes the alignment of the targets of this tonal pattern in French. The initial low target (L) of the early rise (LHi) normally aligns with the onset of the initial syllable of the first content word of the phrase, and the high target (H*) of the late rise (LH*) aligns quite stably with the last full syllable of the accentual phrase. By contrast, the first high target (Hi) and the second low target appear not to align with any specific segmental landmark. Therefore, while the late rise is associated with a metrically strong syllable, the early rise aligns with a syllable that may not be metrically strong. There is no agreement on the nature of the early rise: for example, whereas Post (2000) describes it as a pitch accent, Féry (2001) regards it as a boundary tone and Jun and Fougeron (2002) consider it a phrase accent.

Fig. 1 shows an example of this pattern with two rises in French[4]. The initial rise (LHi) aligns with the first syllable [na] of the content word *attardé*: the L aligns with the onset consonant [n] of the syllable (even if it belongs to the indefinite article *un*, the liaison phenomenon makes this consonant play the role of onset of the next syllable) and the peak occurs within the vowel. The late rise aligns with the last full syllable of the phrase [ˈðe]: its onset aligns with the beginning of the syllable and the peak occurs within the vowel. A final boundary tone is responsible for the following pitch fall.

[3] This prosodic domain has received many different names in the literature. However, Jun and Fougeron's (2002) denomination of "accentual phrase" has been retained here for it underlines its accentual definition and the obligatory presence of an accent at its end.

[4] We are very grateful to Trudel Meisenburg for making available the data this example was taken from. The data was recorded in 2004 in the locale of La Cauna/Lacaune (in the Tarn *département*) for an ongoing study of Occitan and French prosody in which we are currently participating.

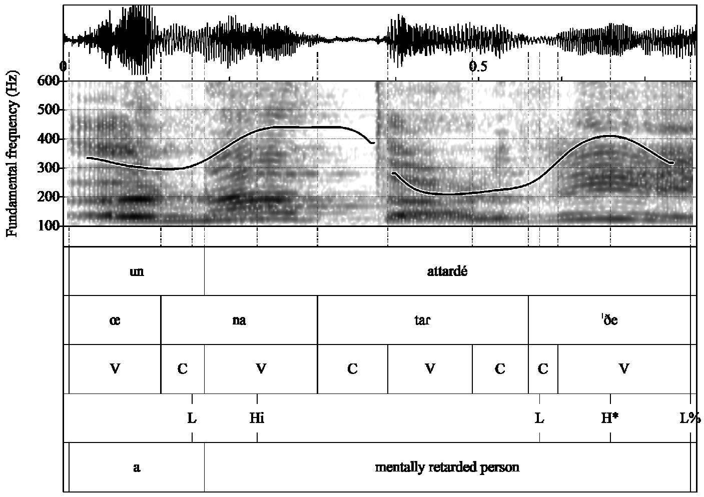

Fig. 1 - LHiLH pattern in southern French (recorded at La Cauna/Lacaune-les-Bains, Tarn)*

Hualde (2003) also finds this type of pattern in Occitan. Fig. 2 shows an example of it taken from our own recorded data. The onset of the initial rise (L) aligns with the beginning of the content word *maionesa* and the peak (Hi) occurs within the vowel of the first syllable. The late rise starts at the beginning of the lexically stressed syllable [ˈne] and the peak (H*) occurs within its vowel. The pitch then falls because of a final low boundary tone that associates with the postaccentual syllable [ʒɔ].

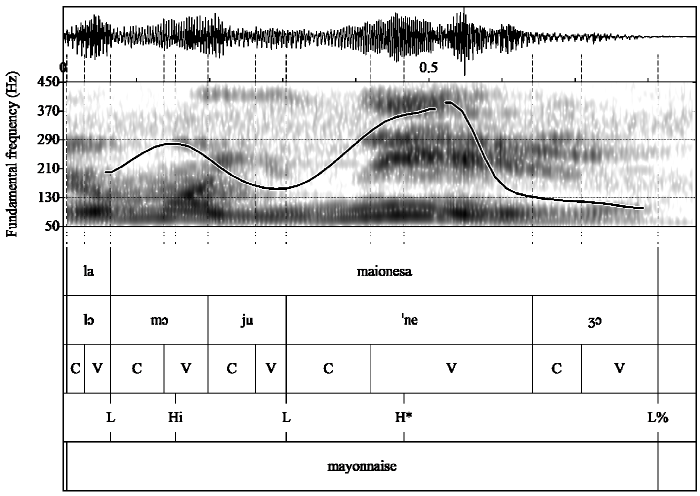

Fig. 2 - LHiLH pattern in Occitan (recorded at Las Leschas/Les Lèches, Dordonha/Dordogne)*

Hualde (2003) remarks that pitch rises may appear in positions adjacent to the accented syllable in Occitan, and that "the falling (or low) nuclear accent of Occitan appears to differ from that of the other languages", arguing that he very often found "a fall from a preceding syllable with a secondary accent". Thus, Occitan appears to present rises on syllables that are not metrically strong not only in content-word initial position but also in preaccentual position.

This study focuses on the nuclear pitch accent of Occitan disapproval statements, which we found show exactly this sort of rising-falling pattern, in which the preaccentual syllable bears a rise and the accented one a fall, as represented in Fig. 3.

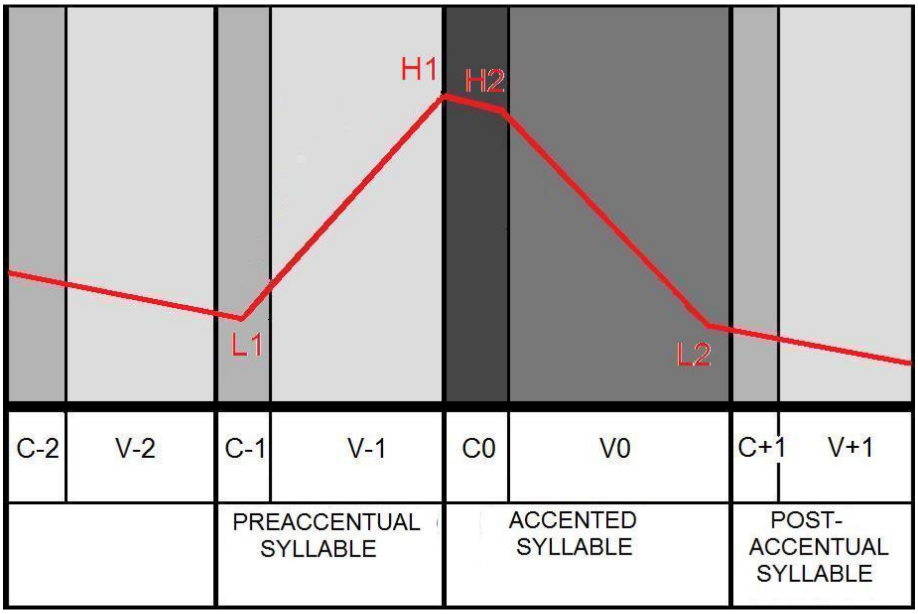

Fig. 3 - Contour diagram of the nuclear pitch accent of an Occitan disapproval statement

This fits what Hualde (2003) describes since the fall in the accented syllable is preceded by a rise aligned with the preaccentual syllable. Actually, the onset of the rise (L1 in Fig. 3) appears to coincide with the onset of the preaccentual syllable and the peak (H1 in Fig. 3) with the syllable boundary, and while the end of the fall (L2) seems to occur within the vowel of the accented syllable.

This pattern has also been described for French. Post (2000) distinguishes two types of pitch accents in French: H* and H+H*. H+H* may only appear in IP-final position. It presents a peak in the preaccentual syllable followed by a fall in the accented one. In Post's model, if the H+H* pitch accent is followed by a 0% boundary tone, the pitch falls to a mid level because when two H targets are adjacent, the second one is downstepped. In the event that H+H* is followed by an L% boundary tone, the pitch falls to a low level after the preaccentual peak. Two H targets may be separated by an L tone –which moreover prevents the second H tone from being subject to downstep– so Post's intonational grammar of French allows for tonal patterns like L H+H* L%, which correspond to the same pattern as the pitch accent which we will focus on in the present study.

Post (2000) finds that falls from a preaccentual peak are "used to convey that the speaker thinks that what he says is evident, or that he does not want to commit himself". Actually, this appears to be the meaning conveyed by this pitch accent in Occitan too. This pattern is attested in many different dialects in the data of the *Atlàs interactiu de l'intonacion de l'occitan*, in utterances labeled under the following categories: contrastive focus, emphasis, categorical statement, obvious statement and exclamation[5]. In fact, all of these utterances, as well as the disapproval statements used in the present study, are perfectly consistent with Post's (2000) description of the pragmatic meaning associated with this pitch accent.

This nuclear pitch accent has also been found to be preceded in some cases by a rise on the first syllable of the content word that bears it, that is, by an initial rise similar to those found in French. In this case, the tonal pattern consists of a rise that starts at the beginning of the first syllable (Li in Fig. 4), followed by a high plateau (from Hi to H2 in Fig. 4), and then a fall (H2 to L2 in Fig. 4) associated with the accented syllable. The initial rise has been described as a marker of emphasis (Hualde 2003), but the general

[5] The sentences showing this pitch accent were found at the locales of Bruèjols (categories: *contrastive focus (2)*, *categorical statement (2)*, and *obvious statement*), La Vessèira (*contrastive focus*, *emphasis*, *categorical statement*, and *exclamative*), Selhans (*emphasis*), Le Fossat (*contrastive focus*, *emphasis*, and *exclamative*) and Auloron (*contrastive focus*).

meaning of the sentence presenting the pitch accent in question does not change whether there is an initial rise preceding it or not.

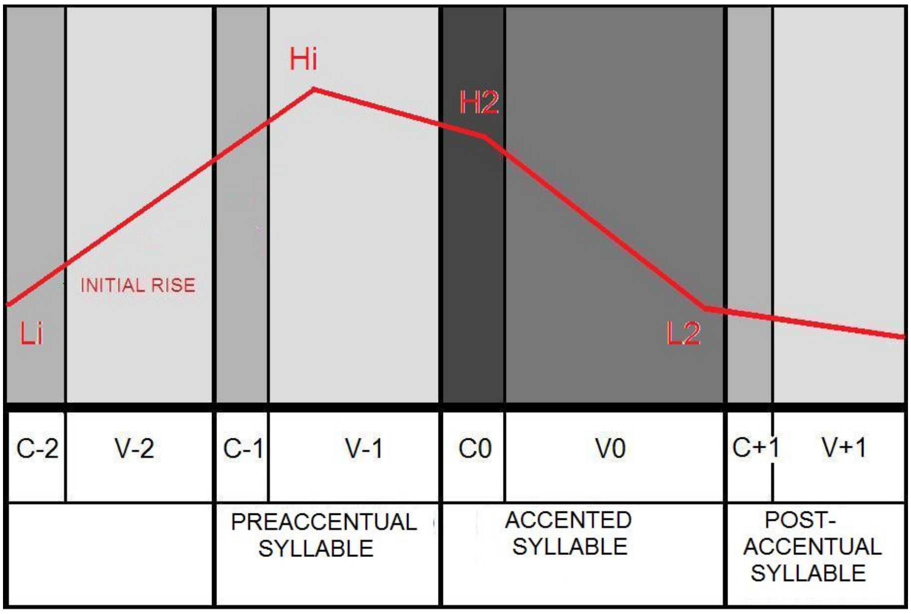

Fig. 4 - Contour diagram of the nuclear pitch accent of an Occitan disapproval statement in the presence of an initial rise

As far as we know, the alignment of the tonal targets of this pitch accent has not been studied in much detail. However, tonal alignment has already been described in the literature for pitch accents of other Romance languages that convey different meanings but present some similar phonetic/phonological characteristics.

Frota (2002) describes falling pitch accents in European Portuguese. The pitch accent she finds in broad focus statements is labeled H+L*, that is, it is composed of a high leading tone and a low starred tone. This pitch accent shares with the one focused on here the fact that it presents a fall on the accented syllable. The author finds that the high leading tone target preceding the nuclear fall always aligns just before the accented syllable. Thus, in European Portuguese nuclear falls, the H leading tone anchors at a particular point of the segmental stream: the left boundary of the accented syllable.

Prieto (2009) deals with tonal alignment in nuclear falls in Catalan neutral yes-no question headed by the particle “que”. This nuclear pitch accent is also labeled H+L* in the Cat_ToBI system. She finds that “while the beginning of the falling accent gesture (H) is tightly synchronized with the onset of the accented syllable, the end of the falling gesture (L) is more variable”. Thus, the high leading tone also has a fixed anchor point in the segmental stream in Catalan nuclear falls, but in this case it is the onset consonant of the accented syllable.

Gili Fivela (2002) describes the differences between two contrastive peak accents in Pisa Italian, one appearing in a broad focus context, and the other one in a contrastive focus context. Both present a peak within the accented syllable, preceded by a low turning point aligned with the onset consonant of this syllable. In the contrastive focus context, the peak is followed by a fall to a low target whose alignment does not depend on the number of syllables that separate the pitch accent location from the next prosodic boundary, whereas there is a tonal interpolation from the peak to the next low boundary tone in the broad focus context. Therefore, the author concludes that the contrastive focus pitch accent presents a low trailing tone, which is absent in the broad focus pitch accent, so the broad focus pitch accent is rising and the contrastive focus one is rising-falling. Thus, the contrastive focus pitch accent shares its tonal pattern with the pitch accent investigated in the present work, even if its alignment pattern is not the same.

Following Pierrehumbert’s (1980) work, the autosegmental metrical (AM) tradition usually accepts monotonal and bitonal pitch accents. Pierrehumbert & Steele (1989) described pitch accent structure in detail, and since then Grice (1995b) and Frota (1998), among others, have made alternative proposals. Monotonal pitch accents consist of a high or low tone associated with an accented syllable. This tone receives a star in the AM model transcription in order to indicate its association with the accented syllable: thus H* stands for a high tone associated with the accented syllable, and L* for a low one. Bitonal pitch accents are represented by a starred tone plus one other tone. If the unstarred tone precedes the starred tone, it is a leading tone. A leading tone is normally associated with the preaccentual syllable or the onset of the accented syllable. L+H* stands for a rising tone during the accented syllable, and H+L* for a falling tone during the accented syllable. The unstarred tone may also follow the starred tone, and in this case, it is a trailing tone, normally associated with the post-stressed syllable(s). L*+H stands for a low tone aligned with the accented syllable followed by a rising movement, and H*+L for a high tone aligned with the accented syllable followed by a falling movement.

The AM model traditionally avoids tritonal representations for pitch accents. Actually, three tonal targets per pitch accent would generate a huge combinatory of possible pitch accents, many more than the quantity of contrastive pitch accents within a linguistic variety. This overgeneration has been the biggest argument against incorporating three targets in a pitch accent.

In this connection, Gili Fivela (2002, 2006a) faces a problem in the representation of the contrast between the two peak accents in Pisa Italian as far as the low turning point preceding the peak is concerned. In fact, the broad focus rising pitch accent could be labeled L+H* without any problem in the AM model, but to include the first L target in the representation of the contrastive focus pitch accent would lead to a tritonal pitch accent L+H*+L. The above mentioned problem of overgeneration has led Gili Fivela (2002, 2006a) to leave open the question as to whether the low turning point preceding the peak accents of Pisa Italian is to be considered a leading tone target or not. She argues that peaks in Pisa Italian may have the property of always being preceded by a low turning point aligned with the onset of the syllable, which might not have to be accounted for in the phonological representation.

The hypothesis of the present study is that the nuclear pitch accent of Occitan disapproval statements is tritonal, with a low target associated with the accented syllable, preceded by a complex leading tone configuration involving two targets: one low and one high. In the same way, this rising-falling pattern implies three tonal targets and thus poses a problem for its representation within the AM model.

One of the main aims of this study is to determine the alignment patterns of the tonal targets of the pitch accent with respect to the segments and syllables, with a special emphasis on the alignment of the leading tones. To our knowledge, there are no detailed empirical studies of how leading and trailing tones are aligned, except that it is generally assumed that "the position of the unstarred tone with respect to the segmental material [...] varies considerably depending on the speech rate and the intrinsic length of the segments" (Pierrehumbert & Steele, 1989:183). To our knowledge the only author to go beyond such generalizations is Grice (1995:215ff.), who proposes two different representations for leading and trailing tones and argues that leading tones are associated with the syllable preceding the accented syllable (if one is available), while trailing tones occur a fixed interval in "normalized time" after the starred tone. Section 3 describes the alignment of the tonal targets of the nuclear pitch accent of Occitan disapproval statements with respect to the segments, and shows that the leading tones align with regard to the preaccentual syllable.

Finally, Section 4 attempts to match these results to three different models that have been proposed for pitch accent structure: the model proposed Pierrehumbert and Beckman (1989), the hierarchical model exposed by Grice (1995b) and followed by Frota (1998, 2000a, 2002), and the flat model proposed by Grice (1995b). All three models make predictions regarding the relationship between leading, starred and trailing tones. The dependence between tones within a pitch accent differs from one model to another and this implies different predictions in terms of tonal alignment. The results of section 3 will shed a bit of light on how these models can be improved to give a better account of leading tone alignment patterns with respect to the segmental stream and syllables.

2. METHODOLOGY

2.1. SUBJECTS

Four subjects were recorded, one female (G) and three males (J, N and P). They are native speakers of the Limousin dialect of Occitan spoken in the region of Moissídan (in French "Mussidan", in the Dordonha/Dordogne *département*, France), where they were born and have lived their whole lives. All were between 70 and 80 years old when they participated in the experiment. Their schooling was limited to compulsory education, and all of them are now working class pensioners.

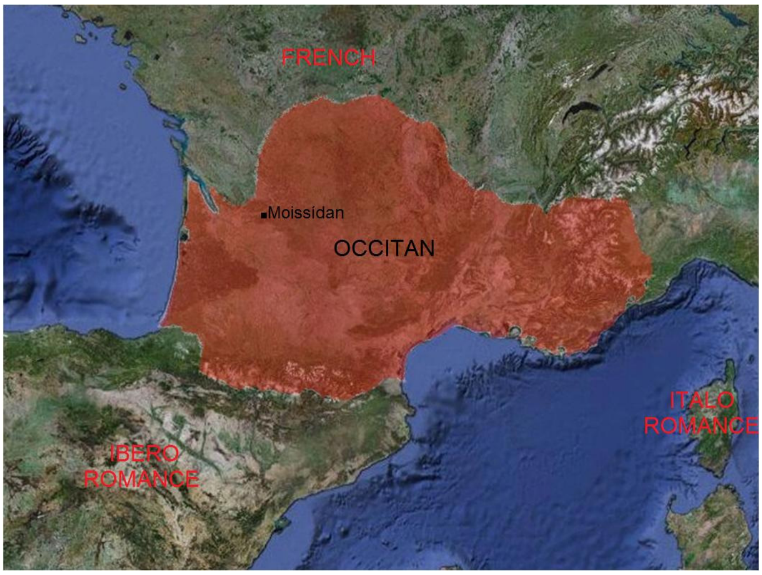

Fig. 5 - Location where data was collected within the linguistic domain of Occitan (map created using Google maps)

Since the pitch accent under study is attested in many (almost all) dialects of the Occitan language, we chose the locale of Moissídan because we had lived in this locale for many years and were acquainted with speakers of Occitan from this area.

2.2. DATA

The data were obtained from a situation survey based on the methodology applied by Prieto (2001). This is an inductive method thought to yield recordings of semi-spontaneous speech in a natural way. The subjects are prompted to imagine everyday-life situations and then utter sentences that correspond to the reaction they would have in such situations.

Five types of situations were created in order to elicit disapproval statements. For each type of situation, a set of 12 different items was used to change the words in utterance-final position. These 12 final words were the same for the five types of situations: 6 oxytones and 6 paroxytones, all containing only CV syllables in accented and preaccentual position.

The situations were as follows:

1. *Arribatz chas vos après èsser 'nats far las comissions e en botant las chausas dins los armaris vos rendètz compte qu'avètz obludat de 'chaptar **de la limonada**. Vòstre/a marit/femna vos ditz de tornar en vila per ne 'chaptar. Vos ne sètz pas d'acòrd e emmaliciat/da li disètz que non, que volètz pas tornar en vila per 'chaptar **de la limonada**.*

   You arrive at home after shopping and as you are putting away what you have bought, you realize that you have forgotten to buy **lemonade**. Your husband/wife tells you to go back to town and buy some. You do not agree and tell him/her angrily that you do not want to go back to town to buy **some lemonade**.

   The expected sentence was: "*A non! Vau pas tornar en vila per 'chaptar **de la limonada**!*" (No, I'm not going back to town to buy **some lemonade**!)

2. *Vos e vòstra/e femna/marit sètz convidats a un sopar. Volètz portar quauquarren, e vos damandatz çò que podètz be portar. Vòstra/e femna/marit vos prepausa de portar **de la limonada**, mas vos, trobatz que quò vai pas far plaser a las gents que vos an convidats. Dijatz a vòstra/e femna/marit que non, que vatz pas lur portar **de la limonada**.*

   You and your husband/wife are invited for dinner. You want to take something to give to your hosts, but you are not sure what. Your husband/wife proposes that you take **some lemonade**, but you feel that it would not please your hosts. Say to your husband/wife that you are not going to bring them **lemonade**.

The expected sentence was: "*A non! Vam pas lur portar* ***de la limonada****!*" (No, we're not going to bring them **lemonade**!)

3. *Sètz en vila emb daus amics e cerchatz un restaurant per 'nar dinnar. Aimatz ben* ***la limonada,*** *e coma anuèch quo es un jorn de fèsta, volètz pas 'nar a un restaurant onte n'i aia pas. Passatz davant un restaurant e un amic vos prepausa d'I 'nar. Coneissètz lo restaurant e sabètz qu'aquí n'an pas. Dijatz-li que volètz pas 'nar dins un restaurant onte n'an pas* ***de la limonada****.*

   You are in town with some friends looking for a restaurant for lunch. You like **lemonade** very much, and since today is a special day, you do not want to go to a restaurant that does not serve **lemonade**. As you are passing in front of a restaurant, one of your friends proposes that you go there. You know the place and know that they do not have **lemonade**. Tell him that you do not want to go to a restaurant where they do not serve **lemonade**.

   The expected sentence was: "*A non! Ieu vau pas dins un restaurant onte ne serven pas* ***de la limonada****!*" (No, I'm not going to a restaurant where they do not serve **lemonade**!)

4. *Un amic vòu se garçar de vos e vos incita a beure* ***tota 'na botelha de limonada*** *perque sap que z'aimatz pas. Mas volètz pas vos laissar far. Dijatz-li que non, que vai pas vos far beure* ***tota 'na botelha de limonada****.*

   A friend of yours wants to make fun of you and challenges you to drink *a whole bottle of lemonade* since he knows that you do not like it. But you do not want to play along. Tell him that he's not going to make you drink *a whole bottle of lemonade*.

   The expected sentence was: "*A non! Vas pas me far beure* ***tota 'na botelha de limonada****!*" (No, you aren't going to make me drink **a whole bottle of lemonade**!)

5. *Avètz un amic qu'es fanatic de* ***limonada,*** *e quand comença de ne'n parlar s'arrèsta pus. Dins la conversacion, lo subjèct es estat abordat. Pensatz pas lo laissar monopolizar la conversacion tota la serenada. Dijatz-li sechament que non, que comence pas a parlar de* ***limonada.***

   A friend of yours is *lemonade* fanatic, and once he starts talking about it, he won't shut up. In the course of a conversation, the subject comes up. You are not disposed to let him monopolize the conversation all night long, so you tell him tersely not to start talking about *lemonade*.

   The expected sentence was: "*A non! Començas pas a parlar* ***de limonada****!*" (No, don't start talking about **lemonade**!)

In each of these situations, the item in bold was replaced with each of the twelve items in the following set:

- paroxytones:
    - *de la limonada* [dɛ lɔ limuˈnadɔ] (lemonade)
    - *dau vin d'Alemanha* [dow ˈvi dɔlɛˈmaɲɔ] (German wine)
    - *de la camamilha* [dɛ lɔ kɔmɔˈmiʎɔ] (chamomile)
    - *una moleta* [nɔ muˈletɔ] (an omelet)
    - *de la maionesa* [dɛ lɔ mɔjuˈneʒɔ] (mayonnaise)
    - *de la remolada* [dɛ lɔ rɛmuˈladɔ] (remoulade, mayonnaise-type dressing)
- oxytones:
    - *un melon* [ym mɛˈlu] (a melon)
    - *daus botarèus laminats* [dow butɔˈɾew lɔmiˈna] (sliced mushrooms)
    - *dau salami* [dow ʃɔlɔˈmi] (salami)
    - *daus canelats* [dow kɔnɛˈla] (canelats; these are cakes typical of Bordèu/Bordeaux)
    - *de la blanqueta de Limós* [dɛ lɔ blɔ̃ŋˈketɔ dɛ liˈmu] (sparkling wine from Limós/Limoux)
    - *daus chocolats au pralinat* [dow sɔkɔˈla ow pɾɔliˈna] (praline chocolates)

The utterances were recorded by means of a SONY ECM-MS907 microphone connected to a computer. The GoldWave v5.14 audio program was used to create and edit the WAV files.

Some utterances were rejected because they presented intonational patterns corresponding to other meanings, such as neutral statements or statements with a narrow focus on the last word of the sentence.

175 utterances were retained for the study:

SUBJECT	**G**	**J**	**N**	**P**	**All**
UTTERANCES WITHOUT INITIAL RISE	27	20	36	13	96
UTTERANCES WITH AN INITIAL RISE	7	38	9	25	79
TOTAL NUMBER OF UTTERANCES	34	58	45	38	175

Fig. 6 - Database as a function of the presence or absence of initial rises by speaker

2.3. ANNOTATION OF THE DATA

WAV files were annotated to TextGrid in Praat version 5.0.33, with three tiers:

- **orthographic tier**: interval tier with the orthographic transcription of the last word(s);

- **segments tier**: interval tier with the different segments of the last word(s); the segments annotated were:

  - C-2: onset consonant of the syllable two syllables before the accented one
  - V-2: vowel of the syllable two syllables before the accented one
  - C-1: onset consonant of the preaccentual syllable
  - V-1: vowel of the preaccentual syllable
  - C0: onset consonant of the accented syllable
  - V0: vowel of the accented syllable
  - C+1: onset consonant of the postaccentual syllable when there was one
  - V+1: vowel of the postaccentual syllable when there was one

The boundaries of the segments were determined first on the basis of visual examination of the spectrogram and then verified by acoustic perception.

- **tone tier**: point tier with the tonal targets of the nuclear pitch accent, and the initial rise when there was one; the tonal targets annotated were:

  - the first low target: L1 (when there was no initial rise) or Li (when there was an initial rise)
  - the F0 maximum: H1 (when there was no initial rise) or Hi (when there was an initial rise)
  - the beginning of the fall: H2
  - the end of the fall: L2

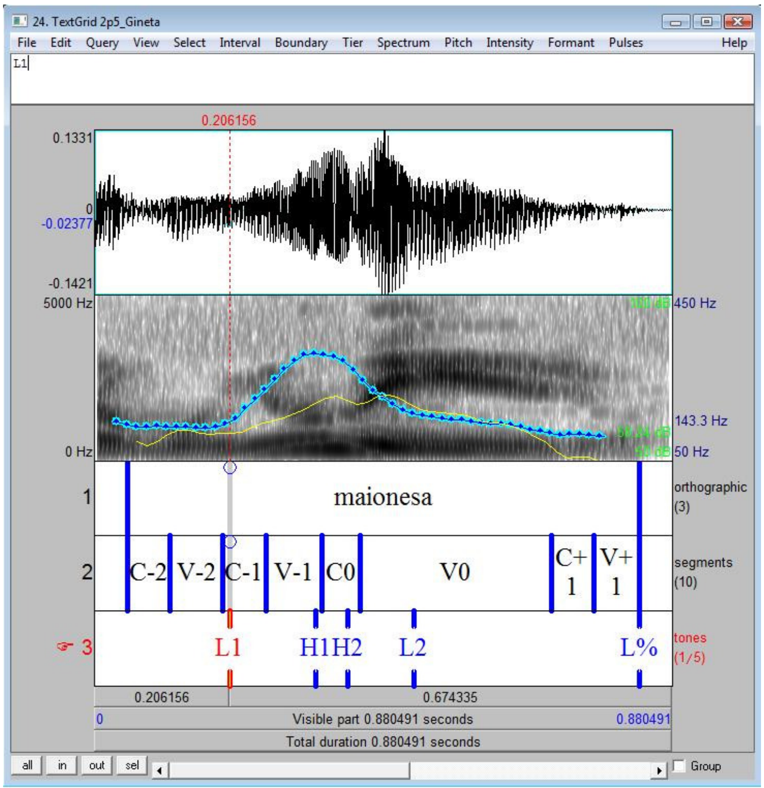

Fig. 7 - Example of annotation in Praat of an utterance without initial rise

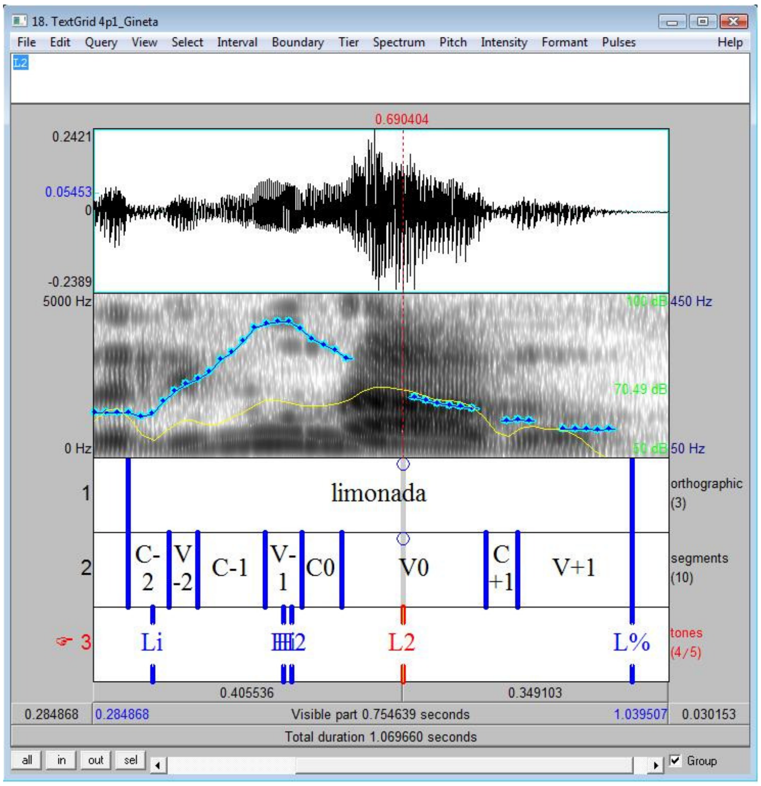

Fig. 8 - Example of annotation in Praat of an utterance with an initial rise

The F0 maximum was detected automatically by the corresponding function of the Praat program. The other tonal targets (L1, H2 and L2) were located visually at the turning points in the curve. A pitch extraction was done with the corresponding Praat function in order to locate more accurately the points where the slope of the curve changed. If one selects a point on the Praat pitch curve, the corresponding F0 value is automatically visible, and since points are equidistant in time, F0 values of adjacent points were compared. L1 was annotated manually just before the point for which the F0 increase from the previous point started to become significantly greater. In the same way, H2 was annotated where the F0 decrease started to become greater, while L2 was the point where the F0 decrease began to diminish.

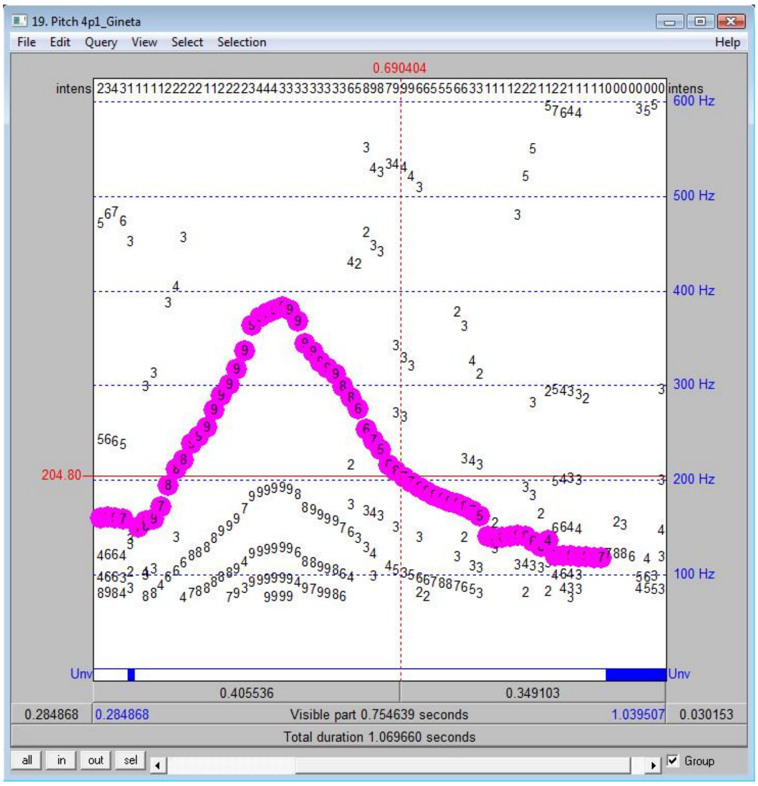

Fig. 9 - Pitch extraction in Praat of the utterance of Fig. 8 and location of L2

Then, two Praat scripts were used in order to extract respectively time and F0 values at all the annotated segment boundaries and tonal targets, and Microsoft Excel and statistics programs SPSS 15.0 and PASW Statistic 10.7 were used to analyze the numeric data. Finally, graphs were created using SPSS 15.0 and PASW Statistic 10.7.

3. ALIGNMENT OF THE TONAL TARGETS OF THE NUCLEAR PITCH ACCENT OF OCCITAN DISAPPROVAL STATEMENTS

This section of the paper presents the results in terms of time alignment for the different tonal targets of the nuclear pitch accents of our data with respect to the segmental stream, that is, segments and syllables. The tonal targets taken into account are:

- L1: the low turning point at the beginning of the rise when there is no initial rise
- the F0 maximum: H1 in absence of initial rise, Hi in its presence
- H2: the beginning of the fall
- L2: the end point of the fall

Since the tonal pattern observed was different in the presence or absence of an initial rise, the data were separated into two different sets in function of this factor in order to analyze them separately.

The time at the tonal targets analyzed was subtracted from the time at different segments' onset and/or offset for each utterance, and then the distribution of these values was evaluated for each subject and for all the subjects together.

The results are shown as box plots. In each graph, the brown box shows the distribution of 50% of the values of the cases analyzed, the thick black line within the box corresponds to the median value, the vertical black lines extending from the top and bottom of the box indicate the distribution of the extreme values, and the horizontal line which traverses the box marks the 0 level. The values are first presented for each subject and then for all the subjects together.

3.1. ALIGNMENT OF L1 WITH RESPECT TO C-1

Since L1 is not visible in the presence of an initial rise, the data taken into account in section 3.1 are only those that did not present initial rises.

3.1.1. ALIGNMENT OF L1 WITH RESPECT TO THE BEGINNING OF C-1

The time at the beginning of C-1 was subtracted from the time at L1 in the data set without initial rise, in order to determine the alignment of L1 with respect to the beginning of the preaccentual syllable.

The five graphs in Fig. 10 show the alignment patterns of the L1 target with respect to the beginning of C-1 for each one of the four speakers and for all speakers together.

The results show that the time at L1 is consistently higher than the time at the beginning of C-1, so L1 is aligned after the beginning of C-1.

Thus, in the absence of an initial rise, the onset of the rise is aligned very closely to the beginning of the preaccentual syllable, at a mean value of 11.56ms (±19.120) after its beginning.

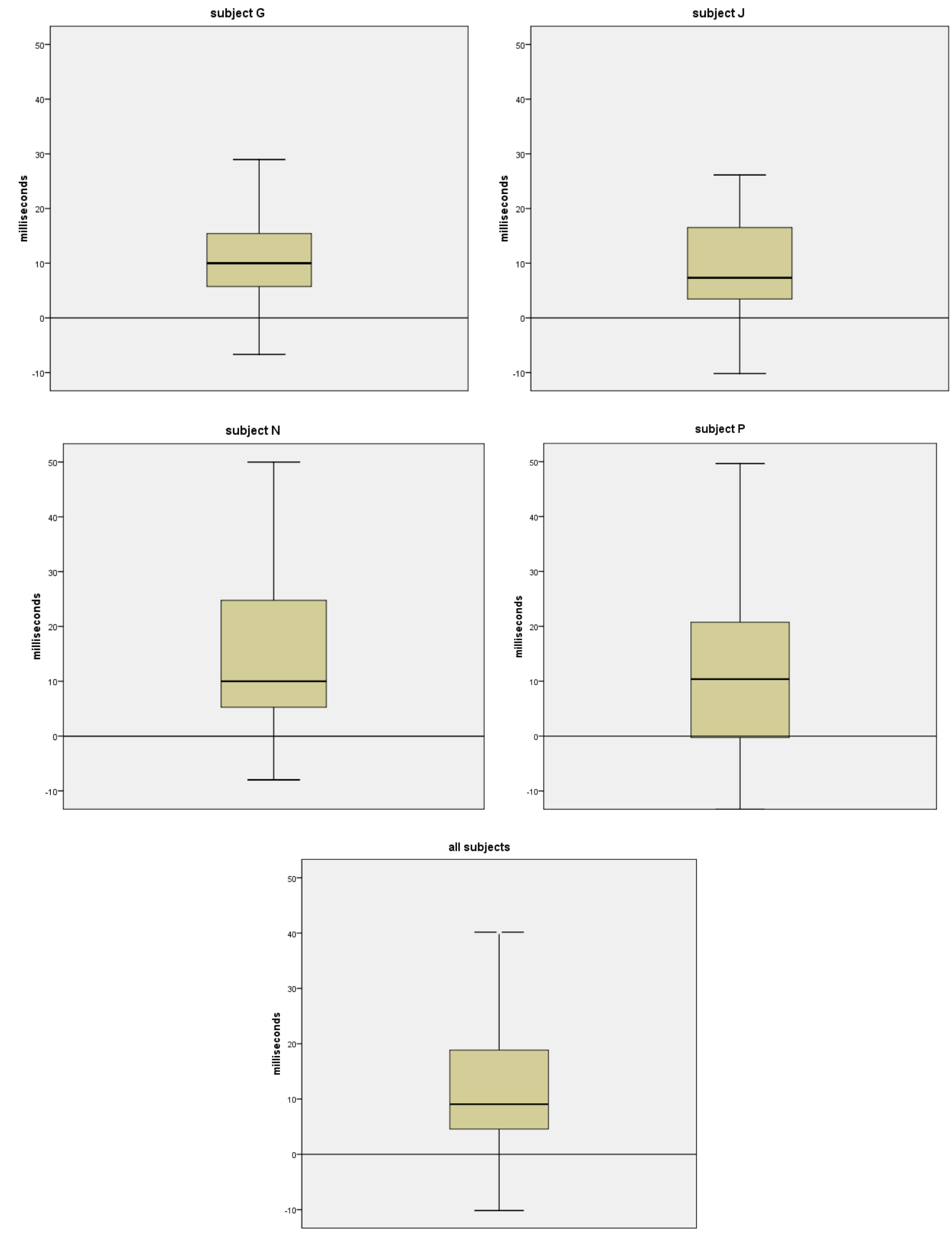

Fig. 10 - Time alignment of L1 with respect to the beginning of C-1 for each and all of the subjects

3.1.2. ALIGNMENT OF L1 WITH RESPECT TO THE END OF C-1

The time at the end of C-1 was subtracted from the time at L1 in the data set without initial rise, in order to determine whether L1 aligns within the onset consonant of the preaccentual syllable.

The five graphs in Fig. 11 show the alignment patterns of the L1 target with respect to the end of C-1 for each one of the four speakers and for all speakers together.

The results show that the time at L1 is consistently lower than the time at the end of C-1, so L1 is aligned before the end of C-1, at a mean value of -47.97ms (±27.445).

Thus, **the onset of the rise (L1) is aligned within the onset consonant of the preaccentual syllable (C-1)**.

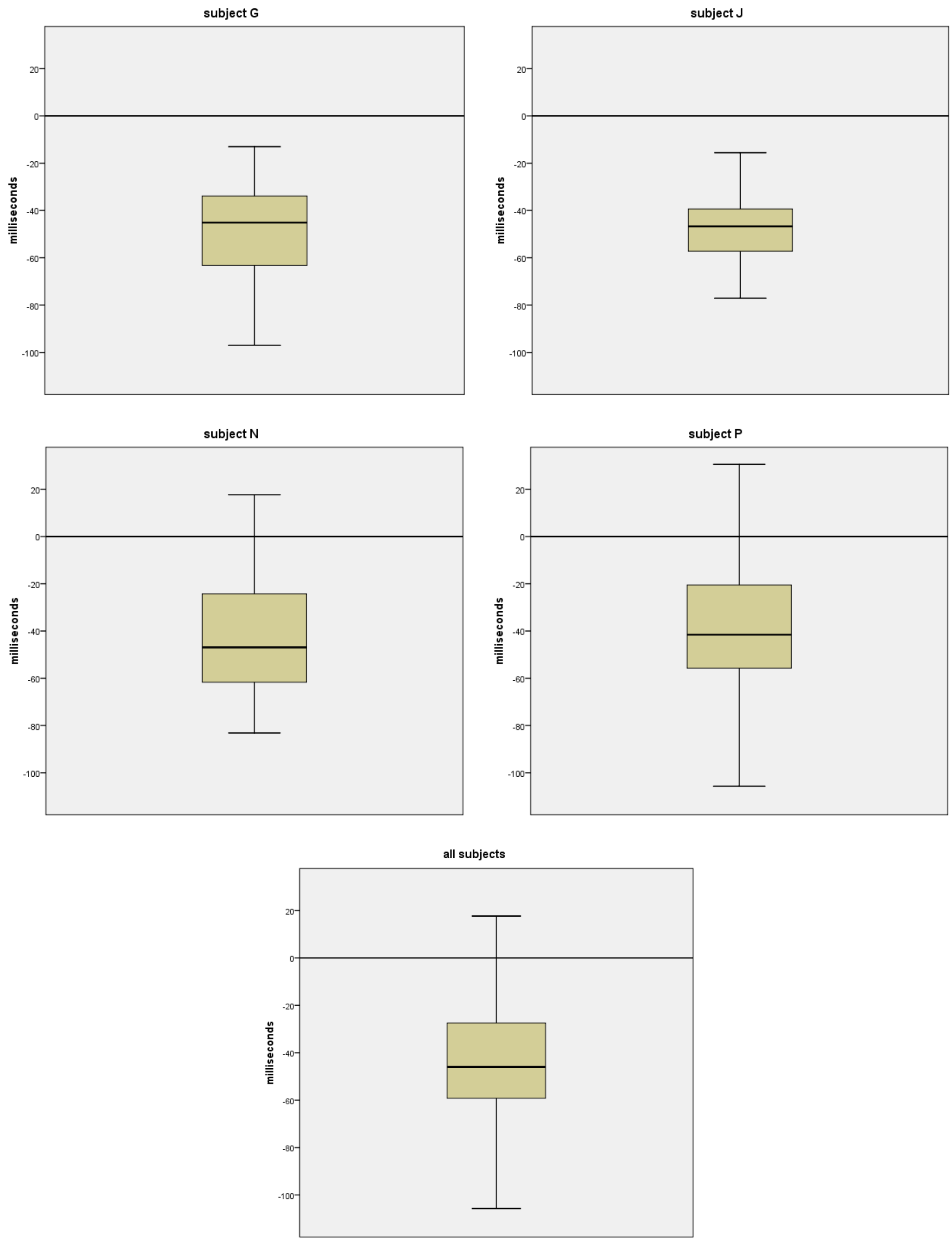

Fig. 11 - Time alignment of L1 with respect to the end of C-1 for each and all of the subjects

3.2. ALIGNMENT OF THE F0 MAXIMUM IN THE PRESENCE AND ABSENCE OF AN INITIAL RISE

The alignment of the F0 maximum was treated separately for the two data sets, i.e. with and without an initial rise, because the F0 maximum corresponds to two different entities depending on the presence or absence of an initial rise. In the absence of an initial rise, the F0 maximum corresponds to the end of the rise of the nuclear pitch accent leading tone configuration (H1). In presence of an initial rise, it corresponds to the end of this initial rise itself (Hi). Therefore, the alignment pattern of the F0 maximum is expected to be different depending on the presence or absence of an initial rise.

3.2.1. ALIGNMENT OF THE F0 MAXIMUM WITH RESPECT TO THE BEGINNING OF V-1

The time at the beginning of V-1 was subtracted from the time at the F0 maximum in both data sets in order to determine at what distance from the beginning of the vowel of the preaccentual syllable the F0 maximum is reached in each case.

The five graphs in Fig. 12 show the alignment patterns of the F0 maximum with respect to the beginning of V-1 for each one of the four speakers and for all speakers together. In each case, results are separated into two sets: with initial rise on the left, without initial rise on the right.

The results show that the time at the F0 maximum is consistently higher than the time at the beginning of V-1, so the F0 maximum is aligned after the beginning of V-1. However, there appears to be a difference between the two sets: the F0 maximum seems to be reached earlier in the presence of an initial rise than in its absence. In numerical terms, the F0 maximum is aligned at a mean value of 33.86ms (±34.509) after the beginning of V-1 in the presence of an initial rise, and at a mean value of 73.71ms (±34.694) in its absence. A t-test for independent samples showed that this mean difference of 39.852ms (±5.295) is statistically significant ($F=0.62$, $p<0.001$).

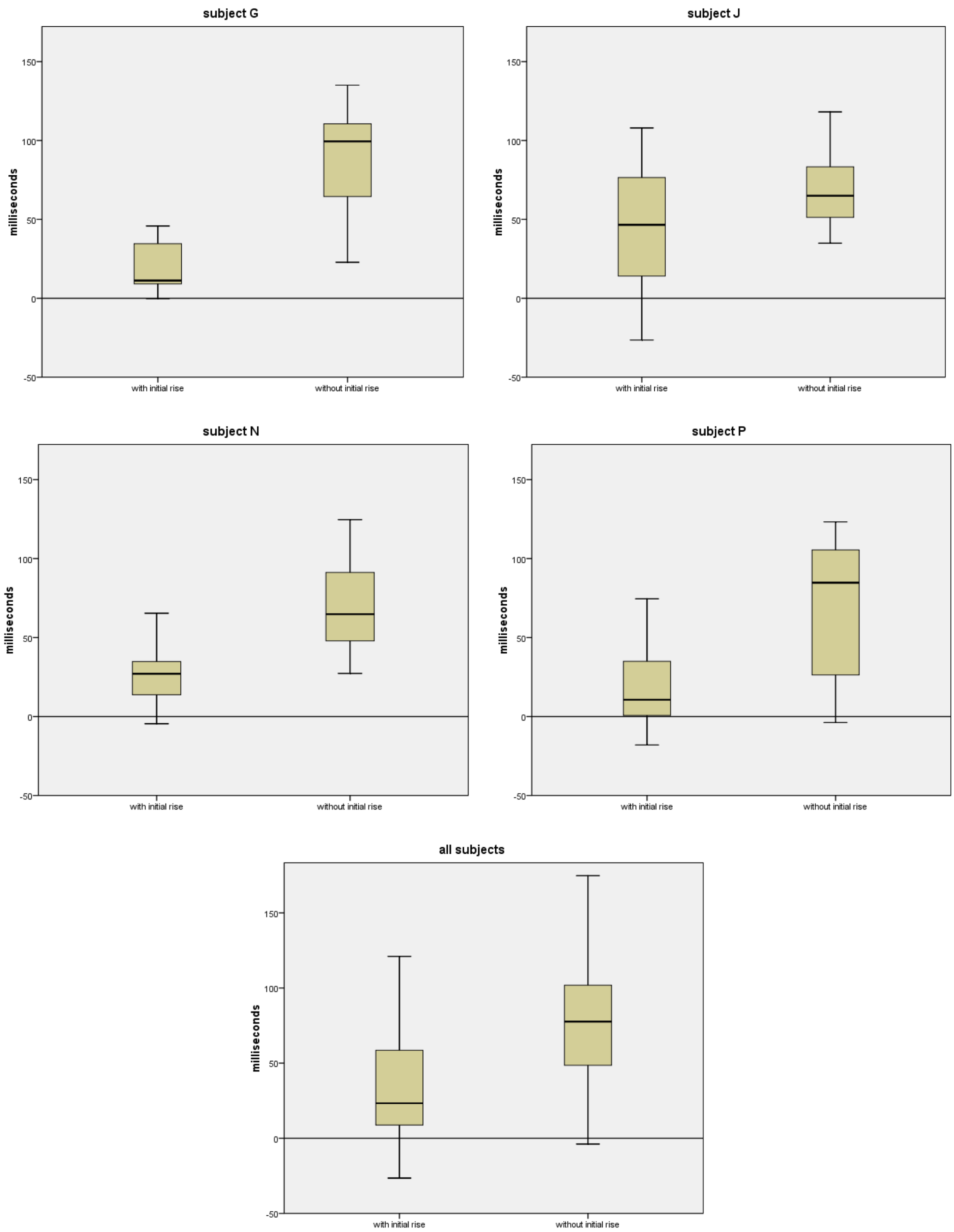

Fig. 12 - Time alignment of the F0 maximum with respect to the beginning of V-1 in the presence (left) and absence (right) of an initial rise, for each and all of the subjects

3.2.2. ALIGNMENT OF THE F0 MAXIMUM WITH RESPECT TO THE END OF V-1

The time at the end of V-1 was subtracted from the time at the F0 maximum in both data sets, in order to determine the alignment of the F0 maximum with respect to the end of the preaccentual syllable and to see whether it is reached within the vowel of this syllable in each case.

The five graphs in Fig. 12 show the alignment patterns of the F0 maximum with respect to the end of V-1 for each one of the four speakers and for all speakers together. In each case, the results are separated into two sets: with initial rise on the left, without initial rise on the right.

As we already pointed out in the previous subsection, the results show two different patterns depending on the presence or absence of an initial rise. The F0 maximum is aligned at a mean value of -39.08ms (±35.489) before the end of V-1 in presence of an initial rise, and at a mean value of 0.45ms (±34.250) after it in its absence. A t-test for independent samples showed that this mean difference of 39.535ms is statistically significant ($F=1.452$, $p<0.001$).

Thus, on the one hand, the F0 maximum aligns within V-1 in the presence of an initial rise: **the end of the initial rise (Hi) aligns within V-1**. On the other hand, it appears to align at the syllable boundary in the absence of an initial rise: **the end of the leading tone rising configuration (H1) aligns with the boundary between the preaccentual and the accented syllables in the absence of an initial rise**.

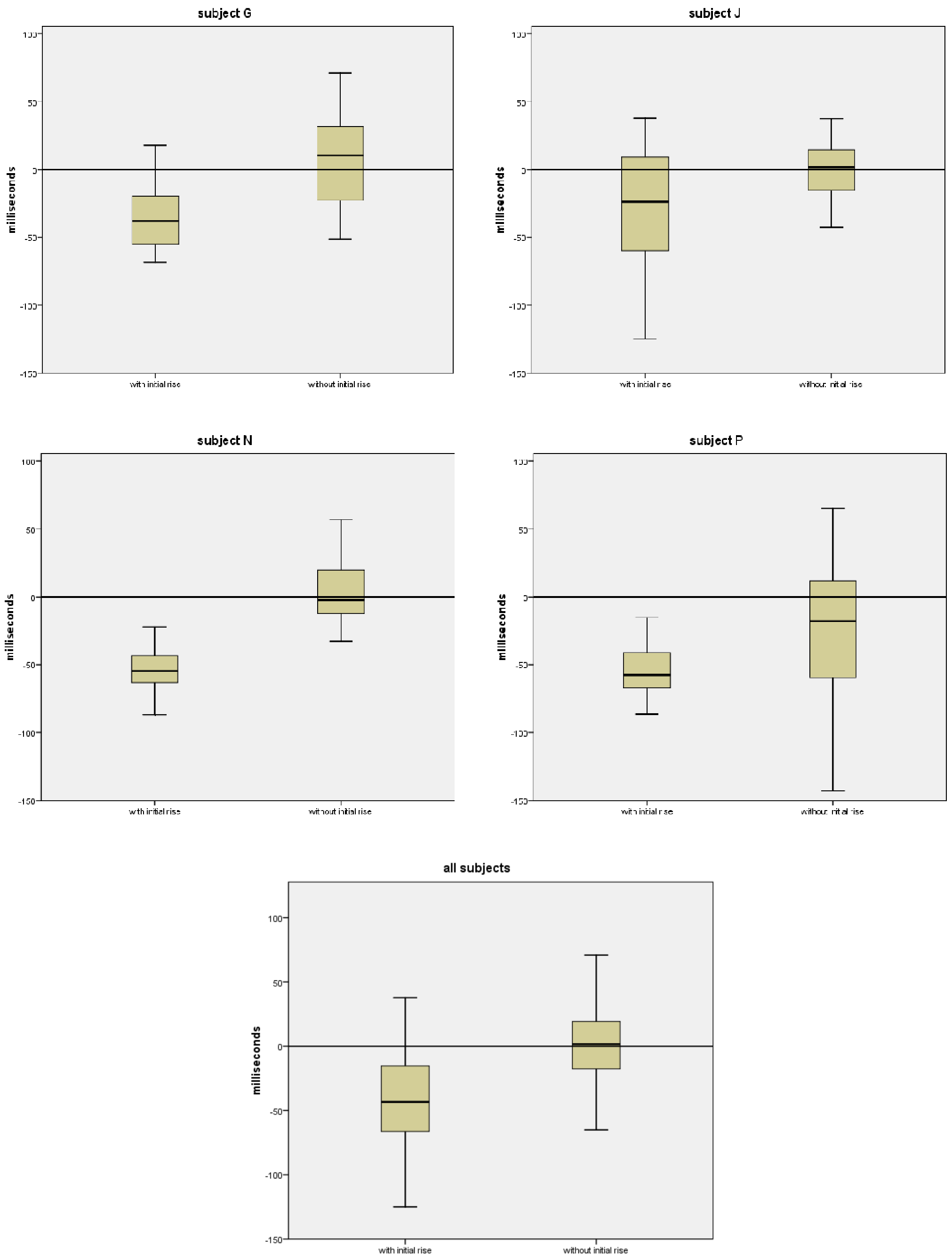

Fig. 13 - Time alignment of the F0 maximum with respect to the end of V-1 in the presence (left) and absence (right) of an initial rise, for each and all of the subjects

3.3. ALIGNMENT OF THE RISE (L1-H1) WITH THE PREACCENTUAL SYLLABLE IN THE ABSENCE OF AN INITIAL RISE

In the absence of an initial rise, a low target (L1) has been found to be aligned with the onset consonant of the preaccentual syllable (C-1), and a high target (H1) with the end of the preaccentual syllable. So the rise is aligned with the preaccentual syllable.

Fig. 14 shows the correlation between the duration of the preaccentual syllable and the duration of the rise. Since the rise starts within the onset consonant and ends at the syllable boundary, the duration of the preaccentual syllable has been calculated by subtracting the time at the midpoint of the onset consonant from the time at the end of the vowel.

The Pearson correlation coefficient is 0.376 ($p<0.001$), so **there is a significant positive correlation between the duration of the preaccentual syllable and the duration of the rise in absence of an initial rise**. However, this correlation is not very strong, probably because the distribution of the data on target alignment with respect to the segmental landmarks shows quite a high standard variation for both L1 and H1.

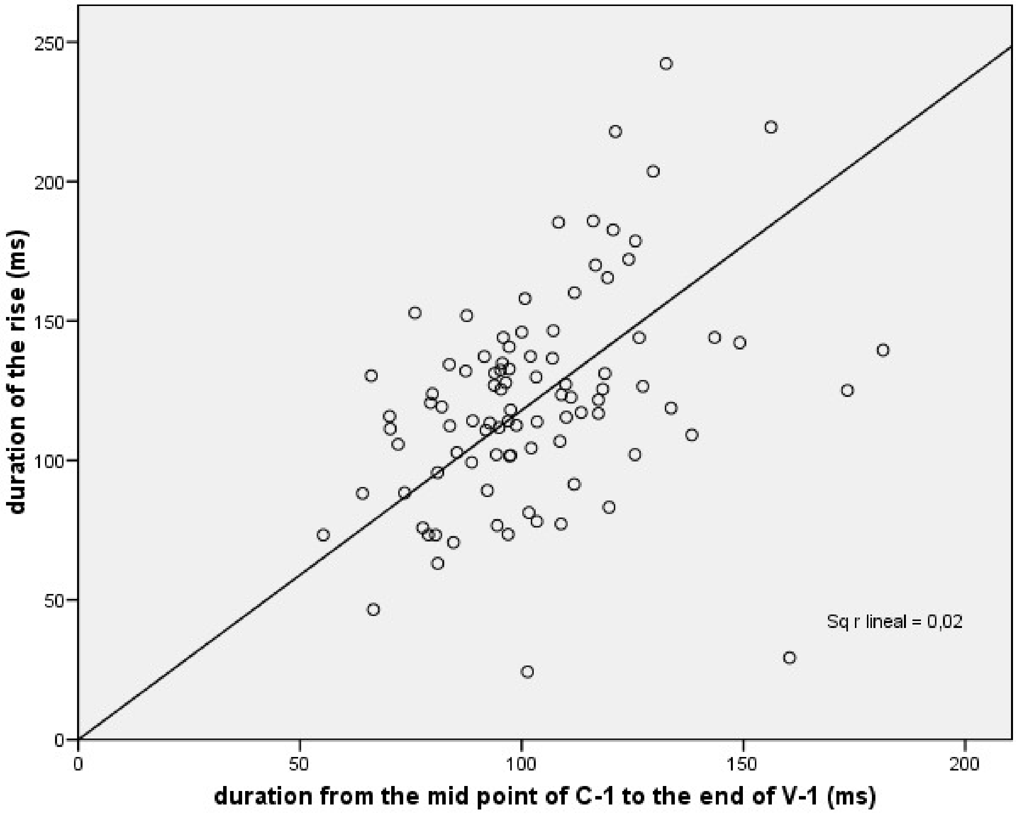

Fig. 14 - Correlation between the duration of the preaccentual syllable (from the midpoint of C-1 to the end of the syllable) and the duration of the rise

3.4. L1 UNDERSHOT IN THE PRESENCE OF AN INITIAL RISE

In the absence of an initial rise, the low target at the beginning of the rise of the pitch accent leading tone configuration (L1) is normally aligned with the onset consonant of the preaccentual syllable (C-1). Nevertheless, the initial rises have been shown to end within the vowel of the preaccentual syllable (V-1), that is, later than the point of anchorage for L1.

Therefore, **in presence of an initial rise, the low target of the leading tone rise (L1) is undershot because of tonal crowding**.

3.5. ALIGNMENT OF THE BEGINNING OF THE NUCLEAR FALL (H2)

3.5.1. ALIGNMENT OF H2 WITH RESPECT TO THE BEGINNING OF C0

The time at the beginning of C0 was subtracted from the time at H2 in data sets with and without initial rise, in order to determine the alignment of the beginning of the fall (H2) with respect to the beginning of the accented syllable.

The five graphs in Fig. 15 show the alignment patterns of the H2 target with respect to the beginning of C0 for each one of the four speakers and for all speakers together. In each case, the results are separated into two sets: without initial rise on the left, with initial rise on the right.

The results show that **H2 is aligned after the beginning of C0**, but there appears to be a difference between the two sets: **H2 is aligned earlier in the presence of an initial rise than in its absence**. In numerical terms, the latency from the beginning of C0 to H2 is 23.42ms (±37.471) on average in the presence of an initial rise, and 39.09ms (±32.454) in its absence. A t-test for independent samples showed that this mean difference of 15.671ms (±5.302) is statistically significant ($F=2.261$, $p<0.005$).

In the absence of initial rise, the F0 maximum is aligned with the boundary between the preaccentual and the accented syllables. By contrast, the F0 maximum corresponding to the end of an initial rise is reached earlier within the vowel of the preaccentual syllable, so the fall can begin earlier in the presence of an initial rise.

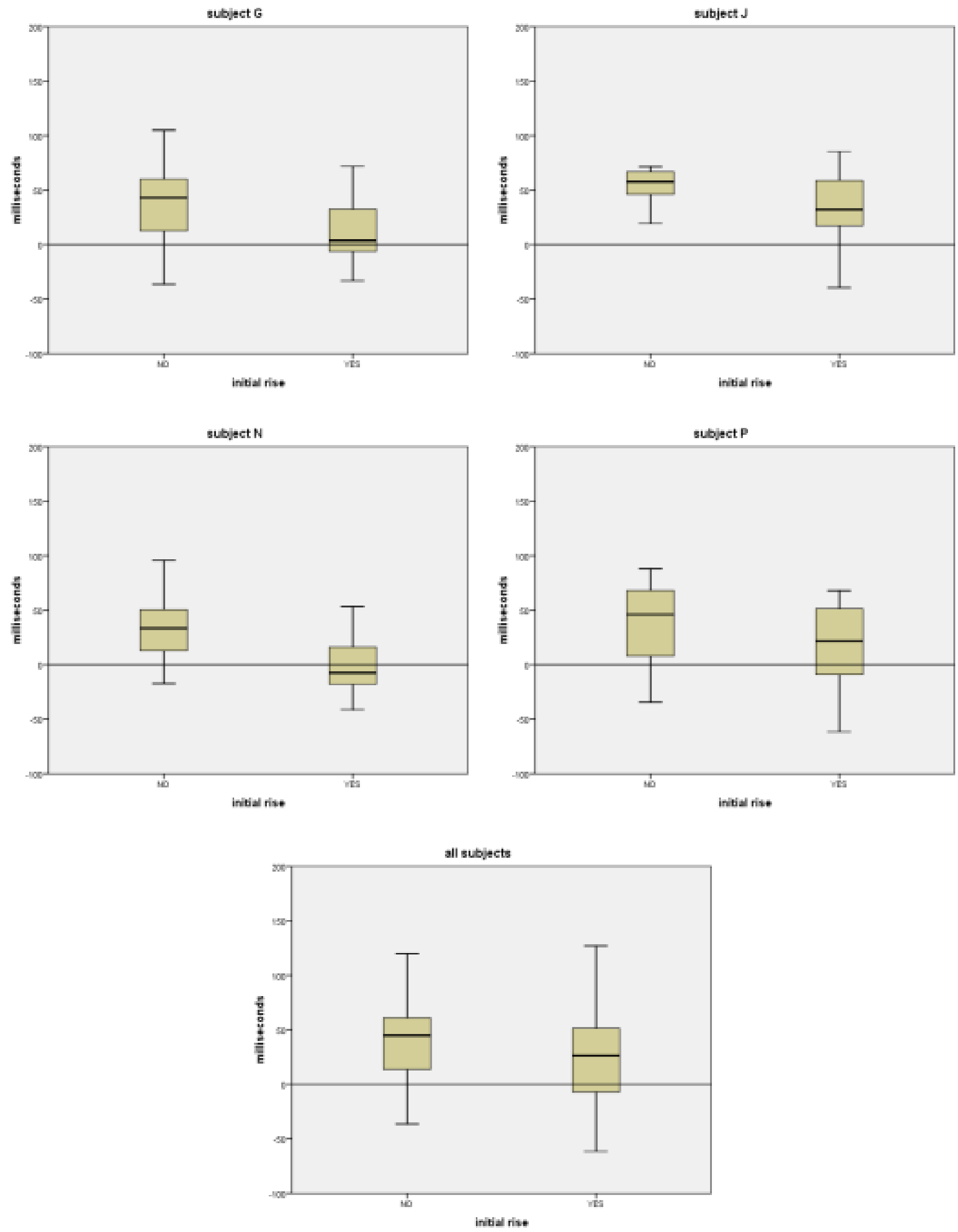

Fig. 15 - Time alignment of H2 with respect to the beginning of C0 in the absence (left) and presence (right) of an initial rise, for each and all of the subjects

3.5.2. ALIGNMENT OF H2 WITH RESPECT TO THE END OF C0

The time at the end of C0 was subtracted from the time at H2 in both data sets in order to determine whether the nuclear fall starts within the onset consonant of the accented syllable in each case.

The five graphs in Fig. 16 show the alignment patterns of H2 with respect to the end of C0 for each one of the four speakers and for all speakers together. In each case, the results are separated into two sets: without initial rise on the left, with initial rise on the right.

The results show that H2 is aligned on average 38.03ms (±39.182) before the end of C0 in the presence of an initial rise, and 24.54ms (±31.859) in its absence, so H2 is aligned within C0, and it is thus confirmed that H2 is aligned earlier in the presence than in the absence of an initial rise. A t-test for independent samples showed that this mean difference of 13.490ms (±5.385) between the two sets in terms of the alignment of H2 with respect to the end of C0 is not as significant ($F=5.490$, $p<0.014$) as it was with respect to the accented syllable left boundary.

Thus, in the absence of initial rise, both F0 maximum (H1) and the beginning of the fall (H2) are aligned with the onset of the accented syllable (C0). In the presence of an initial rise, the F0 maximum (Hi) is reached within the vowel of the preaccentual syllable (V-1), pitch remains high until the onset of the accented syllable (C0), and the fall starts a little bit earlier than in the absence of an initial rise.

Prieto (2009) has demonstrated that for falling pitch accents of the type H+L* in Central Catalan, the high leading tone target is consistently aligned with the onset consonant of the stressed syllable. So the results presented here for Occitan are consistent with her findings.

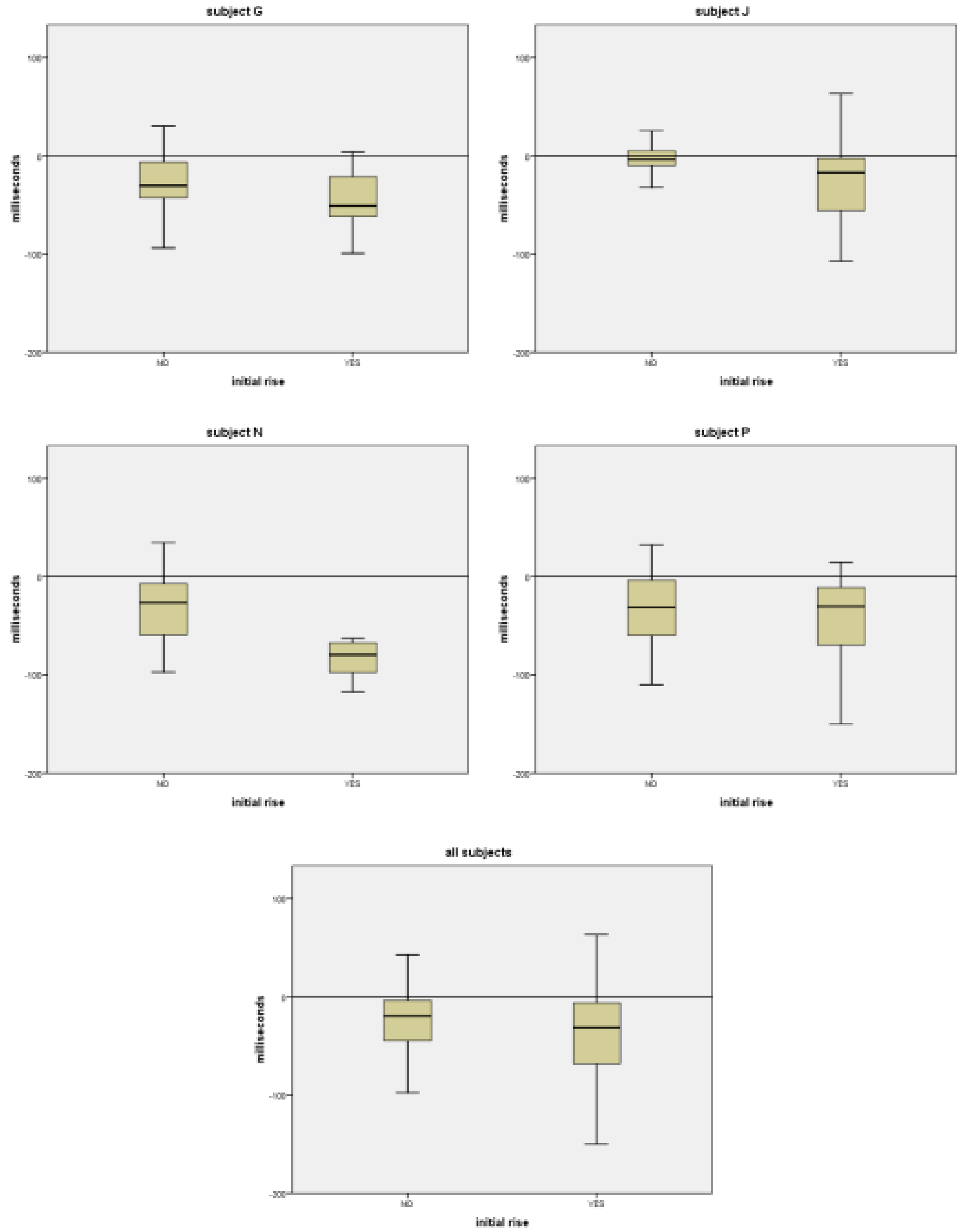

Fig. 16 - Time alignment of H2 with respect to the end of C0 in the absence (left) and presence (right) of an initial rise, for each and all of the subjects

3.6. ALIGNMENT OF THE FINAL LOW TARGET (L2)

Though the focus of this study is the alignment of the leading tones of the nuclear pitch accents of Occitan disapproval statements, the alignment of the final low target (L2) at the end of the nuclear fall is presented here to justify its starredness and to compare its alignment behavior to that of the leading tones.

As explained in the description of our methodology, the option was taken to locate the L2 target at the turning point where the slope of the fall becomes flatter. Since pitch continues falling after the nuclear pitch accent because of the presence of a low boundary tone at the end of the word, it was not always easy to locate this point very precisely. This problem was encountered mainly in oxytones, where the final low boundary tone affects the accented syllable, but also in paroxytones, where pitch could keep falling without flattening the slope throughout both accented and postaccentual syllables.

No effect of the presence or absence of an initial rise was encountered. By contrast, the stress position, that is, the presence or absence of a postaccentual syllable, did appear to have an effect on the alignment of L2. Therefore, the data were split into two sets: oxytones and paroxytones.

3.6.1. ALIGNMENT OF L2 WITH RESPECT TO THE BEGINNING OF V0

The time at the final low target (L2) was subtracted from the time at the beginning of the vowel of the accented syllable (V0) in these two new data sets (oxytones and paroxytones).

The five graphs in Fig. 17 show the alignment patterns of the L2 target with respect to the beginning of V0 for each one of the four speakers and for all speakers together. In each case, the results are separated into two sets: paroxytones on the left, oxytones on the right.

The results confirm that L2 is aligned after the beginning of V0, as expected. There appears to be an effect of the subject ($F=42.940$, $p<0.001$) and a cross-effect between subject and stress position ($F=6.024$, $p<0.002$). The stress position alone has no significant effect ($F=0.033$, $p=0.855$). Actually, for one of the four speakers (subject N), L2 is aligned 39.960ms (±4.969) later when there is a postaccentual syllable than when there is none ($F=3.450$, $p<0.001$). However, for the other speakers, the stress position has no significant effect on the alignment of L2 with respect to the beginning of V0.

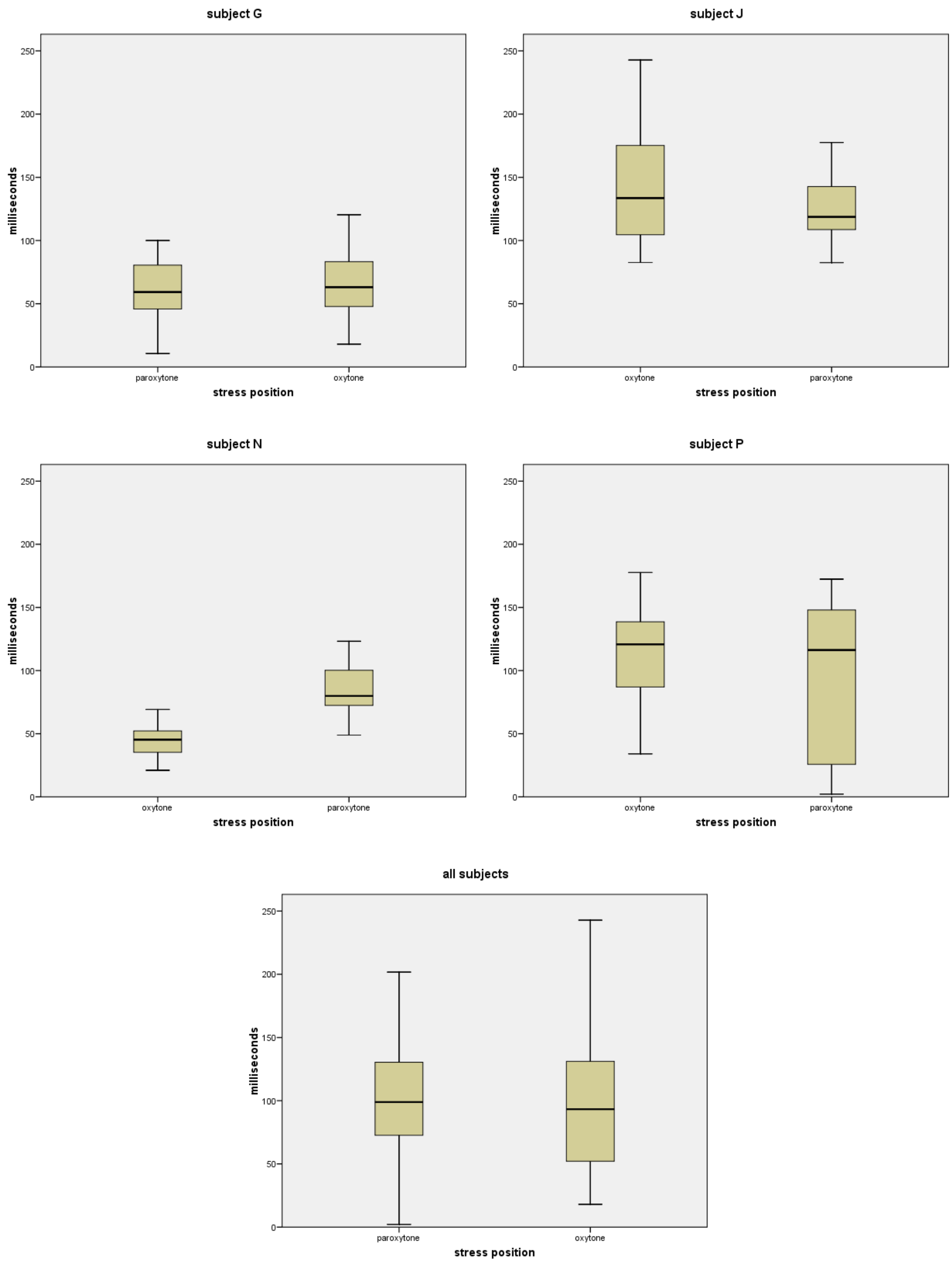

Fig. 17 - Time alignment of the final low target (L2) with respect to the beginning of the vowel of the accented syllable (V0), as a function of the stress position for each and all of the subjects

3.6.2. ALIGNMENT OF L2 WITH RESPECT TO THE END OF V0

The time at the final low target (L2) was subtracted from the time at the end of the accented syllable in both data sets (oxytones and paroxytones).

The five graphs in Fig. 18 show the alignment patterns of the L2 target with respect to the end of V0 for each one of the four speakers and for all speakers together. In each case, the results are separated into two sets: paroxytones on the left, oxytones on the right.

The results confirm that L2 is aligned before the end of V0 in almost all cases. However, the alignment of L2 with respect to the end of the accented syllable appears to be affected by the subject ($F=5.355$, $p<0.003$) and by the stress position ($F=13.461$, $p<0.001$), and there is also a cross-effect between these two variables ($F=16.834$, $p<0.001$). Actually, the subjects do not all show the same pattern. For subject G, L2 is aligned 40.981ms (±11.110) later in oxytones than in paroxytones ($F=7.443$, $p<0.002$). On the other hand, it is aligned earlier in oxytones than in paroxytones for speakers J and N: 77.276ms (±7.192) for subject J ($F=2.890$, $p<0.001$) and 38.161ms (±6.933) for subject N ($F=1.107$, $p<0.001$). There is no significant effect of the stress position for subject P ($F=1.515$, $p=0.501$). Fig. 19 shows how these alignment patterns as a function of the stress position differ from one subject to another.

Thus, **L2 is aligned within the vowel of the accented syllable for all speakers, but there is considerable variability in the alignment of the low elbow at the end of the nuclear fall, that is the L* tone, with respect to segmental landmarks. This contrasts with the alignment patterns found for the low and high target of the leading tone configuration, which align respectively with the left and right boundaries of the preaccentual syllable.**

These results are consistent with the findings of Prieto (2009), who showed that in Catalan nuclear falls the high leading tone is consistently aligned with the onset of the accented syllable whereas the low starred tone shows a greater variability in its alignment with respect to segmental landmarks.

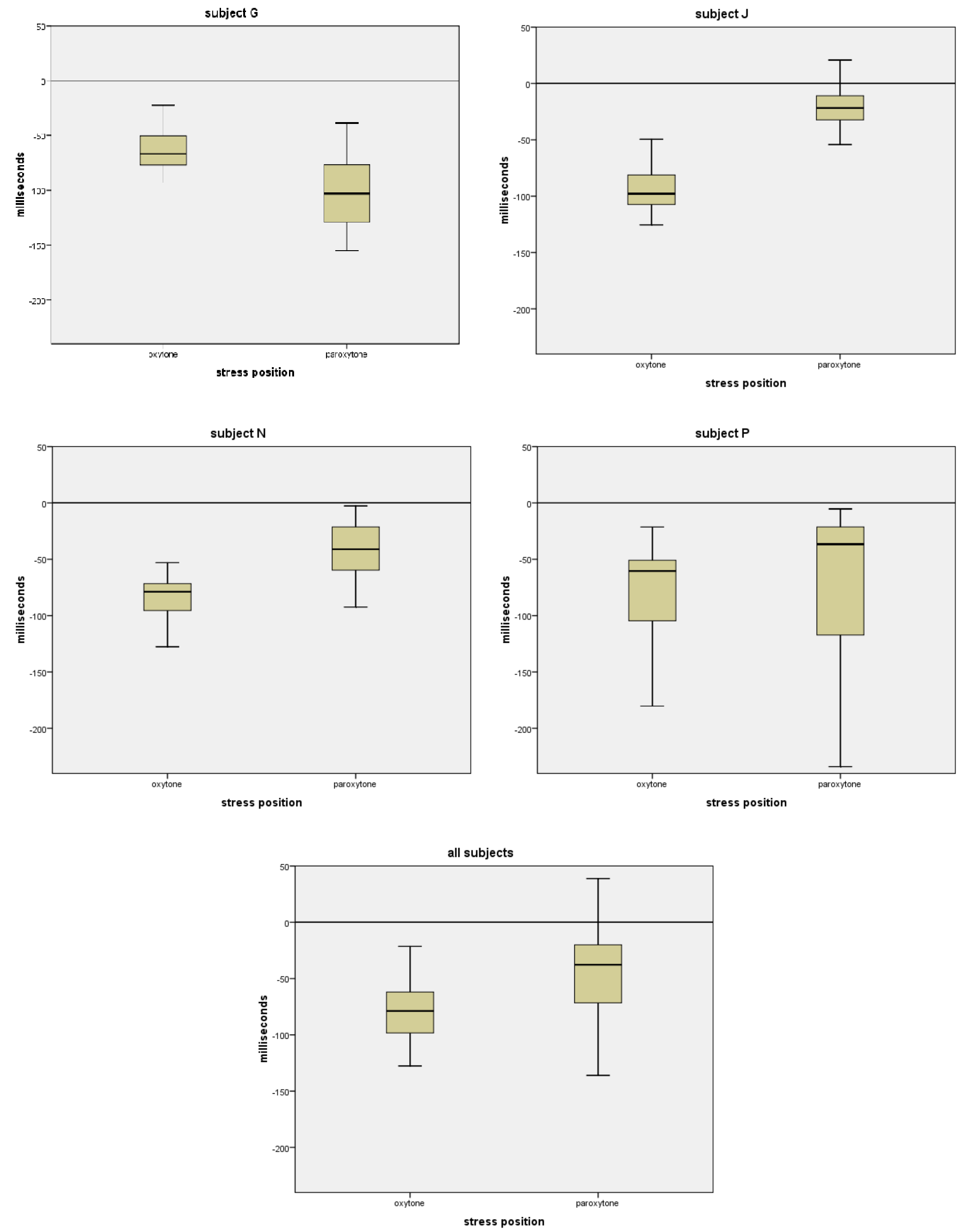

Fig. 18 - Time alignment of the final low target (L2) with respect to the end of the vowel of the accented syllable (V0), as a function of the stress position for each and all of the subjects

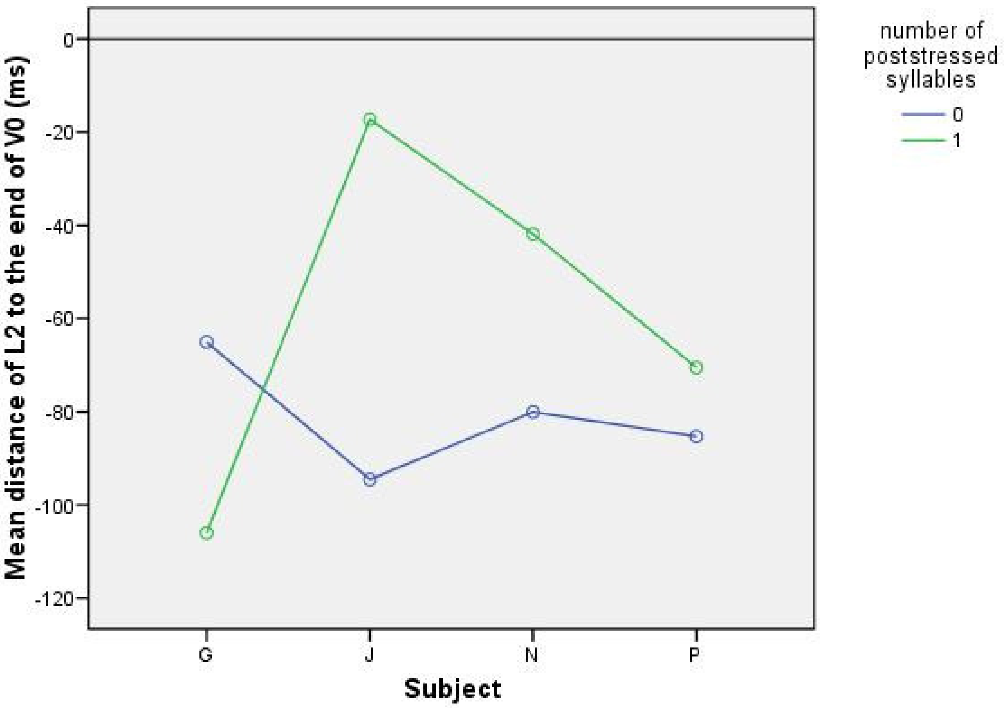

Fig. 19 - Differences in average time alignment of L2 with respect to the end of V0, as a function of stress position and subject

4. DISCUSSION OF PITCH ACCENT STRUCTURE AND TARGET ALIGNMENT PROPERTIES

4.1 OBSERVATIONS ON THE TARGETS OF THE NUCLEAR PITCH ACCENT OF OCCITAN DISAPPROVAL STATEMENTS AND THEIR ALIGNMENT

The results of this production experiment demonstrate the presence of **three tonal targets** in the nuclear pitch accent of Occitan disapproval statements:

- a **low target** aligned with the **onset of the preaccentual syllable**. This target is normally undershot in the presence of an initial rise, but even if it is not phonetically realized in this case, it has to be taken into account in an accurate description of this pitch accent.
- a **high target** aligned with the **onset of the accented syllable**.
- a **low target** aligned within the **vowel of the accented syllable**.

This therefore constitutes a tritonal rising-falling pitch accent. The last low target is aligned with the accented syllable and thus corresponds to the starred tone. As a result, the two preceding L and H targets must be regarded as leading tones. This pitch accent presents thus a **complex leading tone configuration**.

This tritonal structure challenges the models for pitch accent structure thus far proposed. This is because, as noted above, the problem of overgeneration of pitch accents arises when three tonal targets are included in the structure. However, some linguistic varieties such as Catalan and Spanish have been found not to present all six monotonal and bitonal pitch accents predicted by all the models in their intonational system: for instance, the proposals for Cat_ToBI and Sp_ToBI (see Cat_ToBI Training Materials and Sp_ToBI Training Materials) do not consider the H*+L pitch accent. Therefore, in fact, the problem of overgeneration seems to have already been encountered in a model that does not include tritonal pitch accents. Therefore, a particular linguistic variety may not categorically use all the possible pitch accents predicted by the models. **A model for pitch accent structure should thus allow for three tonal targets per pitch accent in order to account for the tritonal surface realizations observed**.

In section 3, the alignment of the L* tone within the vowel of the accented syllable was found to present quite a high variability. By contrast, both L and H targets of the preceding rise align with the left and right edges of the preaccentual syllable, respectively. Thus, the starred tone and the leading tones have different patterns of association with the segments: **whereas the starred tone is associated with the accented vowel and aligns somewhere within it, the leading tones associate with specific anchoring points in the segmental stream, namely the edges of the preaccentual syllable**.

Moreover, many studies (Prieto et al. 1995, Arvaniti et al. 1998, Estebas-Vilaplana 2000, Frota 2002, and Prieto 2009, among others) have shown that leading tones tend to associate with anchoring points at syllable boundaries, whereas trailing tones appear to occur at a fixed interval after the starred tone. Therefore, **the pitch accent structure should reflect this different status of leading, trailing and starred tones in order to allow for an explanation of their different behavior in terms of alignment**.

4.2 THE DIFFERENT PROPOSALS FOR PITCH ACCENT STRUCTURE AND THEIR IMPLICATIONS FOR TARGET ALIGNMENT

4.2.1 PIERREHUMBERT AND BECKMAN'S (1989) MODEL

Pierrehumbert and Beckman (1989) propose a structure for pitch accents as represented in Fig. 20.

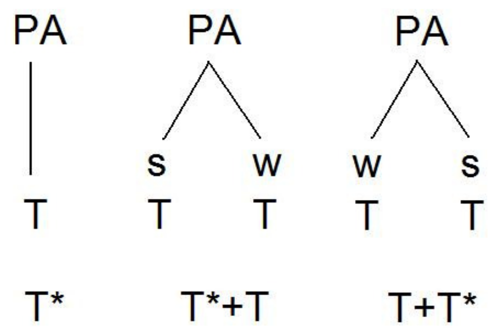

Fig. 20 - Pitch accent structure: the three possible configurations, adapted from Pierrehumbert & Beckman (1988)

According to them, pitch accents may be monotonal (on the left), or branching and either left- (in the middle) or right-headed (on the right). In this model, the star is used to mark the association of a tone with a metrically strong syllable, and in a bitonal pitch accent, an unstarred tone leads or trails the starred tone "by a given time interval" (Pierrehumbert 1980:77). Moreover, Pierrehumbert (1980:221ff) argues that, unlike starred tones, which are associated with a particular syllable, unstarred tones may be subject to spreading over several syllables. Thus **leading and trailing tone have the same status within the structure, and are expected to have the same alignment patterns, occurring at a given time interval from the starred tone**.

One could postulate that pitch accents might branch into three branches. Then, in order to reduce the overgeneration of pitch accents, it could be said that the starred tone might only occur on one of the two last branches of a pitch accent, ruling out in this way pitch accents with two trailing tones. Thus, the nuclear pitch accent of Occitan disapproval statements would have a structure as represented in Fig. 21.

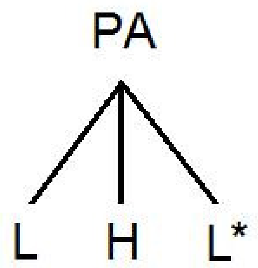

Fig. 21 - Structure of the tritonal nuclear pitch accent of Occitan disapproval statements, following Pierrehumbert and Beckman's (1989) model

However, it has been demonstrated that leading, starred and trailing tones show different alignment patterns. So **the pitch accent structure should reflect this different status of leading, trailing and starred tones in order to allow for an explanation of their different behavior in terms of alignment**.

4.2.2 GRICE'S (1995b) HIERARCHICAL MODEL

Grice (1995b) proposes a two-level hierarchical structure analogous to Nespor and Vogel's (1986) prosodic word structure. Tone nodes (T) are dominated by supertone nodes (τ), which are in their turn dominated by a pitch accent node (PA), as represented in Fig. 22, just as syllables are dominated by feet and feet by a prosodic word in Nespor and Vogel's model.

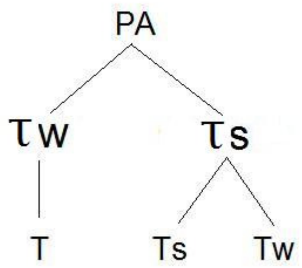

Fig. 22 - Maximal hierarchical structure of pitch accents, adapted from Grice (1995b)

In this model, branching may occur either at the pitch accent node (PA) level or at the supertone node (τ) level. Branching pitch accents are right-headed: the strong supertone (τs) is on the right branch and the weak one (τw) on the left branch. By contrast, branching supertone nodes are left-headed, that is, the strong tone (Ts) is on the left branch of the node and the weak tone (Tw) is on the right one.

Thus, pitch accent can present the three structures presented in Fig. 23.

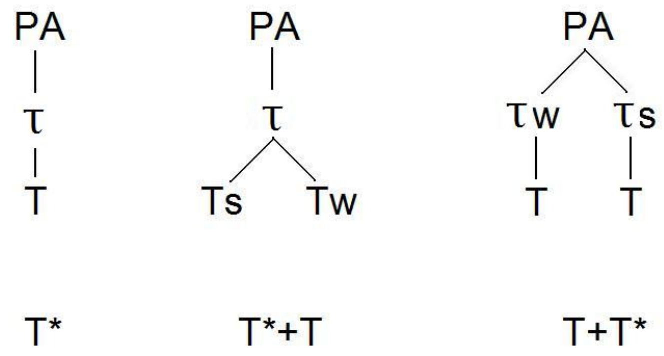

Fig. 23 - Pitch accent hierarchical structure: the three possible configurations, adapted from Grice (1995b)

This model gives a different status to leading and trailing tones: whereas a trailing tone is dominated by the same node as the starred tone, a leading tone is not. This confers a greater independence from the starred tone to leading tones than to trailing tones. Actually, since the same supertone node dominates the starred tone and the trailing tone, **the trailing tone is said to occur a fixed interval in "normalized time" after the starred tone**. By contrast, the leading tone is dominated by another supertone node, which precedes the supertone that dominates the starred tone. Thus, **the leading tone is expected to align with the syllable preceding the accented syllable to which the starred tone is associated, if one is available**.

This is also the model adopted by Frota (1998, 2000a, 2002) to describe the pitch accent structure in European Portuguese.

Even if this restriction on branching possibilities is lifted, the only tritonal pitch accents that would be possible would present a leading tone, a starred tone and a trailing tone, that is, a structure of the type T+T*+T. In the pitch accents this study focuses on, two leading tones are involved, so the weak supertone node should also have the possibility of branching. If branching were postulated to be possible both at the pitch accent node level and either at the weak or at the strong supertone node level, but not in both supertone nodes at the same time[6], this model would predict five different possibilities for pitch accent structure, as represented in Fig. 24.

[6] If both supertone nodes were branching, the pitch accent would be quadritonal. However, OCP could also rule out quadritonal pitch accents since all quadritonal pitch accents would contain either two identical supertone nodes or two identical adjacent tones, within or across supertone nodes.

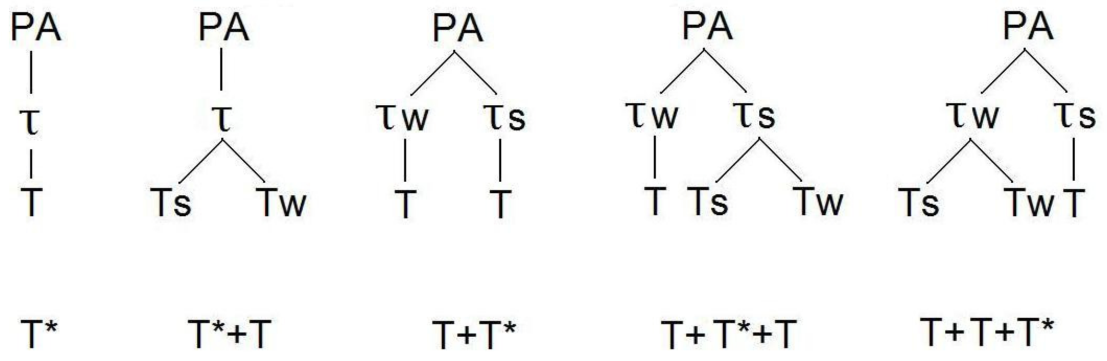

Fig. 24 - Pitch accent hierarchical structure: the five possible configurations postulating branching possible both at the PA and the supertone level but not in both supertones at the same time

Thus, this model can account for the nuclear pitch accent of Occitan disapproval statements. The first two targets of an L+H+L* pitch accent are dominated by a branching weak supertone node, and the L* by a monotonal strong node. So both leading tones are dominated by the same node, while the starred tone is not. This explains why the leading tones show a particular alignment pattern, associating with the edges of the preaccentual syllable. The strong supertone associates with the accented syllable and thus the starred tone aligns within the vowel of this syllable. The weak supertone associates with the preceding syllable, and each tone of the supertone aligns with an edge of the syllable. In the presence of an initial rise, the high target of this rise aligns somewhere within the vowel of the preaccentual syllable, so the low leading tone target cannot associate with the left edge of the syllable and is undershot.

In the same way, this model can account for the peak accents of Pisa Italian L+H*+L and L+H*. Both accents contain an L leading tone target dominated by a separated supertone node, which aligns with the preaccentual syllable right boundary. Then the contrast between the two accents arises from the strong supertone node: in one case, it is branching, and in the other, it is not.

4.2.3 GRICE'S (1995b) FLAT MODEL

Grice (1995b) proposes then a flat model in which the tone tier is constituted by a series of left-headed tonal root nodes that can be branching, but are not dominated by any other superior category. These nodes associate with syllables in the segmental tier. Initially, particular tonal root nodes associate with metrically strong syllables, then the other nodes associate with the remaining syllables. Since nodes are left-headed, leading tones belong to an independent root node, whereas trailing tones are dominated by the same node as the starred tone.

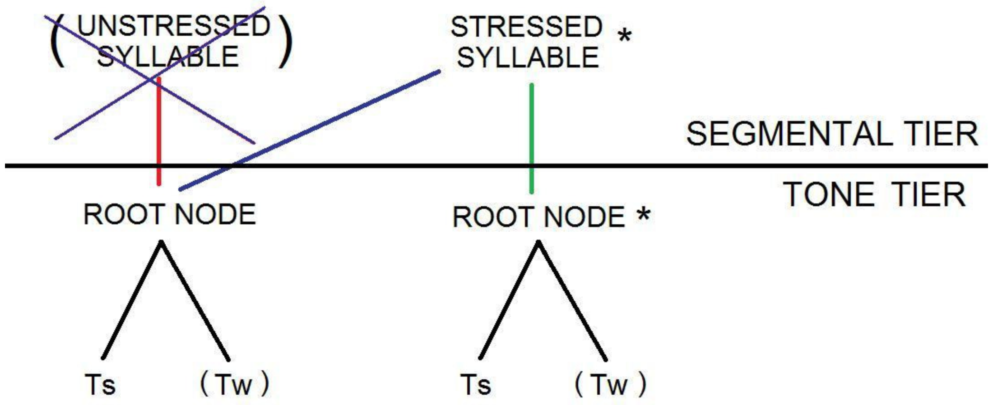

Fig. 25 - Association of tonal root nodes with syllables in the segmental tier, adapted from Grice (1995b)

In Fig. 25, the root node on the right, which is attributed a star, associates with the accented syllable in the segmental tier (green line). This root node dominates the starred tone and eventually a trailing tone. Then the root node on the left, which dominates the leading tone(s), associates with the preceding syllable (red line), if one is available. If there is no syllable before it or if it already bears a tonal root node, the node associates with the next metrically strong syllable (blue line), creating a tonal cluster.

This flat model has the same properties as the hierarchical model as far as predictions about the alignment patterns of the different tonal targets with respect to the segmental stream are concerned. Starred tones and trailing tones are dominated by a single node, whereas leading tones belong to a separate node that precedes it. So **a starred tone aligns with a metrically strong syllable, a trailing tone is expected to occur at a fixed interval with respect to the starred tone, and a leading tone aligns with the previous syllable if one is available**.

However, in this model, the surface realization of pitch accents is postulated to be maximally bitonal. So it allows for:

- monotonal pitch accents: (H*) and (L*)[7]

- bitonal pitch accents with two non-branching nodes: (L)+(H*) and (H)+(L*)

- bitonal pitch accents with one branching node: (L*+H) and (H*+L)

- subjacent tritonal but superficially bitonal pitch accents in which a low tone is on the weak (right) branch of a node and is subject to delinking: (H+L)+(H*) and (L)+(H*+L).[8]

The author rules out other tone combinations invoking OCP, which rules out the possibility of finding either two identical nodes or two identical tones, within or across nodes, in adjacent positions.

If the restriction on the surface realization to be bitonal is lifted, this model can account perfectly for the structure of tritonal pitch accent as well as the different alignment properties of leading, starred and trailing tones.

The nuclear pitch accent of Occitan disapproval statements can be understood as consisting of two nodes. The first node is branching, having a low tone on its left branch and a high tone on its right branch, and the second node, which bears a star, is

[7] In the notation adopted here, parentheses are used to group together tones that are dominated by the same root node.

[8] In this model, branching nodes are what triggers downstep on the next node. So it can explain downstep within an initial pitch accent such as (H+L)+(H*): the first node of the pitch accent is branching, so the H* of the second node is downstepped. The L tone on the weak branch of the first node is subject to a delinking rule that applies after all phonological rules (such as downstep), and thus is not realized. This pitch accent corresponds to the H+!H* label of the MAE_ToBI system. Since a low tone on the weak branch of a node is delinked, the (L)+(H*+L) pitch accent has the same realization as (L)+(H*), but whereas the latter does not trigger downstep on the next node, the branching second node of the former does.

non-branching and dominates a low tone. So the structure of this pitch accent is (L+H)+(L*).

As represented in Fig. 26, the non-branching root node (L*) associates with the accented syllable (green line), then the branching node (L+H) associates with the previous syllable (red line), so the rise is aligned with the preaccentual syllable and then pitch falls throughout the accented syllable until the low target. During secondary association, the first L target is associated with the onset consonant of the preaccentual syllable and the H target with the offset of the syllable.

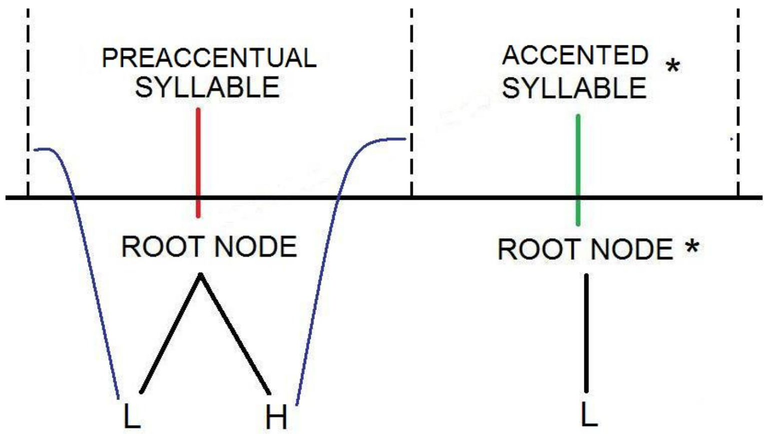

Fig. 26 - Association of the tonal root nodes of the nuclear pitch accent of Occitan disapproval statement with syllables in the segmental tier, in Grice's (1995b) flat model

We saw in section 3 that in the presence of an initial rise, the first low target of the pitch accent is undershot. This implies that, when this target associates with the segmental tier, the initial rise is already associated with the left edge of the content word. Since the initial rise normally ends within the vowel of the preaccentual syllable in trisyllabic words, there is tonal crowding in this syllable. The low leading tone target is not realized because it cannot associate with the onset syllable of the preaccentual syllable since the high target of the initial rise is associated first.

If one postulates that pitch accents can be tritonal and that branching can occur in both weak and strong nodes, this flat model makes exactly the same predictions as the hierarchical model. Leading tones associate with the preaccentual syllable whereas starred tones associate with the accented syllable and trailing tones align at a fixed interval with respect to the starred tone. The only difference is that in the flat model, nodes are completely independent since they are not dominated by any superior category, whereas the hierarchical model relates the node that dominates the leading tone(s) with the node that dominates the starred tone and eventually a trailing tone within the same pitch accent.

5. CONCLUSIONS

The nuclear pitch accent of Occitan disapproval statements is a tritonal rising-falling pitch accent. The fact that this pitch accent contains three tonal target challenges the proposals for pitch accent structure made in the autosegmental metrical (AM) tradition because of the well-know problem of overgeneration of possible pitch accents that arises from the huge combinatory of three tones per pitch accent. However, the surface realization observed actually presents three tonal targets: this pitch accent shows a complex leading tone configuration made up of a low and a high target associated respectively with the onset and offset of the preaccentual syllable, and finally a low tone aligned within the vowel of the accented syllable. The low starred tone presents variation of alignment within the vowel of the accented syllable. By contrast, the two leading tones appear to align with specific anchoring points of the segmental stream: the left and right edges of the preaccentual syllable.

The most commonly accepted model for pitch accent structure in the AM theory predicts that both leading and trailing tones align with respect to the starred tone, leading or trailing it by a fixed time interval, which can be affected by speech rate. The results of this experiment show that this is not the case for the leading tones: they align not with respect to the starred tone but with particular anchoring points at the preaccentual syllable edges. Grice's (1995b) proposal for pitch accent structure assigns differing status to leading and trailing tones, such that whereas the same node dominates trailing and starred tones, leading tones are dominated by a separate preceding node. This gives greater independence from the starred tone to leading tones, and thus predicts a different alignment pattern for the two types of unstarred tones: trailing tones align with respect to the starred tone, whereas leading tones associate with the preaccentual syllable independently from the starred tone.

Further research should investigate the alignment of trailing tones in greater depth in order to prove empirically that they align with respect to the starred tone. It also would be interesting to investigate the factors that may influence tonal target alignment, such as syllable structure, speech rate or tonal crowding, in order to improve the model. Moreover, the comparison of the alignment behavior of the targets of different pitch accents within and across linguistic varieties might provide further information that would allow us to insure that the model for pitch accent structure can be generalized.

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