INTONATIONAL STRUCTURE OF LEKEITIO BASQUE

Sun-Ah Jun* **and Gorka Elordieta*°**
* UCLA, Dept. of Linguistics, Los Angeles, CA 90095-1543
° USC, Dept. of Linguistics, Los Angeles. CA 90089-1693
jun@humnet.ucla.edu, elordie@scf-fs.usc.edu/elordie@humnet.ucla.edu

ABSTRACT

The pitch accent in Lekeitio Basque (LB) is realized as H*L on the penult of an underlyingly accented word or on the final syllable of a derived accented word, (=underlyingly unaccented, but accented in a preverbal position). Elordieta claimed that LB has an Accentual Phrase (AP) demarcated by H*L; thus, unaccented words in non-preverbal position never form one AP. It has also been assumed that the peak of H*L is the same whether it is underlying or not. However, results of a phonetic experiment show that unaccented words can form one AP, thus eliminating the H* tone leftward spreading rule. Also, we found that the underlying pitch accent is significantly higher than the derived pitch accent. Finally, an Intonation Phrase final vowel is significantly lengthened while vowels at the end of AP or Intermediate Phrase are not.

1. INTRODUCTION

Lekeitio Basque is a pitch accent language, the accentual system of which has been described in previous work [1-5]. In this language, a word can be accented or unaccented as in Japanese ([7]). Accented words have penultimate stress, triggered by accented morphemes, which can be roots or suffixes (henceforth underlying accent or ëAí). Unaccented words do not receive surface stress unless they are in immediate preverbal position; in this case, the final syllable is stressed (henceforth derived accent or ëUí). Both derived and underlying accent are realized as a high tone followed by a low tone (i.e., H*L). Elordieta [2] proposed an intonational structure for Lekeitio Basque based on the framework of Pierrehumbert [6]. His model is very similar to Tokyo Japanese intonation ([7]) in that there are three levels of intonational units: Accentual Phrase (AP), Intermediate Phrase (ip) and Utterance. In his model, an AP can have more than one word but only one accent, underlying or derived. That is, an AP can contain only one accented word, or a sequence of unaccented words followed by one accented word. Thus, the right edge of AP is always marked by H*L. The left edge of AP is marked by a L tone, and all intervening syllables (between the initial L and the H*L) are tonally underspecified, and surface with a H tone by a phonological rule of leftward spreading of the H* up to the second syllable. He also proposed that there is no difference between the underlying and the derived pitch accent in their f0 realization (either by themselves or after being downstepped), and in triggering downstep or catathesis of the following accent within an Intermediate Phrase.

In Elordietaís model, the ip can have more than one AP, forms the domain of catathesis, and is partially determined by syntactic structure, with no phrasal tones. A focused AP does not undergo downstep, thus creating an ip boundary at the beginning of the phrase. Finally, the Utterance is the domain of declination and is marked by initial and final boundary tones (L%, H%).

In this paper, we quantitatively analyzed the time and f0 realization of the intonational tones proposed in Elordietaís model [2]. We focused on two aspects of the model. First, we were interested in the tonal realization and timing of AP tones, and to see if there is any difference in the realization of accent depending on its lexical status, i.e. underlying or derived. Second, we were interested in finding out if unaccented words can form an AP if there is no accented word at the end of that AP. For this, we examined sentences with more than one Intermediate or Intonation Phrase (IP) where the phrase final word is unaccented. In this case, we expected that following the Strict Layer Hypothesis ([8]), the phrase final word must be the last word within an AP, and there might be a phrasal tone for an ip and/or IP.

2. METHOD

2.1. Subjects and Corpus

Three native speakers of Leketio Basque, two females and one male, participated in the experiment. The subjects are in their mid 20ís or early 30ís.

The corpus includes declarative sentences in which we varied the syntactic organization, the location of an accented or unaccented word, the number of syllables in each constituent, and the location of contrastive focus. Syntactic groupings we examined are: X type, XX type, X-X type, XXX type, X-X-X type, X-XX type, XX-X type. Here, X means either A (=underlying accent) or U (=derived accent, underlyingly unaccented), and a hyphen (-) refers to an XP (=maximal projection, e.g. NP, VP) syntactic boundary. In the X type, the number of syllables in the first word varied from 2 to 6 to examine the timing of the initial rise, H*, and L, as well as f0 peak differences, if any, between A and U in the first Accentual Phrase. F0 difference between A- and U-type accent was also examined in non-initial Accentual Phrase. In addition, to see if a single or a sequence of U-type words can form one Accentual Phrase without including an accented word, a sequence of U-type words were combined in different ways: AU-U type, A-UU type, A-U-U type, UUU type, U-U-X type, and UUUU type. All types occur before a verb phrase, thus the last U is always realized with a derived accent.

Next, to see if there is any phrasal tone for an Intermediate Phrase, topic clauses, wh-, and if-clauses were examined. In each example, the subordinate clause ends with an accented word or an unaccented word.

For all phrase boundaries, rhyme duration was measured to investigate the degree of phrase final lengthening.

2.2. Procedure

Data from the male speaker were collected in the sound booth at UCLA. He uttered 88 sentence types with 5 repetitions. All his data were digitized and pitch tracks were displayed using Entropicís xwaves+ speech analysis software. Tones were labeled, and f0 and time values of each tone were collected. Data from two female speakers were collected by the second author in a quiet room in the Basque Country using a portable tape recorder. Female speaker 1 read 114 sentence types twice each, and female speaker 2 read 95 sentence types one time each. Two repetitions of 75 sentence types from

female speaker 1 and each token of 60 sentence types from female speaker 2 were analyzed for this paper.

3. RESULTS AND DISCUSSION

3.1. Accentual Phrase (AP)

The results confirm Elordietaís claim that H* is realized on the penult of an underlyingly accented word and on the final syllable of a derived accented word. This timing difference is shown in Figure 1a (the error bar is one standard deviation). Underlying accent is realized on the penult of AP while derived accent is realized on the phrase final syllable. The phrase initial H (=H-) is in general realized on the second syllable of the phrase as claimed by Elordieta (see Figure 1b). Here, the AP has 3 to 6 syllables, and H- was increasingly realized toward the end of the 2nd syllable as the number of syllables increased. When an AP is longer than 6 syllables, however, H- tends to be realized on the third syllable (but rarely later than the third syllable of the phrase). Recall that L tone timing has been claimed to occur on the AP final syllable (when the AP is not IP final) for both types of accent, thus predicting a sharper falling slope for a derived accent. But the results show that L in the derived accent is realized on the syllable after the AP boundary (see Figure 1c). Thus, the falling slope of H*L between the underlying and the derived accent was not significantly different (t=-0.123, p=.902).

In addition, H* is higher than H- in the first AP of an utterance. Moreover, both H- and H* in underlying accent showed higher f0 values than those in derived accent, as shown in Figures 1a and 1b; the difference was significant only for H* (paired t=7.66, p<.01). A significant difference was also found between underlying H* and derived H* when both accents were downstepped after an accent within the same ip (t=-2.42, p<.01; see Figure 2) or when both were not downstepped after an ip boundary (t=15.4, p < .01). Figure 2 shows f0 values of three accents where the second and the last accent are downstepped and the last accent is either A or U. Here, downstepped A is higher than downstepped U. It also shows that both H- and H* undergo downstep, and the f0 difference between H- and H*, noticeable in the first AP, becomes very small when downstepped in the third AP.

Next, a sequence of unaccented words not in a preverbal position was examined to see if it is not possible to form an AP without including an accented word, underlying or derived. Contra Elordietaís original claim, we found that unaccented words which do not receive a derived accent can form an AP. In this case, the phrase initial H- was realized as in an accented AP, but no phrasal final falling tone (H*L) was observed. The initial L of the following AP was not as low as an initial L following an accented AP, but it was still lower than the adjacent H- tones. The initial L seems to be undershot between two H tones. This type of AP was often found when a phrase composed of unaccented words is long (e.g. UUU -> (U)(UU) or (UU)(U), UUUU -> (UU)(UU)) or when the phrase corresponds to a structure of XU-X. But female speaker 2 showed this type of phrasing even in UU type sentences. An example pitch track is shown in Figure 3. If the first two words formed one AP, it would show a high plateau from the second syllable of the first word to the last syllable of the second word. Rather, the second word initial f0 in Fig. 3 begins with a slightly lowered f0 compared to the preceding word final syllable. In addition, the high tones in the second AP (following the unaccented words) were not downstepped as in the sequence of accented

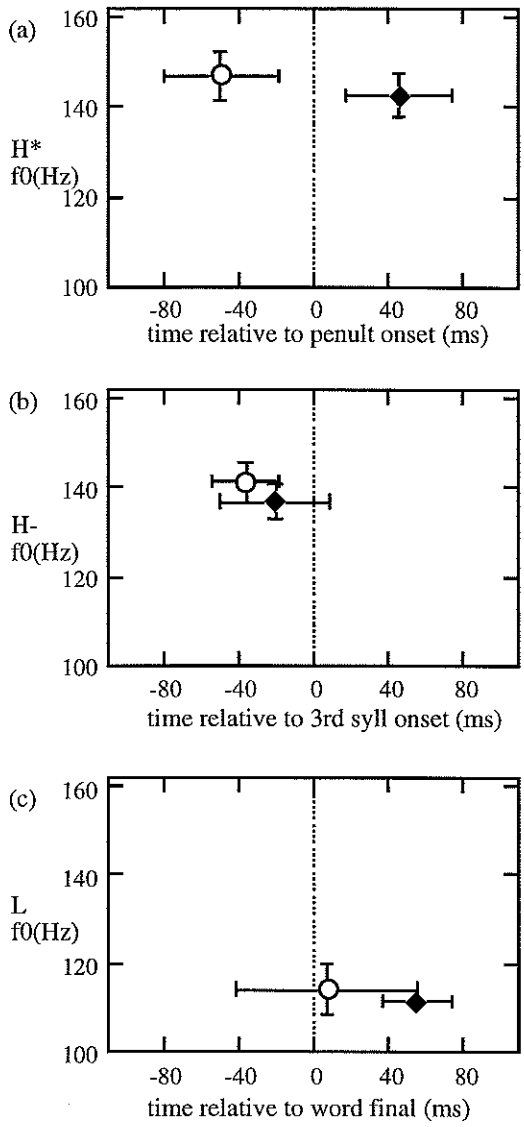

Figure 1. Timing of (a) H* relative to the penult onset, (b) H- relative to the 3rd syllable onset, and (c) L relative to word final boundary. The x-axis shows time in ms and the y-axis shows f0 values in Hz. An open circle represents underlying accent and a filled diamond represents derived accent.

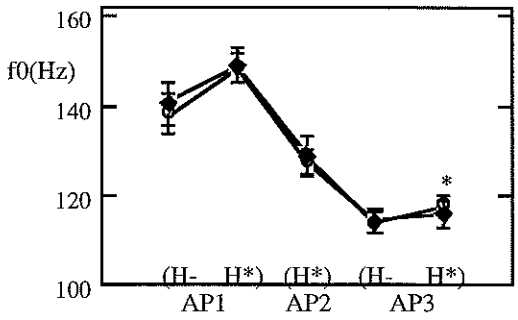

Figure 2. Peak f0 values from A-AA type (empty circle) and A-AU type (filled diamond). The 2nd AP has H* only. In the 3rd AP, H* from A type is significantly higher than H* from U type (p<.05).

APs. This suggests that only the H*L pitch accent (not H-) triggers downstep.

These show that not all APs have the right edge marked by H*L, and constitutes empirical evidence against the rule of leftward H* spreading which Elordieta ([2]) suggests as the mechanism responsible for the H tones left of the accented syllable in an AP. Instead, we propose that an AP has an underlying tonal pattern of /L H- (H*L)/; the initial L marks the beginning of an AP; H- is loosely associated with the second syllable of an AP and spreads rightward until the end of an AP or until the syllable preceding the accented syllable if there is one; H*L is associated with the penult (if A) or final syllable (if U) of AP with L being realized on the following syllable if there is one. Thus, when an AP has no accent (H*L), the AP is realized with a high plateau when it is utterance initial, but with a mid or low plateau when it is downstepped, depending on the degree of downstep. In this case, the initial L tone of the following AP is undershot between two H tones. This highish L tone seems to be similar to the weak L% in Japanese AP, though L in Basque is not influenced by the syllable weight of the AP initial syllable. Because of the weak, phonetically higher L tone, some earlier Japanese linguists posited no L% for these APs. Similarly, we assume that this weak phonetic cue, the undershot L, would have led Basque linguists to believe that there is no phrase boundary after an unaccented word.

3.2. Intermediate Phrase (ip)

As claimed in Elordieta ([2]), the domain of catathesis is found to be an ip, and is not always isomorphic to a syntactic structure. Furthermore, a focused word did not undergo downstep, initiating at least an ip boundary. Unlike Japanese, however, the post-focus APs were never deaccented. Results also show that the AP final tone in the middle of an ip was the same as that at the end of an ip (ex. (AAA) vs. (AA)(A) or (UX) vs. (U)(X)), suggesting that there are no tonal boundary cues specific to an ip.

When the phrase is a XU-U type, which is parallel to a AA-A type where the third A never undergoes downstep, we also found that the second word (U- in XU-U) is realized as a lowish f0 plateau, but does not continue to the following word (-U in XU-U). Rather, the third word (-U) showed slightly higher f0 values than the preceding plateau, providing the perception of pitch rise, and the phrase initial f0 (=L) of the third word was often the same or a bit lower than the preceding syllable. This suggests that there is an Intermediate Phrase boundary between the second and the third word, where the second word forms an unaccented AP and the third word forms an accented (derived) AP. Here, the third word begins a new ip with pitch reset as seen with the third A of AA-A type utterances where the third A does not undergo downstep and marks the beginning of an ip. Figure 4(a) shows mean f0 values of each syllable in a AU-U type based on 15 utterances (where brackets indicate word boundaries and braces indicate XP boundaries). The first point is H* of the first word; the 2nd point is the first word final boundary; the 3rd, 4th, and 5th points are the syllables of the second word; the 6th, 8th, and 9th points are the first, second, and third syllables of the third word; the 7th, 10th, and 11th points are H-, H*, and L of the third word. Here the H- of the third word is higher than the preceding points. This f0 pattern shows a good contrast with that of A-UU type utterances shown in Figure 4(b). Here, the word boundaries and the number of points per word are the same as in those in Figure 4(a). However, the second word shows an initial rising pattern and stays the same until the end of the third

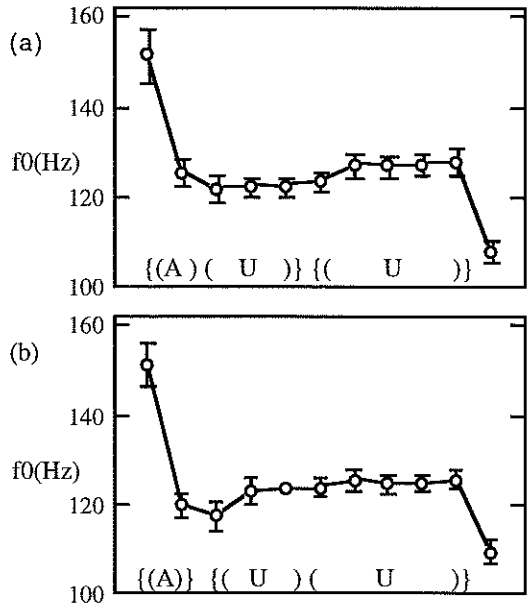

Figure 4. Mean f0 values of 11 points from three words in (a) AU-U type and (b) A-UU type.

word, suggesting that one AP combines the second and the third word. That is, the three words in Fig. 4(b) form two APs and one ip [(A)(UU)], while those in Fig. 4(a) form three APs and two ips [(A)(U)][(U)] (where ( ) =AP constituency, [ ] =ip constituency). These prosodic structures or groupings do not correspond to the syntactic groupings shown in Figure 4; the XP boundary in Fig. 4(a), AU-U, corresponds to an ip boundary while that in Fig. 4(b), A-UU, corresponds to an AP boundary. But, still no prosodic grouping combines words across a syntactic constituent. A similar ip-grouping was found for a sequence of accented words in Elordieta [2] and in our results: A-AA was prosodically realized as one ip, [(A)(A)(A)], and AA-A was realized as two ips, [(A)(A)][(A)]. Thus, pitch reset was found only for the third A of the latter phrasing. Data in Figure 4, therefore, add new evidence that pitch is reset at the beginning of an ip, both after accented and unaccented APs.

Finally, unlike English, the ip final vowel in Lekeitio Basque is not lengthened; it has the same duration as that of an AP final vowel (ip vs. AP: t=-1.34, p=.188). This is shown in Figure 5 together with data from an Intonation Phrase.

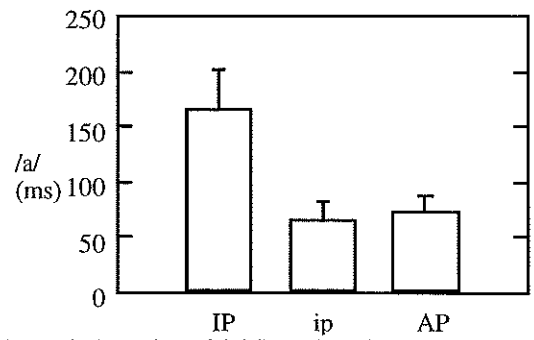

Figure 5. Duration of /a/ (in ms) at the end of three prosodic levels: IP, ip and AP.

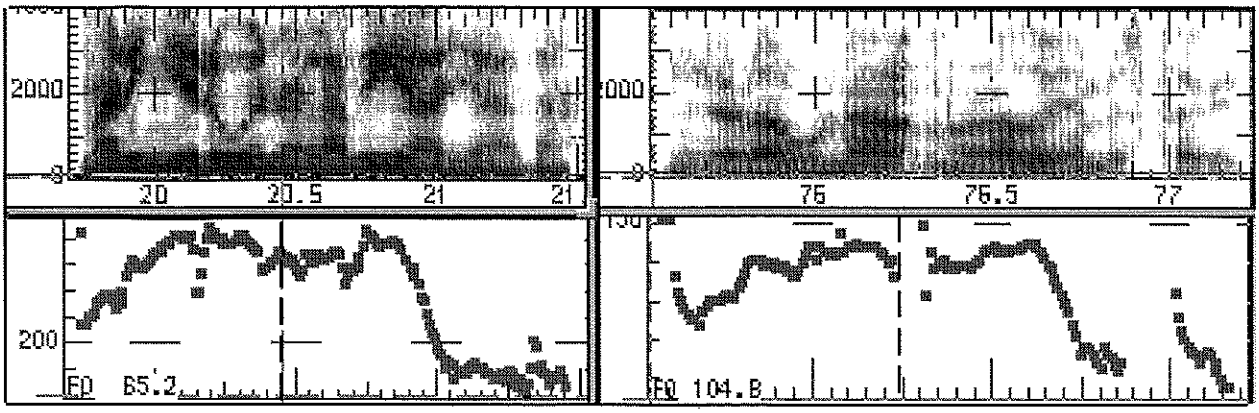

Figure 3. F0 track of the sentence *mariñeruen alabia allaga da* "The fisherman's daughter has arrived". The dotted line is the boundary between the first and the second word. Speaker: female 2.

Figure 6. F0 track of the sentence *nire laguna, nora dóyan be ez dakitx* "My friend, I don't know where s/he is going". The vertical line marks the end of the topic phrase. Speaker: male.

3.3. Intonation Phrase (IP)

In addition to AP and ip, we propose that Lekeitio Basque has an Intonation Phrase, which contains one or more ips. The right edge of an IP is marked by a boundary tone; L% for declaratives and interrogatives, and H% for the end of each member of a list. It is segmentally cued by phrase final lengthening: IP final vowel was significantly longer (about twice) than AP or ip final vowel (IP vs. ip=AP for vowel /a/: t=8.03, p<.001). Figure 5 shows the duration of vowel /a/ at the end of three prosodic levels; the same relation was found for other vowels (or rhymes).

An IP boundary was also observed at the end of a topic phrase before the main clause. When the topic phrase ends in an accented AP and the main clause begins with an accented AP, no downstep is observed for the latter AP. Rather, the f0 is fully reset, higher than across an ip boundary. When the topic phrase consists of unaccented words, we find a similar f0 pattern as those of an unaccented AP in Figure 3 and 4(a) above. The first AP ends in a high tone, and the second AP starts with a very high L tone (i.e. is undershot). A representative example is shown in Figure 6. Here, the spectrogram shows that there is a glottal stop at the beginning of the main clause and the first AP final vowel /a/ is lengthened, indicating an IP boundary. If the f0 track is not broken due to glottalization, this is very similar to that in Figure 3, supporting our finding that unaccented words can form one AP. Finally, we are not sure whether there is an Utterance, a domain of declination as claimed in [2], but it seems that there are different degrees of final lowering between sentence medial IP and final IP. More data are needed to determine if there is any prosodic level higher than an IP.

4. CONCLUSION

In conclusion, special findings of this study are: (1) an unaccented word without a derived accent can end an AP (i.e., H*L is not the only right edge cue of an AP, and pitch is reset at the beginning of an ip, both after accented and unaccented APs, (2) H* is higher than H-, (3) underlying H* is higher than derived H*, (4) downstep is triggered only by H*L, not by H-, (5) no phrasal tone exists for an Intermediate phrase, and (6) phrase final lengthening in IP only.

5. REFERENCES

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