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ABSTRACT

Many tone languages exhibit some form of downdrift or automatic downstep, the lowering of high tones separated by low tones. In extreme cases, the realization of high tones at the end of a domain (such as the sentence) may be lower than the realization of low tones at the beginning. Tone languages with this property are cross-level tone languages. In such languages, high and low tones must be distinguished by reference to the value of neighboring tones rather than to some absolute range of values. As part of a phonetic study of pitch realization in African tone languages, field recordings of natural speech in Anlo, a dialect of Ewe, recorded in Ghana in 1970, were submitted to computerized pitch analysis. This dialect has four phonetically distinct tone levels. Only two are lexically distinct. The text, consisting of 15 intonation groups subdivided into 45 tone groups, was analyzed for syntactic environment as it related to pitch. Results indicate that while downdrift affects all tone levels to some extent, its effect is greatest on the two central tone levels. It is concluded that this dialect qualifies as a cross-level tone language. (MSE)

DOWNDRIFT IN A TONE LANGUAGE WITH FOUR TONE LEVELS*

G. N. Clements

Many tone languages exhibit one form or another of *downdrift* (or *automatic downstep*): the lowering of high tones separated by low tones. In extreme cases, the realisation of high tones at the end of a domain (such as the sentence) may be lower than the realisation of low tones at the beginning. Tone languages having this property may be called "cross-level" tone languages (see Figure 1 on p. 39). In such languages, high and low tones must be distinguished by reference to the F_0 value of neighbouring tones, rather than to some absolute range of F_0 values.

As part of a phonetic study of pitch realisation in African tone languages, field recordings of natural speech in the Anlo dialect of Ewe, recorded in Ghana in 1970, were submitted to analysis by a pitch computation programme designed by S. Maeda. This report is a summary of the results.

Anlo Ewe has four phonetically distinct tone levels, here labelled X (extra-high), H (high), M (mid), and L (low). Only two tone levels are lexically distinctive; underlying H and M tones are realised at one of these four phonetic tone levels by a set of regular and

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productive tone rules (Stahlke 1971, Clements 1977, 1978). The oral text analysed in this study consisted of an excerpt from a description of marriage customs given to the writer by G. K. Blebu, of Anyako, Volta Region. This text was an uninterrupted monologue uttered in a relaxed, conversational style.

The following prosodic units are relevant to a description of Ewe tone:

1. *the intonation group*, defined as the longest stretch of speech in which register raising or resetting does not occur. This unit generally coincides with one of the following four syntactic units:
   (a) the sentence,
   (b) a coordinate clause,
   (c) a subordinate clause introduced by the complementizer *be* (used, for example, to introduce reported speech), and
   (d) serial clauses.
2. *the tone group*, defined by occurrences of pause. Pauses usually occur between words at major syntactic breaks, or following prepositions. Register lowering (downdrift) is not interrupted by pauses; that is, downdrift is continuous within the intonation group, regardless of how many tone groups it consists of. Rules of phonological tone sandhi are restricted to the tone group, however. A further characteristic of the tone group is vowel lengthening in final position.

The text analysed consisted of 15 intonation groups, subdivided into 45 tone groups. Average values for register raising between intonation groups was 14.9 Hz, and for register lowering within intonation groups 13.6 Hz, computed by comparing F_0 values of high tones only. Within the intonation group, downdrift appeared to be uninfluenced by internal syntactic organisation, affecting tones within words to the same extent as tones across words. Slight differences were found,

however, between the syntactic environment V NP (where NP is not a pronoun) and the genitival structure NP N (where N is phonologically CV(V)), in that downdrift across the first syntactic juncture averaged 4.9 Hz (for 10 tokens) and that across the second, only 1.1 Hz (for 8 tokens).

The most significant downdrift effect involved the H and M tone levels. These tones were found to overlap in F_0 quite consistently within the intonation group. For example, comparing the first mid tone and the last high tone within each intonation group, overlap of as much as 16 Hz could be observed:

intonation group	*first M tone*	*final H tone*
1	108 Hz	102 Hz
2	96	91
4	97	89
5	97	85
7	107	91

Significant overlap was not found between the X and H tone levels or the M and L levels. The average value of the interval between H and M levels is much lower than that between either of the latter two levels. The average drop between H and M was 9.6 Hz (15 tokens), and the average rise between M and H was 6.2 Hz (20 tokens). Another measure of the special status of the two central tone levels is that downdrift is very consistent across the tone sequence HMH (M consisting of one or more successive M tones), but not consistent across other sequences, including HLH. Thus 14 of the 17 tokens of HMH sequences showed downdrift of at least 2 Hz and averaging over 8 Hz, while only 2 of the 4 HXH sequences, and 4 of the 11 HLH sequences, showed downdrift. Also, only 3 of 10 MHM sequences showed downdrift affecting the two M tones.

As a further way of comparing the relative effect of downdrift on the four tone levels, each intonation group was divided into three parts of equal length. Average F_0 values were taken within each of these thirds for each tone level. The results are summarised below

(number of tokens in parentheses), and shown graphically in Fig. 2 (on p. 40):

tone level	*first third*	*second third*	*third third*
X	129.4 (27)	125.9 (20)	123.6 (15)
H	107.8 (31)	102.4 (30)	96.2 (34)
M	101.6 (20)	95.0 (28)	90.6 (17)
L	87.7 (14)	85.0 (10)	84.4 (25)

It will be noticed that the drop between the first and third tone group is highest for the H and M tone levels (11.6 and 11.0 Hz, respectively, compared with 5.8 and 3.3 Hz, respectively, for the X and L tone levels). There is significant pitch overlap between the H and M tone levels but not between either of the two other adjacent tone levels. In particular, the average value of the X tone level at the final third is still well above the average value of the H tone at the first third. It should be pointed out that the procedure used here tends to underestimate the amount of downdrift from the beginning of the intonation group to the end, so that the total downdrift for each tone level is somewhat greater.

The average absolute difference between the adjacent tone levels in each third is summarised below:

F_0 *difference between levels*	*first third*	*second third*	*third third*
X,H	21.6	23.5	27.4
H,M	6.2	7.4	5.6
M,L	13.9	10.0	6.2

This way of displaying the data shows that the H and M levels maintain a fairly constant interval between them across the intonation group, while the interval between the X and H levels increases and the interval between the M and L levels decreases.

Summary. While downdrift affects all tone levels to some extent, its effect is greatest on the two central tone levels. One interpretation

of this result might be that downdrift affecting the peripheral tone levels is to be considered a declination effect, not subject to control by the speaker, while downdrift across the medial tone levels is a linguistic effect comparable to the "automatic downstep" familiar in many languages with two tone levels. Finally, since absolute values of H tones at the end of the intonation group are characteristically lower than values of M tones at the beginning, the Anlo dialect of Ewe may be regarded as a *cross-level* tone language in the terms presented at the outset of this paper, at least as far as its H and M tone levels are concerned.

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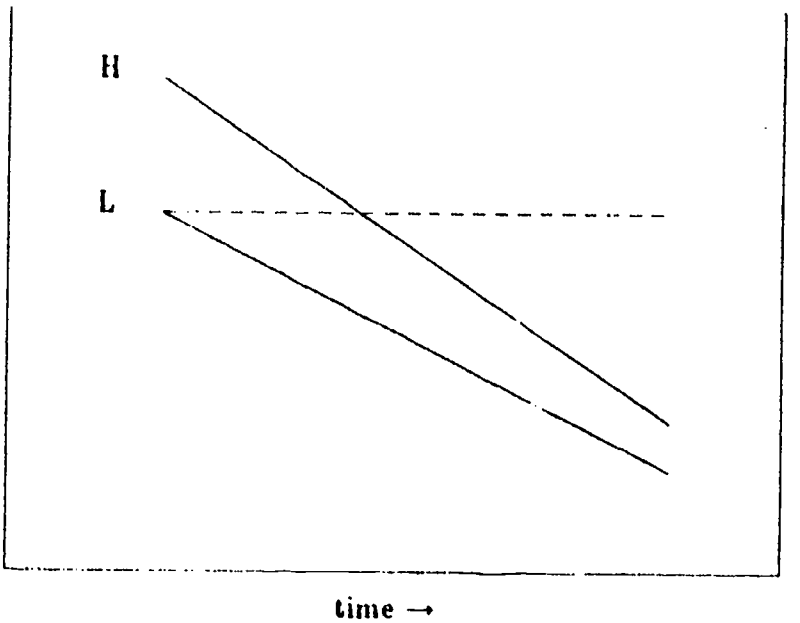

Figure 1: A cross-level tone language. H tone drops into the pitch region initially occupied by L tone.

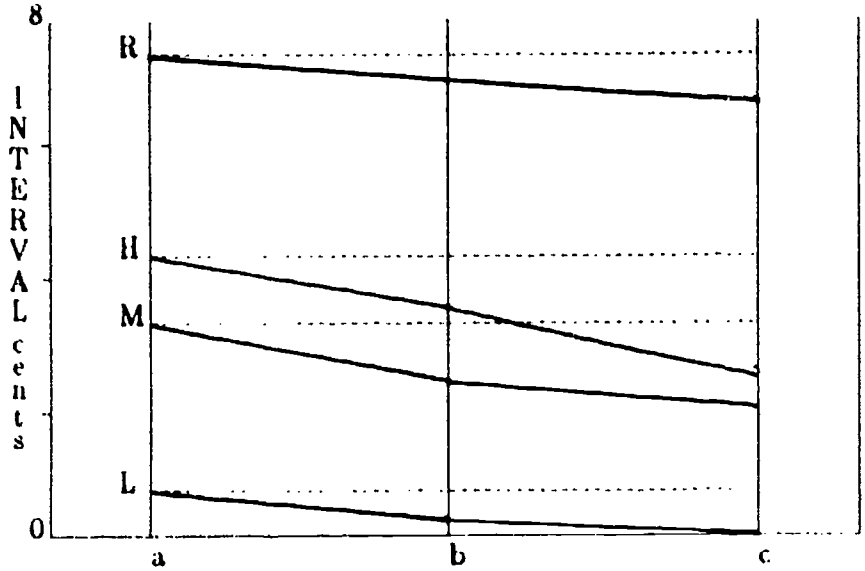

Figure 2: Tone registers in Ewe (Anlo dialect). The descending solid lines represent projected values for each of the four registers, based on tone values averaged over the first third (a), second third (b), and final third (c) of the intonation group.