

Downdrift, Downstep, and Declination

Bruce Connell
York University/SOAS
bconnell@yorku.ca

Abstract

One common means of typologizing tone languages is according to their characteristics of pitch realization. In this paper I look at a set of these that has frequently been used in discussing the typology of tone languages in West Africa – the phonological and phonetic aspects of tone realization which have been grouped together as ‘downtrends’. In particular, I look at the three different downtrends mentioned in the title of this paper, downdrift, downstep, and declination. A review of the literature reveals a conflict in the use of these terms – or in identifying what has been designated by them – in that the same term has been used to refer to different phenomena, or different terms to one and the same phenomenon. This may be problematic in that it may lead to the formulation of inappropriate research questions, and thence to questionable theoretical conclusions. This paper presents instrumental data from a number of different West African languages to illustrate the nature of the problem and then offers a solution. Clarification of this issue sheds new light on the question of which aspects of pitch realization are local and which are global phenomena.

1. Introduction

Several different criteria have been used in attempts to classify tone systems. In this paper I look at just one of these, one that has frequently been used in discussing the typology of tone languages in West Africa. This has to do with a set of characteristics pertaining to phonological and phonetic aspects of tone realization which can be grouped together as ‘downtrends’. In particular, I look at the three different downtrends mentioned in the title of this paper, downdrift, downstep, and declination. A fourth,

final lowering, could also be grouped with these but will not be treated in detail here. Early discussion of these (and related) characteristics of tone systems can be found in Pike (1948), who distinguished between register and contour tone languages; it is register type systems, i.e. those in which the tones are basically level, that are typically found in Africa. Welmers (e.g. 1959, 1965, 1973), drew a distinction among register tone languages, identifying discrete and terracing types of systems, where discrete type systems were those in which, “two or more contrastive levels of pitch are maintained from pause to pause with no intersection of actual pitch” (1965: 50). He adds that in such a system there is generally no systematic restriction on tonal sequences. This characterization is found in a reply to Stewart (1965) who argued there and subsequently (e.g. Stewart 1983, 1993) that there is essentially no difference between the two types. Stewart’s argument was in large part based on the view that the phenomena he termed ‘automatic downstep’ and ‘non-automatic downstep’ were underlyingly the same. There has been continued debate as to whether there is a justifiable distinction between discrete-level and terracing languages, whether automatic and non-automatic downstep are indeed as similar as claimed, and how these are the same or different from downdrift, as scholars attempt to typologize tone languages along these parameters.

My goal in this paper is to examine the characteristics of these different downtrends, in part to see to what extent they can be used as a basis for a typology of tone languages, but also to address a question surrounding the use of these terms which has concerned me for some time. I first present definitions or descriptions of these different downtrends as typically found in the literature: it is shown in particular that the term

downdrift has been used ambiguously, most frequently as being synonymous with automatic downstep, though sometimes as synonymous with declination, however the latter is rarely, if ever, used to refer to automatic downstep. It is this inconsistent use of terminology that has in large part led to disagreements and difficulties in characterizing tone languages, and questions arise as to whether each of these terms are to be identified with distinct phenomena, or are one or more of them in fact redundant? And, more important, is this merely a problem at the level of terminology; or does it indicate a lack of clarity at a theoretical level. If the answer to the first question is 'yes', we must be aware that incorrectly labelling a particular phenomenon may lead to the formulation of inappropriate research questions, and thence to dubious theoretical conclusions.

Instrumental evidence drawn from both published and unpublished work on a number of different languages is then presented, to show that each of non-automatic downstep, automatic downstep, downdrift, and declination are separate phenomena. The inconsistency, or overlap, in their usage stems partly from the simple fact that until recently an insufficiently large range of languages to demonstrate the different phenomena had been examined; but to some extent it can also perhaps be attributed to an uncritical acceptance of the status quo. Separating the terminology is also related to more theoretical questions: whether the different effects are phonetic or phonological in nature, whether they are 'local' or 'global' phenomena, and what they mean for our understanding of the pitch register or span, or tonal space (something else that needs to be properly defined), and how speakers manipulate this space. Seeing them in this light permits the differences among them to be clarified, allowing the classification of tone languages on the basis of these characteristics to be done on sounder footing.

2. Different downtrends

2.1. Declination

The term 'declination' was introduced by Cohen & 't Hart (1967) in work on Dutch intonation; it has since become common in work on intonation particularly in European languages, though it is less well-known or used in work on African tonal systems. Declination is used to refer to "a gradual modification (over the course of a phrase or utterance) of the phonetic backdrop against which the phonologically specified F₀ targets are scaled" (Connell & Ladd 1990: 2). While there has been some debate over the nature of declination, it is now generally agreed to be a phonetic effect. Declination is said to be a universal effect, at least with respect to declarative sentences. The effect is frequently said to be suspended in question and other sorts of non-declaratives (see, e.g. Lindau 1986 for Hausa), or in situations where tonal contrasts might be endangered (Hombert 1974, Connell 1999a). While in tone languages it can occur regardless of tonal combination (i.e. in mixed tone sequences), the existence and degree of declination can most clearly be seen in a phrase consisting of tones all of which have the same phonological value, e.g., all Hs, all Ms, or all Ls. Any lowering in F₀ through the course of the utterance can be attributed to this phonetic effect. (This simplifies the account somewhat: lowering at the end of the phrase may be due to 'final lowering', and it is not always a straightforward matter to decide which effect is responsible for observed lowering in certain cases.) Declination is illustrated in Figure 1, with data from Hausa (Lindau 1986), in a phrase that consists of all Hs, and has a slope of approximately 14% per second.

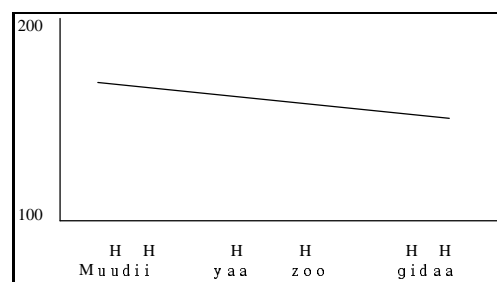


Figure 1: Declination illustrated in a sequence of Hausa High tones in the sentence ‘Muudii yaa zoo gidaa’ (Muudii came home), adapted from Lindau (1986).

2.2. Downstep

The phenomenon of downstep was first recognized in print well over a century ago by Christaller (1875:15) who, in his discussion of Fante grammar, talks of three tones, high, middle and low, but explains the middle tone as “high tones abating by one step or successive steps”, thereby explicitly recognizing the underlying sameness of the middle and high tones. In the modern era, it was work by scholars such as Welmers (1959), Winston (1960), and especially Stewart (1965) that brought the nature of downstep into focus as the lowering of a high tone in certain specifiable circumstances (it was soon discovered that there are languages in which tones other than high tones are also subject to downstep). One of Stewart’s important contributions was the recognition that the lowering of the second H in a HH sequence paralleled the lowering of the second H in a HLH sequence. In the latter case, the lowering was attributed to the influence of the intervening L; in the former it was argued that the lowering was due either to an underlying (floating) L, or one that had been lost historically. These two types of downstep Stewart referred to as ‘automatic’ and ‘non-automatic’, respectively. A second important feature of downstep is that, within specifiable bounds, it sets a new ‘ceiling’ for all Hs subsequent to the one downstepped. In other words, subsequent Hs do not rise above the height of the one downstepped, and hence the descriptive label ‘terracing’. The limit of downstep is frequently the entire utterance, but may be defined by a syntactic boundary within the utterance, at which point a ‘reset’ occurs; F0 regains its original starting height. The term ‘key-lowering’ was adopted by Stewart to describe this effect, and it has often been described as a downward shift in register (e.g. Snider 1990, Snider & van der Hulst 1993). A third characteristic of downstep is its cumulative nature: successive downsteps result in

successively lower pitch levels, though one might consider this to be incidental. Figures 2 and 3 illustrate automatic downstep and non-automatic downstep, respectively, in Ibibio.

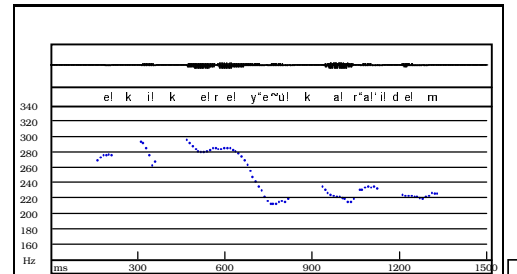


Figure 2: Illustration of automatic downstep in the Ibibio phrase *ék'kéré yè úkára íd ɛn* (HHHHLHHH) ‘thought and self-rule’. (Speaker EU.)

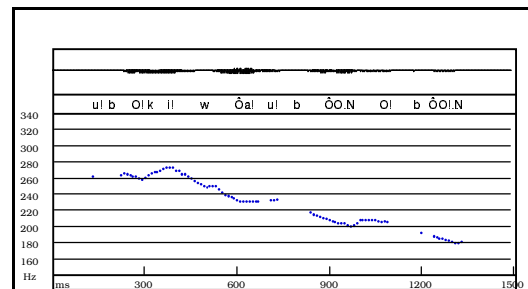


Figure 3: Illustration of non-automatic downstep in the Ibibio phrase *úbók íwá úbók ɔ́b ɔ́n* (HHH!HH!HH!H) ‘hand of cassava of king’s kingship’. (Speaker EU.)

2.3. Downdrift

Downdrift is somewhat more difficult to characterize precisely because, as mentioned earlier, the term has been used in different senses. Most commonly, it has been used synonymously with Stewart’s automatic downstep. Hombert (1974), for example, characterizes downdrift as “the progressive lowering of a high tone after a low tone” (p. 171), and in a footnote explicitly equates it to automatic downstep. Similar views are expressed by a range of authors including, more recently, Snider & van der Hulst (1993) and Hyman (2001). However, Hombert also attributes an intonational element to downdrift, observing that Ls also descend, and then suggests that the term downdrift refer to “the lowering of

like tones (consecutive or not)” (p. 172, fn 6). Downdrift, then, given this stipulation concerning consecutive tones (or when it applies to consecutive like tones), is obviously the same phenomenon as that described earlier as declination, though declination just as obviously is something quite different from automatic downstep. Both of these views on downdrift, that it involves a local assimilation between Ls and Hs and that it is intonational, i.e. a phrase or sentence level effect, have been found in the subsequent (and preceding) literature, though again most frequently as synonymous to automatic downstep. An illustration of downdrift of a presumably assimilatory nature, through the alternation of Hs and Ls, can again be taken from Lindau’s (1986) study of Hausa, and is shown in Figure 4. In this figure, as in Figure 1, a trend line for the H tone only is represented (in Lindau’s representation, the second sentence also shows a downtrend affecting the Ls, and both map the actual F0 trace). In comparing the two, it is important to note that the slope in Figure 4 is steeper than that in Figure 1, with a slope of 33% per second. This is because it combines the declination of Figure 1 with the effect of downdrift, the local assimilation of Hs to Ls.

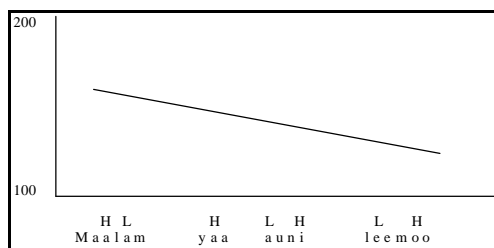


Figure 4: *Downdrift in alternating H and L tones in the Hausa phrase ‘Maalam yaa auni leemoo’. (The teacher weighed the oranges), adapted from Lindau (1986).*

To summarize, declination is generally agreed to be a phonetic effect, a backdrop lowering of F0 that has an expanded, or global, domain, often the entire utterance. Downstep, whether automatic or nonautomatic, appears to come about through the local interaction of adjacent tones; its terracing effect (the lowering of the ceiling) has frequently been described as key-lowering (Stewart) or register shift (Snider & van

der Hulst 1993). And while downstep is in a sense ‘local’, in that a specific site – the adjacent tones – can be identified as to where it is triggered, it is typically global in its domain, as all subsequent tones are affected. However, unlike declination, it is at least arguably a phonological effect. While some writers attribute the downward shift in register that comes about with downstep to phonetic implementation rules, such argumentation appears to come about from research on languages in which tone is not phonologically contrastive. The fact that in many, perhaps most, tone languages in which downstep occurs it (at least non-automatic downstep) is phonemically contrastive, suggests rather strongly that it must be accounted for in the phonological component of the grammar. This and other arguments for a phonological view of downstep are developed in Snider (1990, 2000), and Snider & van der Hulst (1993). Downdrift has most frequently been equated with automatic downstep, as a local interaction between Ls and Hs that is cumulative in its effect, though attention is drawn to the fact, at the same time the term has also been used to describe the progressive lowering sometimes found in like tone sequences; i.e. declination.

The question therefore arises as to whether each of these terms are identified with distinct phenomena, or are one or more of them in fact redundant? That is, if some phenomena called downdrift are the same as automatic downstep, and other types of downdrift are the same as declination, why not abandon the term downdrift altogether and simply label things consistently as either automatic downstep or declination, as the case may be, and get rid of the terminological ‘confusion’ (laxity)? In fact, as is shown in the the following section, the lack of terminological consistency is more than simply having alternate labels for the same thing; it actually masks to some extent our understanding of tone systems, leading to the formulation of inappropriate research questions, and thence to questionable theoretical conclusions, including conflating what are typologically different languages.

3. Downdrift in Mambila

Mambila is a language with four level tones; it is said not to have downstep (automatic or non-automatic – Perrin 1974; Connell 1999a, b), and the presence of declination appears to be variable, occurring consistently only with T4 (L), and never with T1 (H). It does, however, have something that resembles what has often been called downdrift: a successive lowering of F0 in alternating tone sequences. Figure 5 shows averaged plots (based on a minimum of five repetitions of each sentence) of pitch traces for like tone sequences in Mambila, illustrating the absence of declination – or any sort of downtrend – for all but T4. For each tone, sentences of different lengths (short and long, or short, medium and long for T4, are superimposed) in the figure.

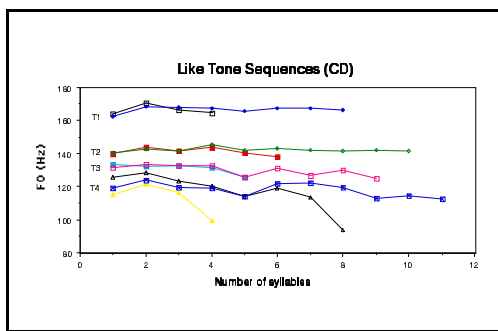


Figure 5: Averaged pitch traces (5 repetitions) for like tone sequences. (Male speaker.)

Figure 6 shows averaged pitch plots of sentences comprised of alternating sequences of Hs and Ls for the same speaker, which show a slight downtrend; again, three sentences, short, medium and long are represented, and Figure 7 shows alternating sequences of upper mid (T2) and lower mid tones (T3).

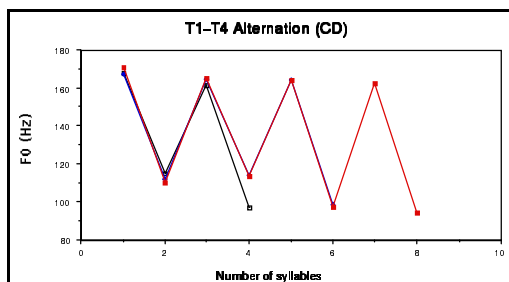


Figure 6: Averaged pitch traces (5 repetitions) for T1 – T4 alternating tone sequences of three different lengths. (Male speaker.)

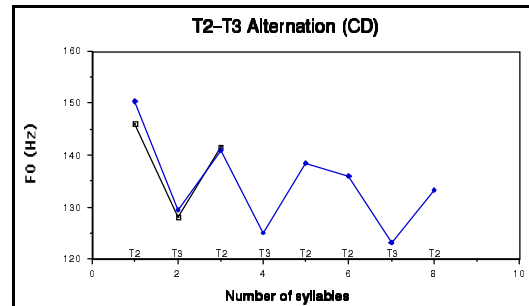


Figure 7: Averaged pitch traces (5 repetitions) for T2 – T3 alternating tone sequences of two different lengths. (Male speaker.)

Regression analyses for the longer sentence in each of the two cases are graphed in Figures 8 and 9, respectively. In Figure 8 the upper line represents T1 and the lower line T4, and in Figure 9, the upper line represents the trend for T2 and the lower for T3. In both cases the slope of the trend line indicates a significant downtrend for the higher of the two tones, though only T4 in Figure 8 shows this for the two lower tones. A summary of the regression analyses are presented in Tables 1 to 4.

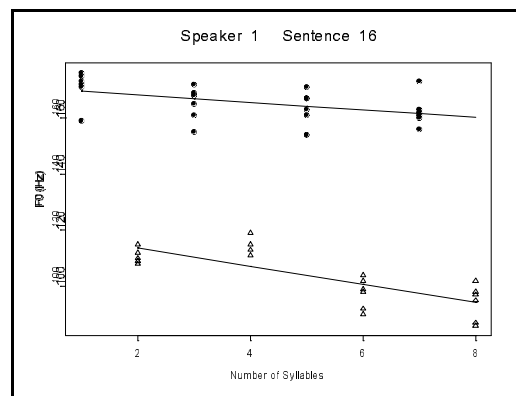


Figure 8: Regression analysis of alternating High and Low tones (T1 and T4) in Mambila, showing downdrift.

Coefficients:

	Value	Std.Err	t value	Pr(> t)
Intcpt	170.91	2.46	69.58	0.0000
NS0	-1.33	0.54	-2.49	0.0209

Table 1: Regression summary for T1.

Coefficients:

	Value	Std.Err	t value	Pr(> t)
Intcpt	120.08	2.99	40.14	0.0000
NS0	-3.24	0.55	-5.93	0.0000

Table 2: Regression summary for T4

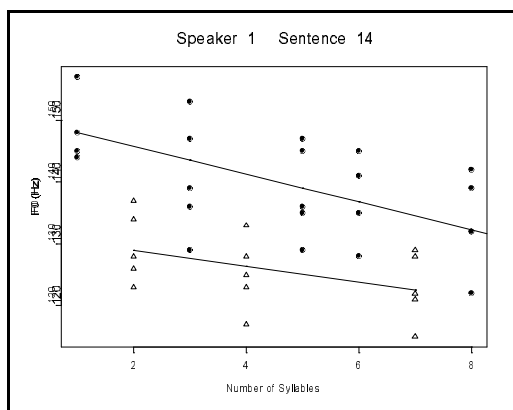


Figure 9: Regression analysis of alternating Upper Mid and Lower Mid tones (T2 and T3) in Mambila, showing downdrift.

Coefficients:

	Value	Std.Err	t value	Pr(> t)
Intcpt	150.24	3.12	48.05	0.0000
NS0	-2.24	0.60	-3.73	0.0011

Table 3: Regression summary for T2

Coefficients:

	Value	Std.Err	t value	Pr(> t)
Intcpt	131.45	3.40	38.64	0.0000
NS0	-1.27	0.70	-1.79	0.0958

Table 4: Regression summary for T3

These results show plainly the existence of a downtrend in Mambila that is statistically significant: a progressive lowering of tones through the interaction of adjacent lower and higher tones; i.e. it appears to meet the criteria for, and can be termed, downdrift. Figure 10, on

the other hand, shows pitch plots from two speakers, again averages of at least five repetitions, for a phrase with a tonal sequence of T1T4T1T1T1, i.e. HLHHH, and Figure 11 for a phrase with a tonal sequence of T4T1T1T1 (LLHHH). What is striking in these utterances, though, is that the lowered H, i.e. the one immediately after the low, does not established a new ceiling for subsequent Hs; these rise to the height of the initial H in Figure 10 and a similar rise is in evidence in Figure 12.

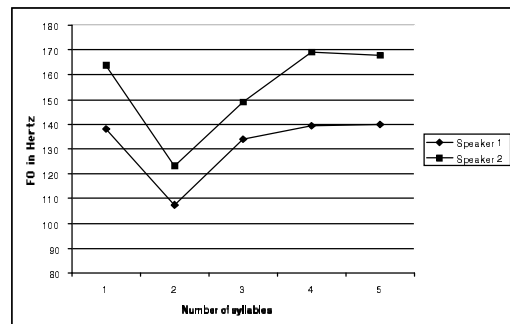


Figure 10: Pitch traces of HLHHH for two Mambila speakers showing an absence of automatic downstep in the language. Average of five repetitions.

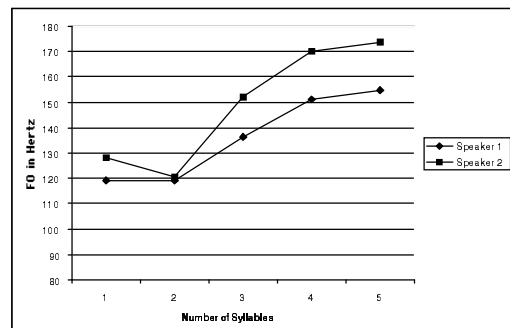


Figure 11: Pitch traces of LLHHH for two Mambila speakers showing an absence of automatic downstep in the language. Average of five repetitions.

This, then, supports the earlier assertion in the literature that Mambila doesn't have downstep. Rather, what it does have is a lowering of a high(er) tone following a low(er) tone, a local interaction that appears to be simply a phonetic effect that is corrected once the low tone is not involved, allowing the H to regain its former heights. That the effect of this interaction is cumulative gives it the appearance of automatic

downstep, but without the register shift it can hardly be seen as the same phenomenon (i.e. automatic downstep) that, for example, was illustrated in Figure 2 from Ibibio. One may wish to argue that Mambila has both downstep and upstep, i.e. the lowering seen is corrected by a floating H (cf. Stewart 1993 on Ebrie), but such arguments fail on at least two grounds:

- first, the length of time it takes for H to regain or attain its target is variable: one or two syllables typically, but sometimes within one and at other times more than two syllables. This, impressionistically at least, appears to correlate with speech rate/style.

- second, the tonal system of Mambila becomes unnecessarily complicated: why invoke such a device when there is no independent evidence for it, and when the effect in question is well explained by other means?

To be sure, something may well be happening to the Mambila register (or tonal space or span), but it is not the same as what is happening in Ibibio. Recognizing the difference between the two types of downtrend leads to the formulation of a different set of questions about the nature of register manipulations.

4. Conclusion

There is no question that declination and downstep are distinct phenomena, nor that similarities between non-automatic and automatic downstep exist. There is, though, some question as to what constitutes downdrift, or whether the term is even necessary. What I have shown is that an effect that in many ways resembles downdrift occurs in Mambila, but that this effect, in the absence of terracing, cannot be called automatic downstep. What occurs in Mambila is, in other words, a phenomenon quite distinct from downstep as manifested, for example in Ibibio. The tone system of Mambila, and of languages like it, are typologically different from those of languages like Ibibio, Igbo and Akan, classic terracing languages.

5. References

- Becker, L.A. (1979). 'Once more on the nature of downdrift.' *Studies in African Linguistics*, Vol 10. 3, 233–245.
- Christaller, J.G. (1875). *Grammar of the Asante and Fante Languages*.
- Cohen, A., & 't Hart, J. (1967) On the anatomy of intonation. *Lingua*, 19 177–192.
- Connell, B. (1999a). 'Four tones and downtrend: a preliminary report on pitch realization in Mambila.' *New Dimensions in African Linguistics and Languages. Trends in African Linguistics, Vol. 3*. P. Kotey (ed.), Trenton, N.J.: Africa World Press, pp. 75–88.
- Connell, B. (1999b). 'Mid tone downtrends in Mambila.' Paper presented to the 7th Manchester Phonology Meeting.
- Connell, B., & D.R. Ladd. (1990). 'Aspects of pitch realization in Yoruba.' *Phonology*, Vol 7. 1, 1-29.
- Hombert, J-M. (1974). 'Universals of Downdrift: their phonetic basis and significance for a theory of tone.' *Studies in African Linguistics*, Suppl. 5, 169–183.
- Hyman, L.M. (2001). 'Tone systems.' *Language Typology and Language Universals: An International Handbook*, M. Haspelmath, E. König, W. Oesterreicher & W. Reible (eds), Berlin: Mouton de Gruyter, pp. 1367–1380.
- Lindau, M. (1986). 'Testing a model of intonation in a tone language.' *Journal of the Acoustical Society of America*, Vol 80, 757–764.
- Perrin, M. J. (1974). 'Mambila.' J. Bendor-Samuel (ed.), *Ten Nigerian Tone Systems*, Jos: Institute of Linguistics, pp. 93–108.
- Pike, K.L. (1948). *Tone Languages*. Ann Arbor: University of Michigan Press.
- Snider, K. (1990). 'Tonal upstep in Krachi: Evidence for a register tier.' *Language*, Vol 66, 453–74.
- Snider, K., & H. van der Hulst (1993). 'Issues in the representation of tonal register', *The Phonology of Tone – the representation of tonal register*, H. van der Hulst & K. Snider (eds.), Berlin: Mouton de Gruyter, pp. 1–27.
- Stewart, J.M. (1965). 'The typology of the Twi tone system.' *Bulletin of the Institute of African Studies, Legon*, 1: 1–27.

- Stewart, J.M. (1983). 'Downstep and Floating Low Tones in Adioukrou.' *Journal of African Languages and Linguistics*, Vol 5, 57-78.
- Stewart, J.M. (1993). 'Dschang and Ebré as Akan-type total downstep languages', *The Phonology of Tone – the representation of tonal register*, H. van der Hulst & K. Snider (eds.), Berlin: Mouton de Gruyter, pp. 185–244.
- Urua, E.E. (1996/97). 'A phonetic analysis of Ibibio tones: a preliminary investigation.' *Journal of West African Languages*, Vol 26. 1, 15–25.
- Welmers, W. E. (1959). Tonemics, morphotonemics, and tonal morphemes. *General Linguistics*, Vol 4, 1– 9.
- Welmers, W. E. (1965) Some comments on J M Stewart' s "The typology of the Twi tone system". *Bulletin of the Institute of African Studies, Legon, 1*, 28–42.
- Welmers W. E. (1973). *African Language Structures*. Berkeley: University of California Press.
- Winston, F. D. D. (1960) 'The ' mid' tone in Efik.' *African Language Studies*, Vol 1, 185-192.