AUTOMATIC AND NONAUTOMATIC DOWNSTEP IN CHUMBURUNG: AN INSTRUMENTAL COMPARISON*

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The present work reports on an instrumental study of tonal downstep in Chumburung, a Kwa language spoken in Ghana. Downstep is the lowering of the tonal register that sometimes occurs between otherwise identical tones. In particular, the study addresses the question of whether the degree of lowering that is attributable to automatic downstep (downstep triggered by an overt low tone) is the same as that which is attributable to nonautomatic downstep (downstep triggered by a floating low tone). The study concludes that the degree of lowering is the same in both cases.

Cet article rapporte les résultats d'une étude instrumentale de la faille tonale en chumburung, langue kwa parlée au Ghana. La faille tonale est l'abaissement du registre tonal qui a parfois lieu entre deux tons par ailleurs identiques. Plus précisément, l'étude répond à la question de savoir si le degré d'abaissement attribuable à la faille tonale automatique (la faille provoquée par un ton bas présent) est le même que celui provoqué par la faille tonale non automatique (la faille provoquée par un ton bas flottant). Selon cette étude, le degré d'abaissement est le même dans les deux cas.

0. INTRODUCTION

The present work reports on an instrumental study of tonal downstep in two slightly different dialects of Chumburung, a North Guang language spoken by some 69,000 people along the south end of the Dakar River in Ghana's Northern and Volta Regions (Gordon (2005: 124). The Guang family, in turn, belongs to the Tano subgroup of Kwa languages. Chumburung is most closely related to Krachi, Nawuri, Gichode, Gonja, and Nkonya, and more distantly related to Akan, which is also a Tano language. Previous research on the phonology and tone system of this language includes Hansford (1988) and Snider (1986, 1989a, 1989b, 1990a, 1999).

Downstep is a common tonal phenomenon in African languages that normally results in a high tone being lowered to an intermediate pitch level when it follows a low tone. [1] Following Stewart (1965, 1983), I use the terms "automatic downstep" and "nonautomatic downstep" in an attempt to avoid the confusion that exists in the literature regarding various pitch lowering phenomena. Automatic downstep, often also called "downdrift" in the literature, occurs when the low tones that trigger the downstep are realized phonetically. Nonautomatic downstep, often also just called "downstep" in the literature, occurs when the low tones that trigger the downstep are not realized phonetically (i.e., they are "floating").

Although downstep of high tones results in syllables being pronounced with intermediate pitch levels, the downstep process is nevertheless distinguishable from other processes that result in intermediate pitch levels because the downstep effect is cumulative. Successive occurrences of the phenomenon therefore result in ever lower

* Earlier versions of this paper were presented at the *Workshop on the Phonology of African Languages*, *9th International Phonology Meeting*, University of Vienna, Austria, November 1-3, 2002 and at the *2003 Colloquium Series* of The Summer Institute of Linguistics at the University of North Dakota, July 24, 2003. I am grateful to Steve Parker and a JWAL referee for comments on an earlier draft of this paper. The usual disclaimers apply.

[1] Some of the earliest descriptions of downstep include: Pike 1966, Stewart 1965, 1971, Welmers 1959, Williamson 1970, and Winston 1960. More recent theoretical works include: Clark 1993, Clements 1979, Hyman 1979, 1986, 1993, Inkelas 1987, Ladd 1993, Snider 1988, 1999, and Stewart 1993.

settings of the tonal register or ceiling. Following widespread practice in descriptive African linguistics, automatic downstep is not overtly indicated in the phonetic transcriptions of this paper because it is entirely predictable. In the case of nonautomatic downstep, a "down arrow" (ꜜ) is placed immediately before the downstepped tone.[2]

Since both automatic and nonautomatic downstep of high tones are attributable to low tones, and both phenomena result in downward shifts in tonal register, many theories of downstep formally equate, in one way or another, the two types of downstep. These include Clements (1981), Huang (1980), Hyman (1986, 1993), and Snider (1999). By the same token, some theories of downstep do *not* formally equate the two types of downstep. These include Poser (1984), Beckman and Pierrehumbert (1986), and Pulleyblank (1986). For those theories that do not formally equate the two types of downstep, there is no reason for the two types of downstep to have the same phonetic realization, and so any phonetic equivalence should be purely coincidental. If however, both phenomena *do* lower the tonal register to the same degree phonetically, those theories that formally equate the two are justified. Instrumental support for or against formally equating the two is, however, greatly lacking.[3]

In view of this lack of empirical evidence, the present work attempts to help fill this void by addressing the question of whether the degree of lowering that is attributable to automatic downstep is the same as that which is attributable to nonautomatic downstep. The study concludes that for Chumburung, the degree of lowering is the same in both cases.

1. TONE IN CHUMBURUNG

Chumburung has two contrastive tone levels, high tone and low tone. Unless the word ends in a glottal stop, pre-pausal low tones are always realized as low falling pitches.

(1) Pre-pausal low tones

[– ˎ] [– ˎ]

kèrì 'lizard' **wàd͡ʒà** 'cloth'

Elsewhere (i.e., when the low tone is not pre-pausal or when the word ends in a glottal stop), low tones are realized with a low level pitch.

(2) Non-pre-pausal low tones

[– – – ˎ] [– –]

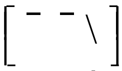
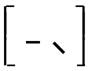
kèrì wàd͡ʒà 'lizard's cloth' **tìmpàʔ** 'cat'

[2] Ocasionally, in languages like Kikuyu (Clements and Ford 1977), downstep of high tones results in "total downstep," in which the high tones are lowered to the level of the preceding low tones. For an excellent discussion on the topic of total downstep languages, the interested reader is referred to Stewart 1993. Although much rarer than downstep of high tones, downstep of low tones also occurs (e.g., Bamileke Dschang, Hyman and Tadadjeu 1976, Nawdm, Nicole 1980 and Ngyemboon-Bamileke, Anderson 1983).

[3] Studies that do address this issue include Liberman *et al*. (1992), Laniran (1992), and Snider (1998).

In addition there is a lexical process of high tone spreading in which high tones, regardless of where they occur in the word, spread rightward to the right edge of the word. When this happens, high-falling contour pitches occur at the right edges of words when they are spoken phrase finally, unless the words end in a glottal stop.

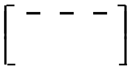
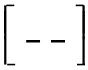
(3) Lexical high tone spreading without glottal stop

a–kérî 'lizards' cf. **kèrì** 'lizard'

If the words end in a glottal stop, high tone spreading results in a level high pitch at the right edge of the word, and the displaced low tone is forced to "float."

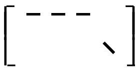
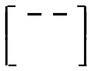
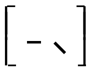
(4) Lexical high tone spreading with glotal stop

á–tímpáʔ` 'cats' cf. **tìmpàʔ** 'cat'

High tone spreading is very common in African languages (cf. Newman 1995, Yip 2002) and in Guang languges in particular (e.g., Foodo, Plunket 1991; Gichode, Snider 1988; Krachi, Snider 1990b; and Nawuri, Casali 1994). There is also a postlexical process of high tone spreading in which high tones at the right edges of words spread rightward across a word boundary to the first Tone Bearing Unit (TBU) of a following word that begins with low tone. This results in the first TBU of the second word being realized with the same high pitch as the preceding syllable.

(5) Postlexical high tone spreading

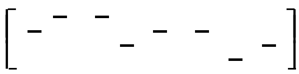
  

fʊ́rí kérì 'deer's lizard' cf. **fʊ́rí** 'deer' **kèrì** 'lizard'

Finally, the language has both automatic and nonautomatic downstep of high tones, which is the focus of the present work. For a more in-depth presentation of tone in Chumburung, the interested reader is referred to Snider (1986) and Chapter 4 of Snider (1999).

Whenever a high tone follows a low tone in Chumburung, whether the low tone is floating or not, the high tone is realized on a lower register than any preceding high tones, and any following low tones are also realized on a lower register than any preceding low tones. (6) is an example of automatic downstep.

(6) Automatic downstep

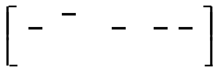


/**nàná mì nàná mì nàná**/ → [**nàná mí nàná mí nàná**]
grandfather his grandfather his grandfather
'grandfather's grandfather's grandfather'

In (6) we see that the high tone from the final syllable of **nàná** has spread rightward onto **mì**. We also see that the tonal register is lowered at each sequence of LH in such a manner that low tones as well as high tones are progressively lowered.

Next, we look at nonautomatic downstep, which is downstep caused by a floating low tone.

(7) Nonautomatic downstep



/**nàná à sá náatí**/ → [**nàná ꜜsá náatí**]
grandfather 3S.PERF give cow
'Grandfather gave a cow.'

In (7), the segmental part of the low-toned perfective marker (viz. **à**) is deleted in the context of the preceding **a**; however the low tone of that marker is not deleted (i.e., it is left floating) and it causes the following high-toned **sá** and subsequent high-toned syllables to be downstepped. Vowel elision is a very common phonological process in African languages (Casali 1996). In Chumburung, whenever two vowels are adjacent across a word boundary, the first vowel is deleted (Snider 1985, 1989a). The reader will notice in 0 that the downstepped pitch level of **ꜜsá** is phonetically identical with that of the word initial low-toned **nà**, as opposed to (perhaps more expectedly) being realized somewhere between the level of the low and high. This should *not* be taken to mean that Chumburung has total downstep, in which a high tone is lowered to the phonetic pitch level of a preceding low tone. In this case, it must be remembered that the high tone of the second syllable has also been lowered by automatic downstep due to the preceding low on the first syllable, and that the level of the third syllable, in fact, represents two downsteps from the beginning of the utterance. The question, of course, arises whether the pitch levels of L and ꜜH in a LHꜜH sequence are expected to be identical in all languages that have both varieties of downstep. The answer to this question, in short, is, "no, not necessarily." Why this should be the case is beyond the scope of the present work, however the interested reader is referred to Snider (1999) for a discussion on this subject.

2. INSTRUMENTAL STUDY

The instrumental study itself was carried out in Tamale, Ghana from Nov. 1-15, 1997. Two speakers, one female (VN) and one male (ID), supplied ten tokens each of the two utterances in (3). VN grew up in Banda Bunwiesi, Ghana and now lives in Tamale. ID grew up in Ekumdipe, Ghana, where he continues to reside, and speaks a slightly different dialect of Chumburung than does VN. Often in Chumburung, relatively minor phonological differences like the one noted in the present study follow clan lines. Both VN and ID are fluent middle-aged mother-tongue speakers of Chumburung. The utterances were presented to the speakers in a randomized list with a number of other utterances from a different phonetic study.

(8) Utterances of the study

a. Utterance 1 (automatic downstep)
[**nàná mí nàná**] 'grandfather's grandfather'

b. Utterance 2 (nonautomatic downstep)
[**nàná ꜜsá náatí**] 'grandfather gave a cow'

Utterance 1, shown in (8a), is a shorter version of (6), above. It has automatic downstep and consists of a sequence of five surface syllables whose underlying tones are L H L L H. The reason for reducing the utterance of (8a) to five syllables was so that its overall length would be more comparable to the five syllables of the utterance in (8b). Due to the process of postlexical high tone spreading discussed above, the underlyingly low-toned **mì** that follows the first high tone is also realized with a high tone phonetically. The fourth syllable of Utterance 1 is low-toned and is downstepped relative to the low tone of the first TBU. Finally, the fifth syllable of Utterance 1 is high-toned and is downstepped relative to the first and second high tones of the utterance.

Utterance 2, shown in (8b), is repeated from (7), above. It has nonautomatic downstep and also consists of a sequence of five surface syllables whose underlying tones are L H (L) H H H. In this sequence, the L in parentheses is floating, i.e., it is not associated with any TBU. Nonautomatic downstep occurs between the second syllable of the utterance, which is high-toned, and the third and remaining syllables of the utterance, which are also high-toned, but realized on a lower register.

I chose the utterances in (8) for several reasons. First, the two utterances begin with the same word, which makes their initial frequencies more comparable. Second, each utterance has the same number of downsteps that follow the first word (viz. one), which helps to neutralize any differences in pitch that might otherwise be attributable to differing numbers of downstep occurrences. Third, the downstep in the first utterance is automatic and the downstep in the second utterance is nonautomatic, which allows one to compare automatic downstep with nonautomatic downstep. Fourth, the two utterances are composed of the same number of surface syllables (five), which helps to neutralize any differences in pitch that might otherwise be attributable to declination. Fifth and finally, both utterances end in a high tone, which makes measuring the final frequencies more comparable.

For the purposes of this study, I assume that there is a direct correlation between fundamental frequency and pitch. Accordingly, the tokens were digitally recorded directly onto a laptop computer at a sampling rate of 22,050 Hz. using a dynamic microphone and *Windows Sound Recorder*. Although I did not have the use of a sound studio for the recordings, every effort was nevertheless made to minimize background noise. Utterances that were “spoiled” by roosters crowing, children playing, or women pounding fufu were re-recorded when things quieted down again. The fundamental frequencies of each utterance were determined using SIL’s *WinCECIL* program (forerunner to *Speech Analyzer).*

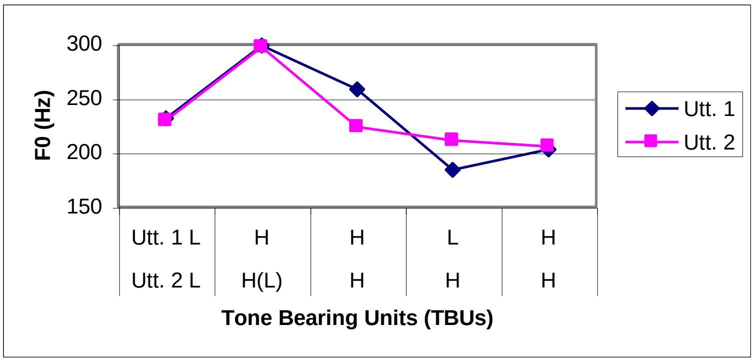
Measurements were taken as follows. If the pitch was constant over the duration of the TBU, I took a single measurement, usually towards the right-hand edge of the TBU. If the TBU was flanked on one side or the other by an obstruent, I took the measurement outside of the influence of the obstruent. If a sequence of TBUs had different phonological tones, I sought to measure the peaks and valleys. These procedures usually resulted in measurements being taken towards the right-hand edge of the TBUs. For more details concerning the acoustic measurement of pitch, the interested reader is referred to the appendices in Connell and Ladd (1990) and in Snider (1998).

The data obtained were then entered into a *Microsoft Excel* spreadsheet for tabulation. In order to determine the significance of critical differences, I used unpaired, two-tailed, Student's *t*-tests, and following standard statistical procedure, for any given comparison I assumed a *p*-value of 0.05 or less to be statistically significant.

3. RESULTS

The data obtained appear in the appendix and the averages of the data obtained appear in (9) and (10).

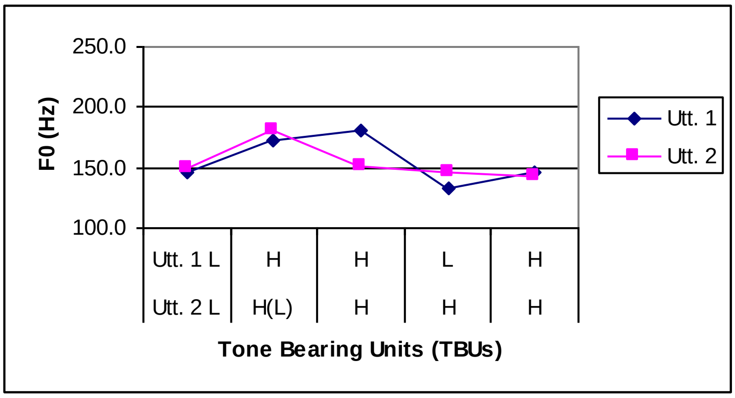
(9) Average F0 values for VN (female)



Utt. 1 Automatic downstep / Utt. 2 Nonautomatic downstep

231.6	298.7	258.5	184.3	203.1		229.6	297.4	223.7	211.2	205.7
nà	**ná**	**mí**	**nà**	**ná**		**nà**	**ná**	**ꜜsá**	**náá**	**tí**

(10) Average F0 values for ID (male)



Utt. 1 Automatic downstep / Utt. 2 Nonautomatic downstep

146.3	172.0	180.4	133.6	146.5		150.0	181.2	151.1	145.5	142.9
nà	**ná**	**mí**	**nà**	**ná**		**nà**	**ná**	**ꜜsá**	**náá**	**tí**

At this point, it should be noticed that there is a difference between VN's dialect (village of Banda Bunwiesi) and ID's dialect (village of Ekumdipe) for Utterance 1. For VN, the second syllable, which is underlyingly high-toned, is realized with the highest pitch. The third syllable, which is underlyingly low-toned, is realized at a pitch level between that of the high-toned second syllable and the underlyingly low-toned fourth syllable. For ID, the second syllable, which is underlyingly high-toned, is realized at a pitch level between that of the underlyingly low-toned first syllable and the third syllable, which is underlyingly low-toned but realized phonetically with the highest pitch of the utterance.

I attribute the difference between VN's and ID's dialects to a difference in targets for the first high tone of the utterance. For VN, the target of the high tone is the syllable that bears the high tone underlyingly, i.e., the second syllable of Utterance 1. The pitch of the following syllable, which undergoes the spread, is supplied through interpolation (i.e., its pitch lies between that of the high tone of the preceding syllable and that of the low tone of the following syllable). For ID, however, the target of the high tone is the syllable that undergoes the high tone spreading, i.e., the third syllable of Utterance 1. The pitch of the second syllable of the utterance is supplied through interpolation, i.e., its pitch lies between that of the low tone of the preceding syllable and that of the high tone of the following syllable.

3.1 VN

In order to address the question of whether the degree of automatic downstep is the same as the degree of nonautomatic downstep in VN's dialect, it is necessary to calculate the mean difference between the second syllable and the last syllable of Utterance 1 (95.6 Hz) and compare that difference to the mean difference between the second and the last syllable of Utterance 2 (91.7 Hz). A *t*-test (t = .65, df = 18, p = 0.53) showed this difference (3.9 Hz) not to be statistically significant.

3.2 ID

In order to address the same question for ID's dialect, the calculation must be done differently. Recall that in ID's dialect the target of the first high tone of Utterance 1 is the third syllable, and not the second syllable, as is the case in VN's dialect. One cannot compare the difference between the third and last syllables of Utterance 1 with the difference between the second and last syllables of Utterance 2. The reason for this is that due to declination, the third syllable of Utterance 1, the target syllable of the high tone that precedes the point of downstep, is realized at a lower pitch than it otherwise would have been had the target syllable of that same high tone been the second syllable, as is the case for Utterance 2.

Given this state of affairs, I have opted to compare the difference between the third and fifth syllables of Utterance 1 with the difference between the second and fourth syllables of Utterance 2. This makes the two differences readily comparable since it minimizes any differences that are attributable to declination. In the case of Utterance 1, we are measuring the difference between the highest peak and the downstepped high, which, for purposes of taking into account declination, is two syllables after the highest peak. In the case of Utterance 2, we are measuring the difference between the highest peak and the downstepped high at the point at which the downstepped high is also two syllables after the highest peak. The chart in (11) illustrates these comparisons.

(11) Comparison of syllables in Utterances 1 and 2

Syll. 3, Utt. 1	Target of high tone before downstep (highest peak)
Syll. 2, Utt. 2	Target of high tone before downstep (highest peak)
Syll. 5, Utt. 1	Downstepped high, two syllables from highest peak
Syll. 4, Utt. 2	Downstepped high, two syllables from highest peak

For ID, the mean difference between Syllables 3 and 5 of Utterance 1 is 33.9 Hz, and the mean difference between Syllables 2 and 4 of Utterance 2 is 35.7 Hz. A *t*-test shows this difference (–1.8 Hz) not to be statistically significant ($t = -1.47$, $df = 18$, $p = 0.16$).

I conclude that the degree of lowering attributable to automatic downstep is the same as the degree of lowering attributable to nonautomatic downstep in both VN's and ID's dialects of Chumburung. The findings of this study therefore support those theories of downstep that formally equate automatic and nonautomatic downstep.

REFERENCES

Anderson, Stephen C. 1983. Tone and morpheme rules in Ngyemboon-Bamileke. Doctoral dissertation, University of Southern California.

Beckman, Mary and Janet Pierrehumbert. 1986. Intonational structure in Japanese and English. Phonology Yearbook 3:255-309.

Casali, Roderic F. 1994. Nominal tone in Nawuri. The Journal of West African Languages 24.2: 45-64.

__________. 1996. Resolving Hiatus. Doctoral dissertation, UCLA.

Clark, Mary. 1993. Representation of downstep in Dschang Bamileke. In The Phonology of Tone: The Representation of Tonal Register, Harry Van der Hulst and Keith Snider (eds.). Berlin: Mouton de Gruyter, 29-73.

Clements, George N. 1981. The hierarchical representation of tone. In Harvard Studies in Phonology 2, George N. Clements (ed.). Cambridge, MA: Harvard University Linguistics Department, 108-77.

Connell, Bruce and D. Robert Ladd. 1990. Aspects of pitch realisation in Yoruba. Phonology 7.1: 1-29.

Gordon, Raymond G, ed.. 2005. Ethnologue, Languages of the World, 15th edition. Dallas: SIL International.

Hansford, Keir. 1988. A Phonology and Grammar of Chumburung. Doctoral dissertation, SOAS, University of London.

Huang, Cheng-Teh James. 1980. The metrical structure of terraced-level tones. NELS 10, Cahiers linguistiques d'Ottawa 9: 257-70.

Hyman, Larry M. 1979. A reanalysis of tonal downstep. Journal of African Languages and Linguistics 1.1: 9-29.

__________. 1986. The representation of multiple tone heights. In The Phonological Representation of Suprasegmentals, Koen Bogers, Harry van der Hulst, and Maarten Mous (eds.). Dordrecht: Foris Publications, 109-152.

__________. 1993. Register tones and tonal geometry. In The Phonology of Tone: The Representation of Tonal Register, Harry Van der Hulst and Keith Snider (eds.). Berlin: Mouton de Gruyter, 75-108.

__________ and Maurice Tadadjeu. 1976. Floating tones in Mbam-Nkam. In Studies in Bantu Tonology, Southern California Occasional Papers in Linguistics 3, Larry Hyman (ed.). Los Angeles: University of Southern California, 57-111.

Inkelas, Sharon. 1987. Tone feature geometry. In Proceedings of NELS 18, James Blevins and Julie Carter (eds.). Amherst, MA: GLSA, 223-37.

Ladd, Robert.1993. In defense of a metrical theory of intonational downstep. In The Phonology of Tone: The Representation of Tonal Register, Harry Van der Hulst and Keith Snider (eds.). Berlin: Mouton de Gruyter, 109-132.

Laniran, Yetunde. 1992. Phonetic aspects of tone realisation in Igbo. Progress Reports from Oxford Phonetics 5: 35-51.

Liberman, Mark, J. Michael Schultz, Soonhyun Hong, and Vincent Okeke. 1992. The phonetic interpretation of tone in Igbo. In Proceedings of the IRCS Workshop on Prosody in Natural Speech. Philadelphia, PA: University of Pennsylvania, 83-92.

Newman, Paul. 1995. Hausa tonology: Complexities in an "easy" tone language. In The Handbook of Phonological Theory, John A. Goldsmith (ed.). Oxford: Blackwell Publishers Ltd., 762-781.

Nicole, Jaques. 1980. Downstepped low tone in Nawdm. Journal of African Languages and Linguistics 2.2: 133-139.

Pike, Kenneth L. 1965. Tagmemic and Matrix Linguistics Applied to Selected African Languages. Norman, OK: The Summer Institute of Linguistics and the University of Oklahoma.
Plunket, Gray C. 1991. The Tone system of Foodo Nouns. MA thesis, University of North Dakota, Grand Forks.
Poser, William. 1984. The phonetics and phonology of tone and intonation in Japanese. Doctoral dissertation, MIT.
Pulleyblank, Douglas. 1986. Tone in Lexical Phonology. Dordrecht: D. Reidel Publishing Company.
Snider, Keith. 1985. Vowel coalescence across word boundaries in Chumburung. The Journal of West African Languages 15.1: 3-13.
__________. 1986. Apocope, tone and the glottal stop in Chumburung. Journal of African Languages and Linguistics 8.2: 133-44.
__________. 1988. Towards the representation of tone: a three-dimensional approach. In Features, Segmental Structure and Harmony Processes (Part I), Harry Van der Hulst and Norval Smith (eds.). Dordrecht: Foris Publications, 237-65.
__________. 1989a. Vowel coalescence in Chumburung: An autosegmental analysis. Lingua 78: 217-32.
__________. 1989b. North Guang Comparative Wordlist: Chumburung, Krachi, Nawuri, Gichode and Gonja, Comparative African Wordlists 4. Legon: Institute of African Studies, University of Ghana.
__________. 1990a. Tone in proto-Guang nouns. African Languages and Culture 3.1: 87-105.
__________. 1990b. Tonal upstep in Krachi: Evidence for a register tier. Language 66.3: 453-74.
__________. 1998. Phonetic realisation of downstep in Bimoba. Phonology 15.1: 77-101.
__________. 1999. The Geometry and Features of Tone. Dallas: The Summer Institute of Linguistics and The University of Texas at Arlington.
Stewart, John M. 1965. The Typology of the Twi Tone System. Preprint from the Bulletin of the Institute of African Studies 1, Institute of African Studies, University of Ghana, Legon, Ghana.
__________. 1971. Niger-congo, Kwa. In Current Trends in Linguistics, Vol. 7, Linguistics in Sub-Saharan Africa, Thomas A. Sebeok (ed.). The Hague: Mouton, 179-212.
__________. 1983. Downstep and floating low tones in Adioukrou. Journal of African Languages and Linguistics 5.1: 57-78.
__________. 1993. Dschang and Ebrie as Akan-type total downstep languages. In The Phonology of Tone: The Representation of Tonal Register, Harry Van der Hulst and Keith Snider (eds.). Berlin: Mouton de Gruyter, 184-244.
Welmers, William. 1959. Tonemics, morphotonemics, and tonal morphemes. General Linguistics 4: 1-9.
Williamson, Kay. 1970. Downdrift/downstep. In Tone in Generative Phonology, Ian Maddieson (ed.). Research Notes [Ibadan] 3.2 and 3.3: 22-23.
Winston, F.D.D. 1960. The “mid tone” in Efik. African Language Studies 1: 185-192.
Yip, Moira. 2002. Tone. Cambridge: Cambridge University Press.

APPENDIX: F0 of corpus tokens and mean values

VN (female)

1.1	227.6	288.7	250.0	174.8	194.8		**2.1**	202.7	271.6	196.2	182.8	180.1
1.2	216.7	283.1	243.7	175.8	202.8		**2.2**	235.8	285.8	227.9	217.3	206.3
1.3	240.6	308.0	264.4	192.7	212.1		**2.3**	233.1	309.9	224.7	220.0	215.9
1.4	249.1	322.5	265.8	195.7	214.5		**2.4**	261.9	334.1	250.1	242.4	234.6
1.5	222.5	276.5	249.8	173.8	197.8		**2.5**	221.9	283.9	212.7	192.8	191.3
1.6	222.3	303.4	266.9	182.0	201.1		**2.6**	225.0	282.7	219.1	204.1	196.9
1.7	242.3	311.0	269.2	187.3	189.9		**2.7**	231.2	296.9	221.0	204.2	196.1
1.8	224.1	295.0	269.8	177.3	198.5		**2.8**	222.1	308.1	218.0	204.7	196.9
1.9	237.7	290.0	240.9	194.5	200.9		**2.9**	215.6	278.3	230.3	219.2	219.2
1.10	232.6	309.1	264.5	189.1	218.2		**2.10**	247.1	322.6	237.1	224.7	219.3
Mean	**231.6**	**298.7**	**258.5**	**184.3**	**203.1**		**Mean**	**229.6**	**297.4**	**223.7**	**211.2**	**205.7**
Std. Dev.	**10.6**	**14.4**	**4.1**	**8.6**	**9.1**		**Std. Dev.**	**16.5**	**20.6**	**14.4**	**17.1**	**16.4**
	nà	**ná**	**mí**	**nà**	**ná**			**nà**	**ná**	**ꜜsá**	**náa**	**tí**

ID (male)

1.1	139.5	157.4	167.0	117.9	128.1		**2.1**	134.5	164.8	136.5	128.0	124.5
1.2	142.2	171.2	174.7	126.5	138.1		**2.2**	141.6	176.4	143.4	139.6	141.0
1.3	150.6	176.2	183.0	134.0	149.5		**2.3**	148.4	186.6	154.0	149.1	145.3
1.4	143.2	162.1	172.5	127.5	139.7		**2.4**	152.9	180.7	153.0	148.7	146.4
1.5	150.1	172.3	184.3	134.3	148.8		**2.5**	158.8	185.2	152.8	148.5	142.9
1.6	142.6	161.9	172.3	131.1	139.7		**2.6**	151.7	187.0	152.8	150.0	148.9
1.7	146.7	176.8	186.8	136.3	152.1		**2.7**	150.8	182.2	151.2	147.5	145.4
1.8	142.0	177.5	185.8	140.6	157.2		**2.8**	146.9	180.6	156.5	148.8	142.4
1.9	148.7	185.2	191.3	143.0	156.3		**2.9**	156.4	179.7	156.5	145.2	141.1
1.10	157.6	179.8	186.6	144.3	155.1		**2.10**	157.6	188.3	154.3	149.1	150.8
Mean	**146.3**	**172.0**	**180.4**	**133.6**	**146.5**		**Mean**	**150.0**	**181.2**	**151.1**	**145.5**	**142.9**
Std. Dev.	**5.5**	**8.9**	**8.1**	**8.2**	**9.6**		**Std. Dev.**	**7.5**	**6.9**	**6.3**	**6.8**	**7.2**
	nà	**ná**	**mí**	**nà**	**ná**			**nà**	**ná**	**ꜜsá**	**náa**	**tí**