

Pitch Tracking of Down-stepped High Tone in Anaañ: An Instrumental

Analysis Approach

Mfon Ekpe & Bassey Okon

Department of Linguistics & Nigerian Languages

University of Calabar

fonybrown@gmail.com

Abstract

Anaañ is one of the languages spoken by the Anaañ people of Northwest part of Akwa Ibom State in the Niger Delta of Nigeria. Genetically, it is a Lower Cross language. Anaañ operates two basic tones and a downstepped. This paper examines the lowering effect of high tones in sequence. Research so far traced down-step historically to a floating low tone. The thrust of this paper is to trace down stepped tone in Anaañ empirically. The objectives of the study were to find out the pitch of Anaañ high tones in isolation, examine H₁ H₂ pitch without lowering effect and investigate H₁ !H₂ downstepped. 50 informants were selected for this study. Collection of data was based on personal interaction with the informants who are native speakers. The conversations were recorded in Panasonic midget and transferred to WAV file for pitch tracking. Filter Model is adopted as the theoretical frame for the analysis. The results show that H in isolation is not amplified or dampened because it is a standalone tone. In H₁ H₂, the H₂ is amplified because the frequencies have similar resonance. In H₁ !H₂, the H₂ is dampened because of the intervening pitch which causes frequency reduction.

Keywords: Tones; Pitch; Down-Step; Frequency Variation; Anaañ

Introduction

Anaañ is a member of the Lower Cross Languages spoken in Akwa Ibom State of Nigeria. Anaañ is classified by Williamson (1984) as a cluster in the Lower-Cross family of the Delta Cross branch of the Cross River of the New Benue-Congo sub-family. Connell (1991) puts Anaañ under the Central Lower-Cross sub-subgroup of the Lower-Cross subgroup of the Benue-Congo sub-family under the Niger Congo phylum. Udoh and Okon (2005, 38) group Anaañ as Lower subgroup which spreads across the Cross River and parts of River State. Researchers such as Udoh (1998), Udontata (2006), Michael (2000, 2008,

2014), Michael & Obot (2001), and Ekpe (2015), have worked on Anaañ either in part or wholly in the structure without particularly treating Down-stepped High tone as a major tonal process which is a significant component in the language and it is also phonemic. Michael et al. (2019, 18), emphasize that ‘in Anaañ, tone, called ‘ujo-iko’...should be marked in Anaañ texts, especially in contrastive words to avoid confusion’. They list the lexical tones in Anaañ as, Low tone [`], High tone [´], Low-High contour [∨], High-Low contour [^], and Down-stepped High tone [!H]”.

Anaañ has two basic tones, high (H) and low (L) and a Down-stepped High tone (!H). The existence of Down-stepped High tone had remained confusing and mysterious as various scholars in different languages and researches either ascribed it to a once existing but lost segment which tone floats and docks on any nearby segment to form a Down-stepped High tone, while others attribute it to a lost low tone. Though all these findings are plausible, instrumental analysis approach is not out to criticize the authenticity of the already existing theories and researches, rather it is to subject them to contemporary scientific methods so that the already existing ideas could be validated or invalidated. Thus, the thrust of this paper is to subject the already acclaimed status of Down-stepped High tone in Anaañ to empirical evidence. The objectives of the study are to find out the pitch range of Anaañ high tones in isolation, examine H H pitch range without lowering effect and investigate H !H downstepped in Anaañ.

The researcher was of the assumption that since many researchers working on different languages traced Down-stepped High tone to floating low tone that survived a deleted tone bearing segment, and others mistook it for mid tone, the only way to resolve these controversies is to subject these conjectures to laboratory test, which is more empirical.

Review of related literature

Down-stepped high tone (DS / [!]), just like down-drift involves lowering of the high tone. Down-stepped high tone unlike Down-drift tone involves a situation in which non-initial high tones in a sequence are lowered without a conditioning intervening low tone. This is a non-automatic lowering because the motivating Low tone is not physically visible as in Down-drift. The Down-stepped high tone at times is confused with a Level mid tone, since it is phonetically realised as a Mid-tone. This is the situation in Efik, where Ward (1933) and Akpanyun (1962) refer to it as a Mid-tone. However, Winston (1960) in a rather painstaking analysis identifies this as a Down-stepped High tone arising from a lost Low

tone. Winston's position is that, it is this delinked L tone which is floating that causes the non-automatic lowering of the High tone.

Synchronic evidence from many African tone languages like Akan, Ghotuo and Ibibio seems to support Winston's position on Down-stepped High tone. Stewart (1983) works on the Akan language and has done much in support of the Down-stepped High tone phenomenon. A good example of this concept is as shown below in 1 from Akan:

1. Down-stepped high tone in Akan

méòbó → mé˘ b́ó → mé!b́ó 'my stone'

(Adopted from Stewart, 1983)

In the above analysis, the Low tone bearing segment has been specified in Akan.

Elugbe (1985) working on Ghotuo (an Edoid language) claims that historical evidence, so far turns in favour of the derivation of DS from underlying Floating Low tone (i.e. underlying unassociated L tone) which is not available at the surface. This is common in many African tone languages like Efik, Igbo, Ibibio, Akan, *Anaañ* (italicised, mine). Elugbe (1985) in his example illustrates that the underlying form of [é!b́ó] is /é˘ b́ó/ as shown in 2 below:

2. Down-stepped high tone in Ghotuo

Underlying Form Surface Form

/é˘ b́ó/ → [é!b́ó]

(Adopted from Elugbe, 1985)

In this example, there is a presence of a Floating Low tone on the first syllable which could have been as a result of a deleted tone bearing segment. In this instance, there were two tone bearing segments within a syllable. The first one being specified as /é˘/, which could equally be represented as shown in 3 below:

3. Likely Down-stepped high tone in Ghotuo, showing deletion and floating low tone

/éà/ → [ě].

For the fact that a second tone bearing segment /a/ → [∅] had undergone the process of deletion, the surviving tone floats and ducks on the first tone to form a contour tone, a supposed High-Low modified tone (H-L). According to Elugbe (1985), the presence of a floating low tone is enough to cause pitch lowering of an adjacent tone. Normally, in most instances when a segment gets deleted within a syllable or across syllable boundary, the surviving tone, if different from the existing tone gets ducked on the sitting tone to form a contour tone, but in this instance, according to Elugbe (1985), the surviving tone of the deleted segment keeps floating and eventually triggers a lowering effect on the High tone. Surprisingly, the degree of lowering effect has not been stated or quantified.

In Akan, the Low tone bearing segment has been specified, unlike what is obtainable in Ghotuo. The deletion of /ɔ/ does not immediately result in the deletion of the Low tone on that segment. The Low tone is re-linked to the following tone bearing syllable which initiates the lowering of the original High tone on /o/ to a Down-stepped High tone. In all the examples cited, it is evident that Down-stepped High tone is always triggered by a Floating Low tone which at times does not exist at the underlying representation but only manifests at the phonetic representation.

Urua (2000, 169) also works on the existence of down-step on Ibibio. She said that in Ibibio a Down-stepped High tone is always preceded by a High tone. According to Urua, "...the Down-stepped High tone has been confused with the Mid tone, since it is phonetically realised as a Mid tone." She illustrates this with the example as shown in 4 below:

4. Down-stepped high in Ibibio

/ó**b**ó**ó**ŋ/ → [ó!bóŋ] 'chief'

Elugbe (2001) investigates on floating tone in Ghotuo. He argues that genitive relation is marked by floating H tonal morpheme (H-Tomorph) which he said sometimes combines with the word sé 'of' which appears to its right. Elugbe (2001) attests to the existence H-Tomorph by stressing that in utterances, it is the H-Tomorph that spreads its influence leftward to raise the one to its immediate left to H. The example as given by Elugbe (2001) is shown in 5a and b below:

5. H-Tomorph in Ghotuo

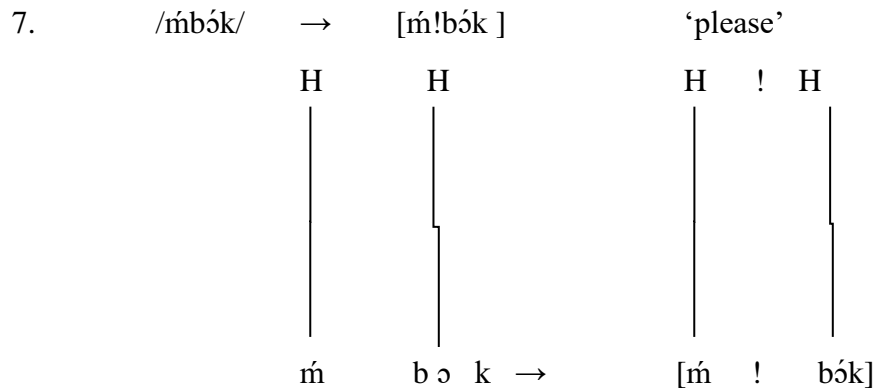
- a. $\bar{o}t\grave{a}$ ' sé ghèrà —————> $\bar{o}t\acute{a}$ sé ghèrà
 wood H-Tomorph of fire 'fire wood'
- b. ghòv\grave{o} ' mhè —————> gh\bar{o}v\bar{o} mhè
 leg H-Tomorph of my 'my leg'

Udontata (2006, 36), lists out words in Anaañ with Mid tone as shown in 6 i-iii below:

- 6.
- i. /udè/ 'that side'
- ii. /irà/ 'mine'
- iii. /mbòk/ 'please'

Udontata did not link the existence of the Mid tone in Anaañ neither to floating Low tone or deleted segments. The tone bearing segments of the first syllables were not marked for one to know how the Mid tones on the second syllable came about.

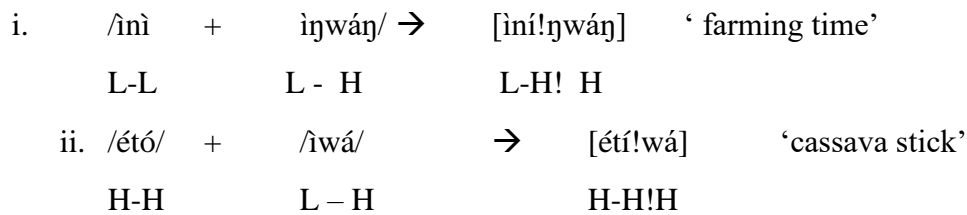
According to Ekpe (2015), Anaañ, a closely related language to Ibibio also exhibits tonal Down-stepped High tone. Ekpe adds that Down-stepped High tone in Anaañ is always preceded by a High tone, that is, H! H. It is difficult to find a Down-stepped High tone after a Low tone, that is, *L! H. The Down-stepped High tone in Anaañ is always motivated by a High tone sequence, in that the second H tone is stepped down to be slightly lower than the initial H tone. The stepping down effect according to Ekpe (2015) makes the H₂ to become as low as a Low tone and it is for this reason that some scholars identified it as mid-tone, which does not exist in Anaañ. The intervening High tone, which has been stepped down is autosegmentally represented at 7 below.



(Adopted from Ekpe 2015)

According to Michael (2008), the Down-stepped High tone can equally emanate from a Floating Low tone in Anaañ in certain syntactic constructions like genitive and agentive constructions as shown in 8a and 8b below:

8a: Genitive Construction



Adopted from Michael 2008

In the instance of 8ai and ii, the Down-stepped High tones are automatically raised at the word boundary in some syntactic constructions. In ‘i’, the second high vowel /i/ in the locative word ‘iǹ’ is deleted, being that it has similar tone and segment with the first segment of the noun /iǹwáŋ/. The tone of the high front vowel in /iǹwáŋ/ that survived deletion becomes fortified and strengthened at word boundary to a Down-stepped High tone.

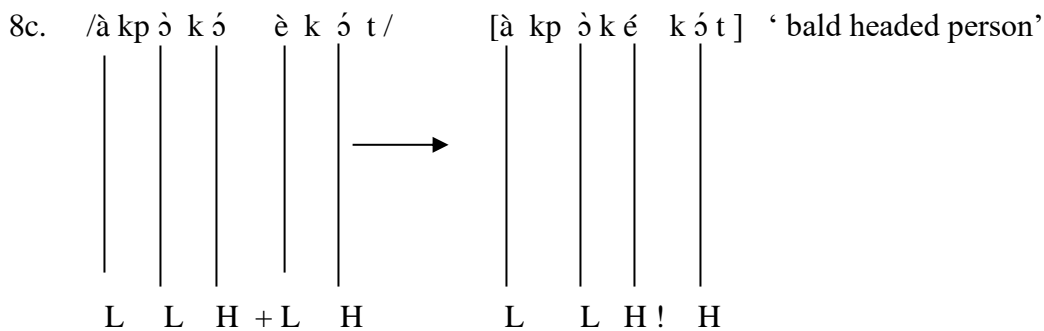
In ‘ii’ the last vowel of /étó/ with H tone, across the word boundary automatically raised the L tone of the first vowel in /iwá/ to a Down-stepped High tone.

8b: Agentive construction

- | | | | |
|-----|------------------|--------------|-----------------|
| i. | /à-kpòkó + èkót/ | [àkpòké!kót] | ‘ bald headed’ |
| | L-L-H L-H | L - L-H!-H | |
| ii. | /à-kpòkó + àtá/ | [àkpòkó!tá] | ‘one who dares’ |
| | L-L-H L-H | L -L-H!-H | |

(Adopted from Michael, 2008)

In the above, Low tone on [è] in /èkót/ in example 7b (i), creates a Down-stepping High tone influence on the following High tone on [ó]. In ‘ii’ the deletion of the prefix [à] on /àtá/ does not mean the loss of its Low tone; rather, the Low tone causes a lowering effect on the following High tone on the final [á]. This is illustrated auto-segmentally in 8c below:



(Adopted from Michael 2008)

The intervening Low tone creates a down step effect on the following High tone. The presence of the floating low (L) tone accounts for the Down stepping of the high tone on [è!kót].

Michael (2014) acknowledges that tone teaching/learning has been seen as a problematic area in indigenous language usage in Nigeria owing to its abstract nature. To overcome this problem, she recommends that, for effective teaching to take place, linguists, teachers and the research communities need to take advantage of the resources of the computer and software. Adeniyi (2018) investigates high tone lowering in Ìgbòmina dialect of Yorùbá spoken in Osun state, and concludes that tone lowering after /é/ in Ìgbòmina may be argued to be as a result of an Obligatory Contour Principle (OCP), which results in prohibition of ‘H-floating L sequence’ after é (*é-H-FLT). This he said is because; the é-H-L sequence

in which the L is not set afloat does not result in lowering. The violation of this *é-H-FLT sequence is resolved by converting the H to M. Adeniyi (2018, 229) ended by saying that the conditioning behind prohibition still has to be explained in the phonology, though he later confessed of ‘not knowing any satisfactory alternative explanation to the underlying floating tone’. Elugbe (2001) and Adeniyi (2018) were basically on genitive construction and morphophonological analysis. Down-stepped High tones in these instances are not significant, being that they are not phonemic, as compared to Down-stepped High tone in Anaan. This could be one of the reasons Elugbe refers to it as H-Tomorph. Following Adeniyi’s position that the best way to handle the mystery behind floating and down-stepped high tones is through the instrumental analysis approach, the researchers were prompted to subject the down-stepped high tone in Anaañ to a laboratory test. This approach is more empirically-grounded and it is the crux of the present research.

Theoretical framework

Filter Model, otherwise called the ‘Source Filter theory’ by Ladefoged and Johnson (2006) is adopted as the theoretical frame for this work. It is a theory of speech production and acoustic patterns that distinguishes the sounds and the prosodies in a language. The basis of filter theory is that sound only travels through a noise making source like the articulatory organs (from the vocal fold vibration to the lips). The human articulatory systems: the oral and nasal cavities contain lots of acoustic filters in which sounds and non sounds are produced. By this, it is possible to adjust the filters by means of resonance, and reinforce any frequency contained in a complex sound and thereby modify the quality of the sound. This can be achieved by movement of the larynx, the tongue, the lips and the soft palate (velum). The shape and volume of the different cavities of our speech apparatus can be adjusted and thus the resonance influence on the complex sound created in the larynx. Resonance in articulations is a feature of syllable, being that each syllable must have a sonority peak. Each sonority peak is identifiable with the vowel sounds /a, e, i, o, ɔ, u/ and some privileged consonants called ‘syllabic consonants’: /m, n, ŋ, l/. The syllabic consonant can function only when there is no vowel sound within that syllabic unit. The usage of syllabic consonants in places of vowels is language specific as what is obtainable in one language may not be obtainable in another language as shown in 9 below:

9. Language specific usage of syllabic consonants

a)	English (British Variety)		
	i. button	/bʊ-tn/	[bʊ-tʔn]
	ii. little	/lɪ-tl/	[lɪ-tʃ]
	iii. important	/ɪm-pɔ:-tənt/	[ɪm-pɔ:-tnʔtʰ]
b)	Anaañ Language		
	i. ñkon	/ŋ-kɔŋ/	[ŋ-kòŋ] ‘leave’
	ii. mfon	/m-fɔn/	[m̃-fón] ‘grace’
	iii. ñnya	/ñ-ɲja/	[ñ- ɲjà] ‘garden egg’

In ‘a’ above being English, an Indo-European, the phonaesthetic of the language allows syllabic consonant to constitute syllabic peak at word or syllable final position. In Anaañ, syllabic consonant which must be strictly nasal consonant mostly occurs at word or syllable initial position and in homogeneity with the following consonant which must share the same place of articulation. For example in b ‘i’, orthographically ‘n’ is an alveolar letter but changes to a velar [ŋ] nasal to share the same place of articulation with the first consonant of the second syllable [k] which is equally a velar sound. The sound of the first syllable loses its alveolarity and assimilates the features of velarity, sharing the same place of articulation. This is achieved by adjusting the sources or filters in which the sound(s) are articulated maintaining a PV position. P is pressure while V is velocity. P is where the energy for the sound to be produced, while V is the speed or location of release of the air pressure. This constitutes the principle of the mechanism of the vowel and the syllabic consonant production where the pitch which can be Low, High, Mid or Down-stepped is located. The variation in pitch which could be stress or tone depending on the language creates the syllable timing or rhythmic pattern for the language. The theory recognizes various overtones of pitches that give distinctive pitch quality to tone bearing segments. The filtering action of the vocal gestures tends to amplify at different frequencies damping or exciting the energy of the pitch.

Research methodology

Survey design was used in deciding on the location and the population of the study. The population of study was made of 20 informants selected non-randomly after a pilot study was carried out on 80 informants. The choice for the 20 informants was on the basis that these Anaañ native speakers had resided in the speech community of study for over 40

years. For corpus gathering, 40 lexical items were extracted from SIL Comparative African Wordlists, and a lexical/phonological file was opened to contain the word lists as shown in appendix 1. The conversations were formally and informally recorded in a Panasonic digital midget. Formally, the lexical/phonological file was presented to each of the informants at different locations for them to read from the wordlist and their utterances were recorded. Informally, the researchers engaged the same sets of informants in conversations and these conversations were recorded without the knowledge of the informants. In both cases, the researchers played, listened to, extracted and transcribed words that have down-steps. The same words were transferred from the Panasonic Digital Midget (PDM) to HP 650 laptop for storage. This was later transferred and stored in PRAAT (version 6.1.42, Boersma & Weenink, 2021) Object WAV file while the visible pitch and contour extract were ripped from the Praat window for laboratory testing. The results of the findings were presented on a table and later transferred to Microsoft spreadsheet and bar chart for a better view.

Data presentation and analysis of down-stepped high tone in ANAAÑ

Few selected words were extracted from our corpus and presented for analysis. These words are as shown in 10i-viii below:

10. Words extracted from our corpus

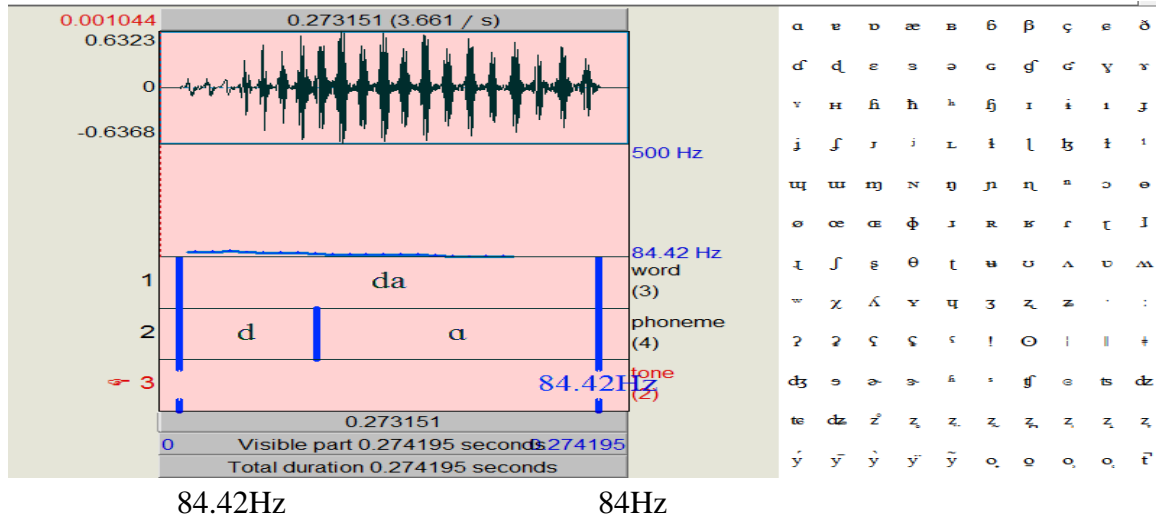
i.	/m̀bók/	[m̀! bók̃]	‘please’
ii.	/ábɔ:ŋ/	[á!bɔ:ŋ]	‘chief’
iii.	/ínúén/	[í!nwén]	‘bird’
iv.	/úké/	[ú!k̃é]	‘where’
v.	/údé/	[ú!dé]	‘that side’
vi.	/írá/	[í!rá]	‘mine’
vii.	/údó/	[ú-!dó]	‘marriage’
viii.	/útó/	[ú! tó]	‘plant (n)’

Acoustic tracking of high tones in Anaañ

In our analysis, since downstep is not predictable in Anaañ and cannot be supported with diachronic evidence as earlier explained, it is imperative to approach it empirically by tracking the spectral features of High tones before the lowering effect takes place.

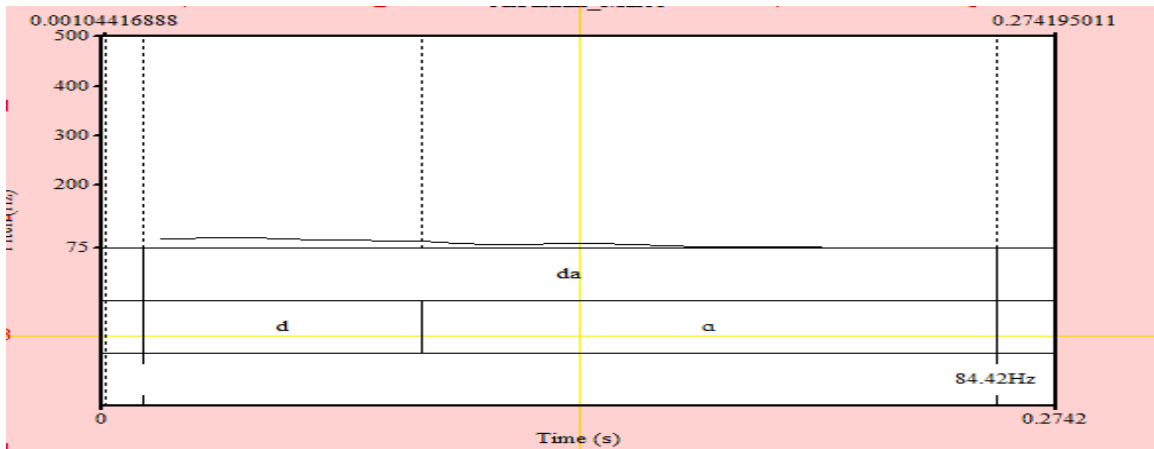
Spectrographic presentation of a word with High tone in isolation is shown in Slide 1a in the next page.

Slide 1a: Acoustic of high tone in Anaan̄ [dá]



The above is an instance of a monosyllabic word with an H tone. The pitch of the voice that produces the H tone falls within the range of 84Hz to 84.42Hz when it occurs in isolation. The pitch range definitely changes when it occurs in disyllabic or polysyllabic words because of the operation of assimilatory effect. A clearer view of H tone in isolation is presented in slide 1b below:

Slide 1b: Visible pitch extraction of H tone in [dá]



The visible pitch extract is horizontally the same from the origin to the nuclear position. The lowest being 84Hz, while the highest is at 84.42Hz. In essence, the pitch of high tone in isolation in Anañ on the average is 84.21 (84Hz by conversion).

That is:

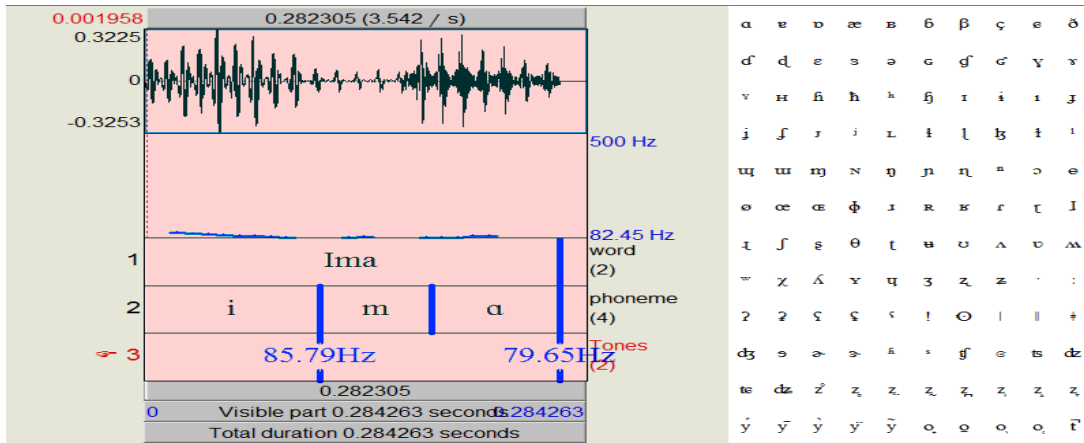
$$\begin{aligned}
 84\text{Hz} + 84.42\text{Hz} &= 168.42\text{Hz} \\
 \frac{168.42}{2} &= 84.21\text{Hz} \\
 \text{H by Conversion} &= 84\text{Hz}
 \end{aligned}$$

The table below shows pitch listings of H tone when it occurs in isolation, alongside with time duration taken in realizing its articulation.

Pitch range listing of H tone in isolation

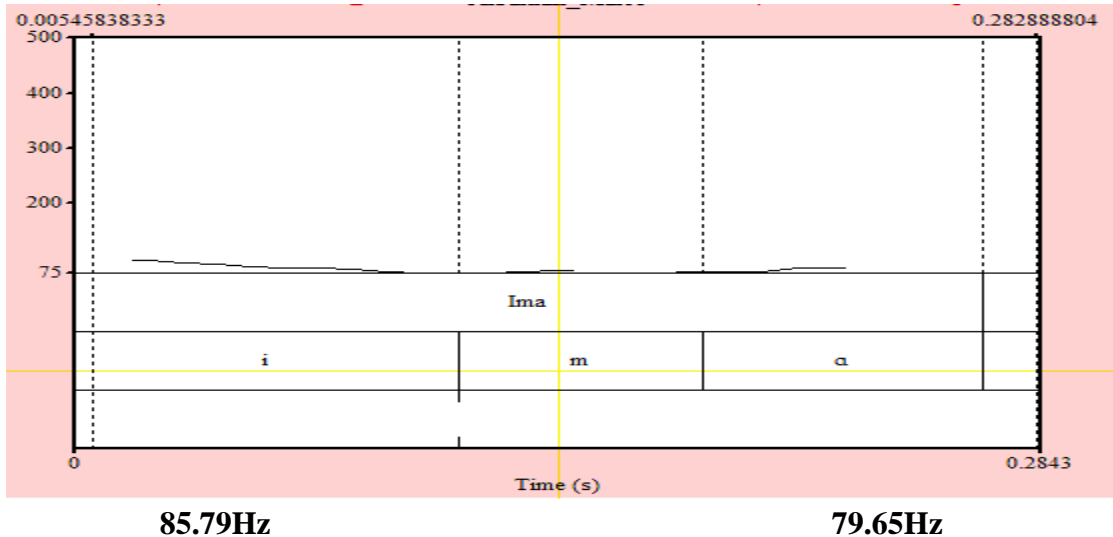
Time_s	F0_Hz
0.102098	83.918489
0.132098	82.370009

Slide 2a: Spectrograph of [ímá] H H without lowering



The above slide is the spectrograph of H H on [í-má] without a lowering effect. It is not in all instances that the occurrence of H₁ H₂ triggers lowering effect on H₂. There are moments that H₂ may resist the lowering effect from H₁, through the resistance feature of opacity. The resistance structure could be caused by the intervening segments /m/, however, this remains a conjecture till it is proven by carrying out a laboratory test. It is attested that the pitch range of H₁ H₂ without lowering falls within 85.79Hz and 79.65Hz, which on the average is 82.72Hz as shown in pitch extracts on slide 2b.

Slide 2b: Visible pitch extract of [ímá] H H without lowering



The variation between the H₁ and H₂ is as infinitesimal as 6.14Hz. The pitch strength of H₁ is synonymous with that of H₂; in that none is strong or weak enough to affect the other, from the F₀ to F₁, towering towards F₂ at 80Hz.

This is attested on the time interval and the pitch range listing. The lowest being 79.65Hz and most at 85.79Hz, which by conversion, this amounts to 80Hz and 86Hz, respectively. On the average the pitch range falls on 83Hz as shown below:

$$85.79\text{Hz} + 79.65\text{Hz} = 165.44\text{Hz}$$

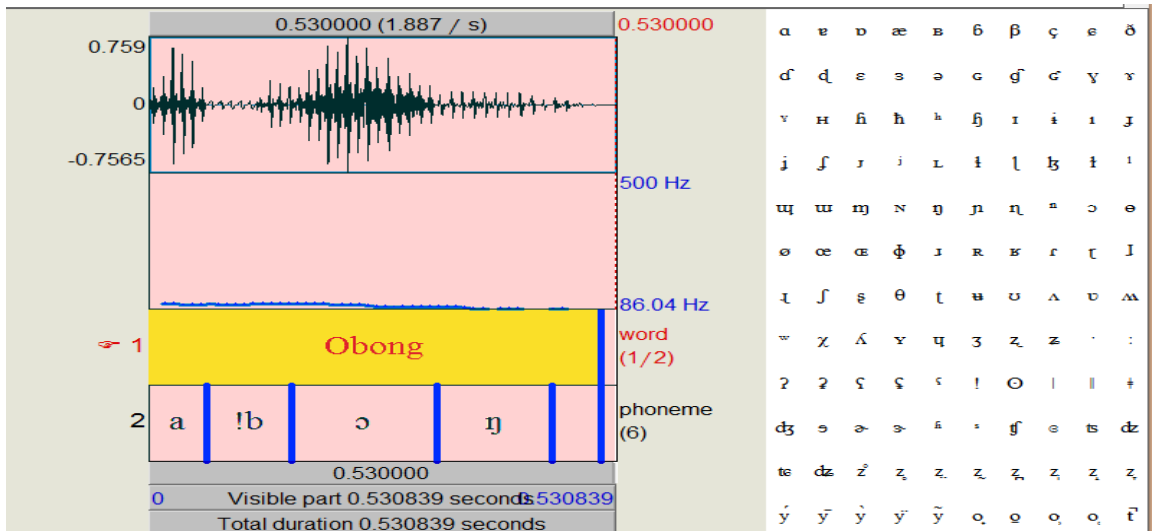
$$\frac{165.44}{2} = 82.72\text{Hz}$$

H H by Conversion =83Hz.

Pitch range listing of H H without lowering

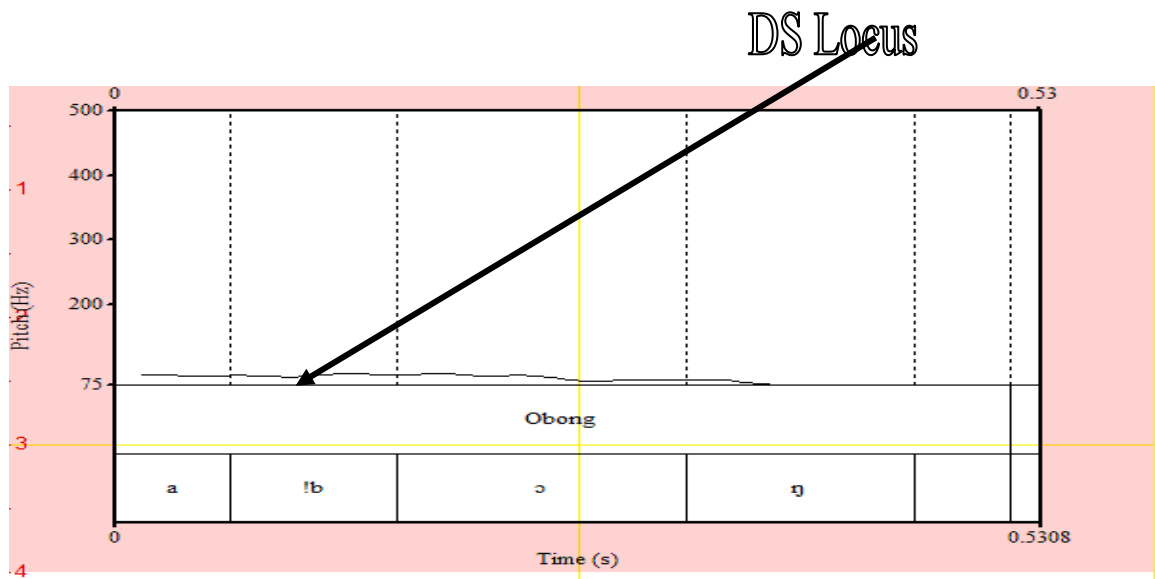
Time_s	F0_Hz
0.052132	85.719125
0.082132	80.243619

Slide 3a: Acoustic of down-step of [á-!bón] ‘king’



The pitch tracking shows an inherent high pitch on the first tone bearing segment [á] on the first syllable and the second tone bearing segment [ó] on the second syllable. The H₁ on the first syllable is at 90.33Hz, while that of the second syllable is at 87.24Hz. The first H is higher than the second high with a difference of 3.09Hz, which is the degree of downstepped gap between the two High tones. The Ds is not low enough to be called a mid-tone and besides mid tone is not attested in Anaani. The Ds is not too low to attain the status of a low tone. Low tone is usually found within 77Hz-80Hz. The downstep causes the immediate key lowering of the second H, represented as Ds [!]. However, the key lowering did not last long as the pitch immediately rises again in response to the following inherent H of the second syllable. A clear view of the [!], is presented in slide 3b and slide 3c showing visible pitch and contour pitch, respectively.

Slide 3b: Visible pitch of /á-bóŋ/ [á-!bóŋ] ‘king’



The key lowering or down step locus (DSL) is shown with an arrow above in 3b. The pitch contour extract of H !H, which range is between 90.33Hz from the F₀ to 147Hz on F₁ and 87.24Hz on F₂ and which calculation is as shown in the next page:

$$90.33\text{Hz} + 87.24\text{Hz} = 177.57\text{Hz}$$

$$\frac{177.57}{2} = 88.785\text{Hz}$$

$$H_1 \text{ !}H_2 \text{ by Conversion} = 89\text{Hz.}$$

Pitch range listing of H₁ !H₂ starts at 90.33Hz and regresses to 87.24Hz with a lowering interval of 3.09Hz, which is so negligible a difference and at times mistaken by some scholars as a mid tone, but it is not attested in Anaañ. The pitch listing and the timing are shown below.

Time_s	F0_Hz
0.040420	90.134588
0.100420	87.890165

Summary, conclusion and suggestion for further study

Based on our analysis of various tone patterns in Anaañ, H in isolation is found at 84Hz, H₁ H₂ without lowering range of (H₁) 86Hz and (H₂) 80Hz, while H₁ !H₂ with stepped down effect at 90Hz and 87Hz, respectively, with a [!] of 3Hz. It is evident that downstepped! H tone in Anaañ is phonologically restricted to pitch or syllable medial position. It is caused by the first High tone which triggers the lowering effect of the second High tone. This is because frequency reduces with distance from the fundamental frequency and the subsequent harmonics; $F_0 < F_1 < F_2$. Variation between the two High tones varies based on source filter and TBU. The variation is presented in the statistical table 1 and chart 1 below:

Table 1: Statistical chart in Anaañ pitch variation

Pitch range in Hertz				
H		84		H in Isolation
H ₁	H ₂	86	80	H H without DS
H ₁	!H ₂	90	87	H H with DS

Chart: Statistical chart in Anaañ Pitch variation



The statistical table and chart on Anaañ pitch variation shows that H₁ H₂ without any blockage or intervening pitch/tone maintains all high pitch range of 86Hz and 80Hz on H₁ and H₂, respectively, with a difference of 6Hz between H₁ and H₂. H₁ and !H₂. The intervening stepped down High tone has 90Hz at H₁ and 87Hz at H₂, while the intervening step down tone at DSL is 3Hz. The DSL ! is the difference between H₁ and H₂. H in isolation on monosyllabic words is at 84Hz, without a preceding or following pitch to dampened or excite the pitch in isolation. Applying the amplified and dampened strands of the applied theory, H in isolation is not amplified or dampened because it is a standalone tone. In H₁ H₂, without DS, the H₁ is amplified while H₂ is dampened. The difference in resonance frequencies between H₁ and H₂ (6Hz) is high because the frequencies have similar resonance. In H₁ !H₂, the H₂ is dampened because of the intervening pitch which causes frequency reduction between pressure (P) and Velocity (V). Besides, resonance frequency dies down with distance.

References

- Adeniyi, K. (2018). High tone lowering in Ìgbòmina-Yorùbá. *Journal of the Linguistic Association of Nigeria (JOLAN) Supplement* 111, 221-231.
- Akpanyun, O. (1962). *A study of Efik for schools and colleges*. London: Thomas Nelson and Sons Ltd.

- Boersma, P. & Weenink, D. (2021). Praat: Doing phonetics by computer. Version 6.1.42, Website: Praat.org
- Connell, B. (1991). *Phonetic aspects of the lower cross languages*. Ph.D thesis. University of Edinburgh.
- Ekpe, M. (2015). Aspects of Anaañ phonology. M.Phil thesis, University of Ibadan.
- Elugbe, B. (1985). *The tone system of Ghotuo*. *Cambridge papers in phonetics and experimental linguistics* (4), 1-21. eva.mpg.de/lingua/conference/2012_Tone/pdf/Elugbe_abstract.pdf
- Elugbe, B. (2001). Tone in the attributive construction in Ghotuo. *Paper presented at Toulouse Tonology Conference, 28-30 June*.
- Essien, O. (1990). A grammar of the Ibibio language. Ibadan: University Press Ltd.
- Ladefoged, P. & Johnson, K. (2006). A course in phonetics. Wadsworth: Wadsworth Cengage Learning.
- Michael, I. (2000). Assimilatory and syllable structure processes in Anaañ. M.A. thesis, University of Uyo.
- Michael, I. & Obot, J. (2001). The orthography of Anaañ language. Calabar: Soturies Communications Ltd.
- Michael, I. (2008). The syllable structure of Anaañ language. PhD dissertation, University of Ibadan.
- Michael, I. (2014). On the use of modern technological techniques for the teaching of Anaañ/Ibibio tones. *Journal of Language Teaching and Research*, 5(4), 791-800.
- Michael, I., Udontata, J., Otong, J., Ikorok, M., Udoidiong, O., Udioko, S., Daniel, J., Mbaba, N., Udoikpong, S., Udoka, A., Inyang, G., Akpabio, A., Essien, E., Unang, V. & Idung, J. (Eds.) (2019). The revised Anaañ orthography. Abuja: NERDC.
- Stewart, J. (1983). Downstep and floating low tones. *Journal of African Languages and Linguistics*, 5(1), 57-78.
- Udoh, I. (1998). The effect of duration on the intonation of Anaañ learners of English. PhD thesis, University of Calabar.

- Udoh, I. & Okon, B. (2005). *The languages of the Niger Delta region of Nigeria*. Lagos: Concept Publications.
- Udontata, J. (2006). *A grammar of Anaañ language*. Ikot Ekpene: Joe Graph Publications.
- Urua, E. (2000). *Ibibio phonetics and phonology*. CASAS: Cape Town, South Africa.
- Ward, I. (1933). *The phonetics and tonal structure of Efik*. Cambridge: Heffer and Sons.
- Williamson, K. (1984). *Practical orthography in Nigeria*. Ibadan: Heinemann Educational Books Ltd.
- Winston, F. (1960). The ‘Mid’ tone in Efik. *African Language Studies*, 1, 185-192.

Appendix 1

1.	/m̀b̀ók/	[m̀!b̀ók̀]	‘please’
2.	/m̀b̀òk/	[m̀b̀òk̀]	‘wrestling’
3.	/ínúén/	[í!nwé:n]	‘bird’
4.	/ìf̀ót/	[ìf̀ẁót̀]	‘witch’
5.	/ákp̀ó/	[ákp̀ ^h ó]	‘corpse’
6.	/àwà̀f̀ì/	[àwà̀f̀ì]	‘God’
7.	/átá̀ùt̀óp/	[át ^w ùt̀óp̀]	‘hunter’
8.	/íǹó/	[íǹó]	‘thief’
9.	/á!b̀ón/	[á!b̀ón]	‘chief’
10.	/áb̀ón/	[áb̀ón]	‘mosquito’
11.	/áb̀ò/	[áb̀ò]	‘cane’
12.	/ǹl̀èl̀è/	[ǹl̀èl̀è]	‘wet’
13.	/ǹf̀át/	[ǹf̀át̀]	‘dry’
14.	/úf̀á/	[úf̀á]	‘new’
15.	/úf̀íóp/	[úf̀á]	‘hot’ (as fire)
16.	/ǹl̀èl̀è/	[ǹl̀èl̀è]	‘cold’
17.	/èt̀é/	[èt̀ ^h é]	‘father’
18.	/èk̀à/	[èk̀ ^h à]	‘other’
19.	/m̀b̀ók/	[m̀!b̀ók̀]	‘please’
20.	/úk̀òt	[úk̀ ^h òt̀]	‘in-law’
21.	/èb̀é/	[èb̀é]	‘husband’
22.	/á-!ǹẁán/	[á!ǹẁán]	‘fight’

23.	/áŋwá/	[áŋwá]	‘open space’
24.	/ŋúán/	[ŋwǎn]	‘wife’
25.	/áčɔ̀n/	[áčɔ̀n]	‘child’
26.	/úfòk/	[úf ^w òk ^ˀ]	‘house’
27.	/ìbènè/	[ìbènè]	‘wall’ (of house)/
28.	/ùbèt/	[ùbèt ^ˀ]	‘room’
29.	/úʃúŋúfòk/	[úʃ ^w úŋúfòk ^ˀ]	‘door’
30.	/àtún/~ìkúló/	[àt ^w ún]	‘compound’
31.	/ìlún/	[ìl ^w ún]	‘village’
32.	/úʃúŋ/	[úʃ ^w úŋ]	‘road’
33.	/ìŋúán/	[ìŋwǎŋ]	‘farm’
34.	/íkót/	[íkót ^ˀ]	‘bush’
35.	/úké/	[ú!k ^h é]	‘where’
36.	/inĩ:ŋuán/	[inĩ!ŋwán]	‘farming time’
37.	/étóiwá/	[ét ^h í!wá]	‘cassava stick’
38.	/àkpòkókót/	[àkp ^h òk ^h é!k ^h ót ^ˀ]	‘bald headed’
39.	/àkpòkòtá/	[àk ^h òk ^h ó!t ^h á]	‘one who dares’
40.	/m-fɔ̀n/	[m̩-fɔ̀n]	‘grace’