UPSTEP OF LOW TONE IN NJYEM AND REGISTER TIER THEORY

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The phenomenon of *tonal upstep* has been described in several languages. However, the focus has been on the upstep of high tone only. In this paper, our research on tone in Njyem, a Bantu language spoken in the Eastern Province of Cameroon and in Souanké, north of the Republic of the Congo, presents an interesting case of upstep of low tone. The analysis of this phenomenon leads to the conclusion that the facts of upstep of low tone can receive an insightful and explanatory account within *Register Tier Theory* (RTT).

Le phénomène de *rehaussement tonal* été l'objet d'analyse tonale de plusieurs langues. Cependant, ces travaux antérieurs sont focalisés sur le rehaussement du ton haut. Cet article démontre que les faits du ton en njyem, une langue bantoue parleé dans la région forestière du sud-est Cameroun et en Souanké, au nord de la République du Congo, présentent un cas intéressant du haussement du ton bas. L'analyse de ce phénomène dans cet article démontre que la Théorie de Registre en Paliers peut donner une explication plus pénétrante du rehaussement du ton bas.

0. INTRODUCTION

In the dynamics of linguistic theory, it is generally admitted that while the *grammar* of languages must be descriptively adequate by satisfying some putative conditions of *descriptive adequacy*, *theories* on the other hand, must satisfy conditions of *explanatory adequacy*. This means, among other things, that the mechanisms of the theoretical paradigm provide the possibility for the theory not only to make claims about language that are correct, self-evident and compatible with observed data, but also go beyond the observed data to make predictions about possible grammars of language (Chomsky 1965, Botha 1973).

One of the language phenomena that can be shown to be directly or indirectly responsible for the increase in theoretical paradigms in phonology in the search of explanatory adequacy is *tone*.

With the advent of the classical Generative Phonology theory (Chomsky and Halle 1968) with its high profile formalism and eloquent justification *vis aè vis* the obvious weaknesses of the time-honoured Classical Phonemics, it was felt that Linguistics had come of age with a theoretical framework that could provide insightful descriptions and explanations of phonological processes. The volume of work (theses and articles) on cross-linguistic studies of languages worldwide, lent credence to the feeling of sufficiency that accompanied the use of the Generative Phonology framework in the late sixties and thereafter. However, for those working on tone languages, there was a growing awareness of insufficiency that bordered on inadequacy in accounting for tonal phenomena. Tone features proposed for Chinese by Wang (1967) and Woo (1969) were applied to African languages but there was the realisation that solutions to the phenomena of contour tones, floating tones, downdrift and downstep may have been descriptively adequate but certainly lacked an intuitively satisfactory explanation.

This led to the advent of Autosegmental Phonology (Goldsmith 1976) which was predicated on what Goldsmith called the theory's "problem solving efficiency"; which includes, notably, the capacity of the Autosegmental theory to give an intuitively adequate account of contour tones, floating tones and the stability of tonal melodies. Further developments within the non-linear perspective such as the theory of Underspecification (Archangeli 1984, 1988, Akinlabi 1985) and Lexical Phonology

(Kiparsky 1982, 1985, Mohanan 1986, Pulleyblank 1986) have been motivated and justified on similar bases of their ability to solve residual tonal complexities, especially, the complex tonal phenomena of the grassfields languages of Cameroon (Archangeli 1984, Pulleyblank 1986, Chumbow and Nguendjio 1991 etc.)

In this same vein of paradigm shift, RTT of Inkelas (1987) and Snider (1988, 1990, 1999a) provides a model of geometric arrangement of tone that recognises not only a Tonal Tier with tonal features *H* and *L* but also a Register Tier with the features *h* and *l* and a Tonal-Root Node Tier (TRN) besides the Tone-bearing Unit Tier (TBU). The functional dynamics of this machinery is expected to account for and explain *inter alia* all observed tonal phenomena. Thus, Snider (1988, 1990, 1999a) shows that such complex phenomena as downstep and upstep (and presumably *super high tone*), receive a better, and more explanatorily adequate account within RTT than within any other previous theory.

In summarising the predictive power of RTT in solving certain complex issues such as *tonal upstep*, Snider (1999a) has this to say:
"Upstep of any tone can be triggered by any floating tone provided the register of the floating tone is opposite in value to the tone that undergoes the upstep" (Snider 1999a:53). This is illustrated with evidence from languages that show Mid (M) tones undergoing downstep and Mids (M) that cause High tones (H) to be downstepped. Snider does not provide instances or information on Low tones (L) undergoing upstep. Nevertheless he indicates (page 39), that **"***Not all that the model can do is yet attested***"** [emphasis ours], thereby setting grounds for further research.

The upstep of low tone in Njyem documented in this paper[1] constitutes a contribution to Snider's anticipated **"***further research***"** expected to provide empirical evidence of other aspects of tonal phenomena that can be accounted for by RTT. Indeed, the study discovers and uncovers the phenomenon of *low tone raising*, presented with objectively measured pitch traces and accounted for within the RTT framework.

1. UPSTEP OF LOW TONE IN NJYEM

In the literature, tonal upstep, as opposed to downstep, has been demonstrated to involve only high tones (as shown below). However, in at least two contexts in Njyem, the tone of the verb root is either downstepped or upstepped. The contexts involved are the present habitual negative, and the present (subject focalised). In these constructions the high tones on high tone verbs are downstepped while the low tones on low tone verbs are upstepped[2], as evidenced in the data in 1 and 2 below. Before taking a close look at the data, it must be said that Beavon (2000:4) observes this phenomenon also but refers to it as *polar tones*. He nevertheless makes the following remark that unwittingly discards that status: "Tandis que le ton bas devient ton haut, le ton haut ne devient pas ton bas. Au contraire, il devient un ton moyen." (*Whereas the low tone becomes a high tone, the high tone does not become a low tone. On the*

[1] We would like to thank Professor Ngessimo Mutaka and Dr. Robert Hedinger for giving very useful feedback after reading the first version of this article. Many thanks also go to an anonymous JWAL referee for the crucial comments and suggestions, which have contributed immensely to the article's present shape and organisation. Any other shortcomings in the work are our responsibility.

[2] The shifts in register in these constructions in Njyem are caused by a floating polar tone. In the context of a following H tone, this floating polar tone is L and causes downstep of that following high tone. In the context of a following L tone, the floating polar tone is H and causes upstep of the following L tone, as demonstrated in section 4.

contrary it becomes a mid tone). Since the low tone becomes high but the high tone becomes mid, not low, they cannot be considered polar tones.

The data that follow show that the processes illustrated here are actually *downstep* (the high tones are lowered to mid – Snider's (1999a) Mid_1) and *upstep* (the low tones are raised to mid – Snider's (1999a) Mid_2). In (1), high tone verbs are presented in the two contexts to show how downstep occurs. In (2), low tone verbs are given in the same contexts to illustrate upstep.

				LH ↓H HL
	L H L H HL			07 0v0b
(1a)	**ɲɛ a ba'lo**	→		[**ɲa ba'lo**]
	3s NEG CER double			'He never doubles'
				H ↓H
	H H L H			0‡ 0v
	bi a ba'	→		[**ba ba'**]
	3p NEG CER give			'They never give'
				H ↓H H H
	H H L H H H			0‡ 0v 0v0v
	bi a ba' tUhU	→		[**ba ba' tUhU**]
	3p NEG CER give difficulty			'They never give difficulty'
				LH ↓H HL
	L H L H HL			07 0v0b
(b)	**ɲɛ e ba'lo**	→		[**ɲe ba'lo**] ♩
	3s PSF CER double			'It's him who doubles'
				LH ↓H
	L H L H			07 0v
	ɲɛ e ba'	→		[**ɲe ba'**]
	3s PSF CER give			'It's him who gives'
				LH ↓H L L
	L H L H L L			07 0v 02 02
	ɲɛ e ba' wunu	→		[**ɲe ba' wunu**]
	3s PSF CER give peanut			'It's him who gives peanut'

While the data in (a) are in the present habitual negative, those in (b) are in the present, with the subject focalised. In all the sets, the high tone of the verb root is downstepped. For further documentation of this downstep, see Akumbu (2006).

Now, consider the next sets of data that illustrate upstep of low tones.

LH ↑L L

(2a)

L H H L L
ɲɛ **a** **ba'lo** → [ɲa **ba'lo**]
3s NEG CER guide 'He never guides'

LH ↑L L L L L
L H H L L L L L
ɲɛ a **ba'lo** **be-kamlo** → [ɲa **ba'lo** **be-kamlo]**
3s NEG CER guide C2-defender 'He never guides the defenders'

H ↑L
H H H L
bi a **ba'** → [**ba** **ba'**]
3p NEG CER careful 'They are never careful'

H ↑L L H H
H H H L L H H
bi a **ba'** **be-kuma** → [**ba** **ba'** **be-kuma]**
3p NEG CER careful C2-assessor 'They are never careful with the assessors'

(b)

LH ↑L L
L H H L L
ɲɛ e **ba'lo** → [**ɲe** **ba'lo**]
3s PSF CER guide 'It's him who guides'

LH ↑L L L L L
L H H L L L L L
ɲɛ e **ba'lo** **be-kamlo** → [**ɲe** **ba'lo** **be-kamlo]**
3s PSF CER guide C2-defender 'It's him who guides the defenders'

LH ↑L
L H H L
ɲɛ e **ba'** → [**ɲe** **ba'**]
3s PSF CER careful 'It's him who is careful'

LH ↑L L H H
L H H L L H H
ɲɛ e **ba'** **be-kuma** → [**ɲe** **ba'** **be-kuma]**
3s PSF CER careful C2-assessor 'It's him who is careful with the assessors'

In both sets of data, the low tone of the verb root is upstepped. The pitch traces[3] in figure 1 and 2 show the realization of low tone verbs in isolation whereas those in figures 3-6 show upstep of the low tone.

(3) Figure 1 and 2: Low tone verbs in isolation

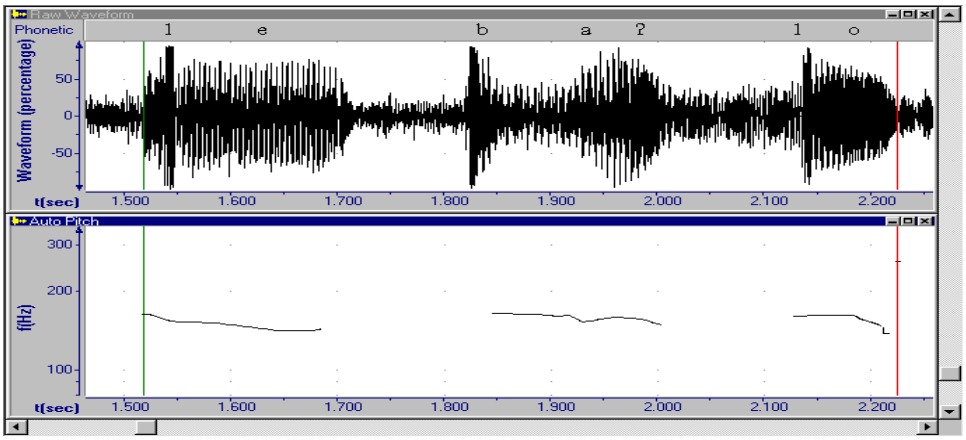


Figure 1: **lè-bà'lò** 'to guide'

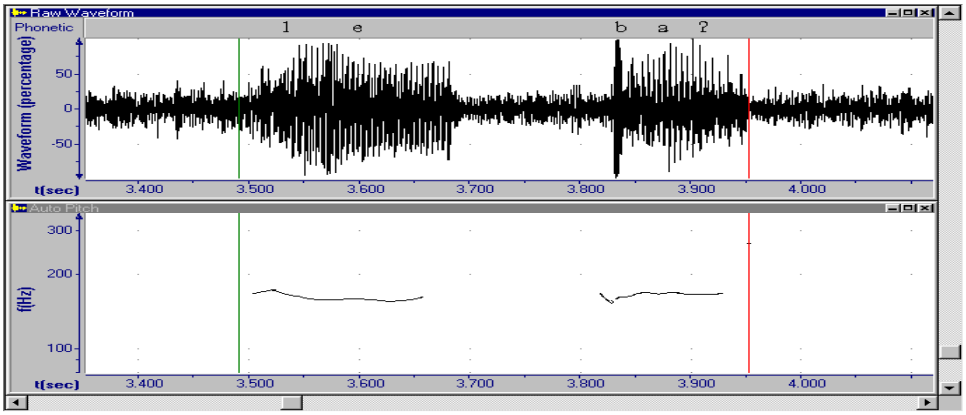


Figure 2: **lè-bà'** 'to be careful'

Figure 1 and 2 show that our informant realises the low tone on both the prefix and the verb root at about 160Hz. The cumulative mean frequency for these two words as pronounced by 3 women and 2 men is 151.4Hz.

(4) Figures 3-6: Upstep of low tones

[3] The pitch traces used in this article are consistently taken from one of our informants. Nevertheless, we state the cumulative mean frequencies of tokens as pronounced 10 times by all our 5 informants.

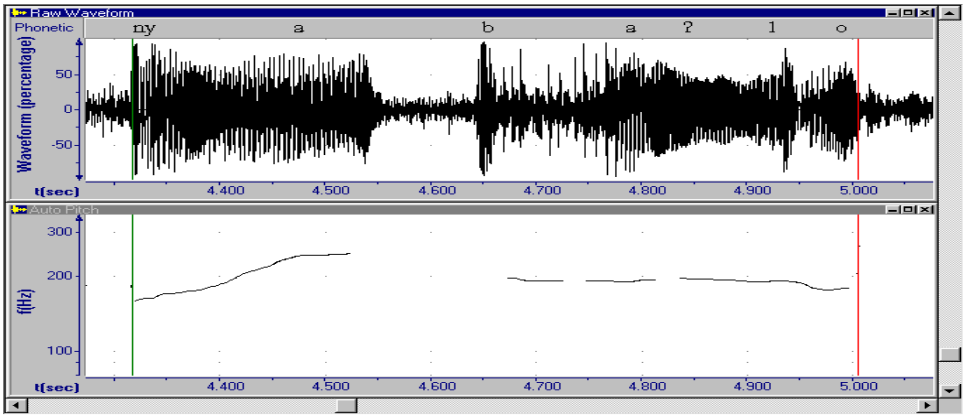


Figure 3: **ɲè á ´ bà'lò** → [**ɲǎ ↑bà'lò**] 'He never guides'

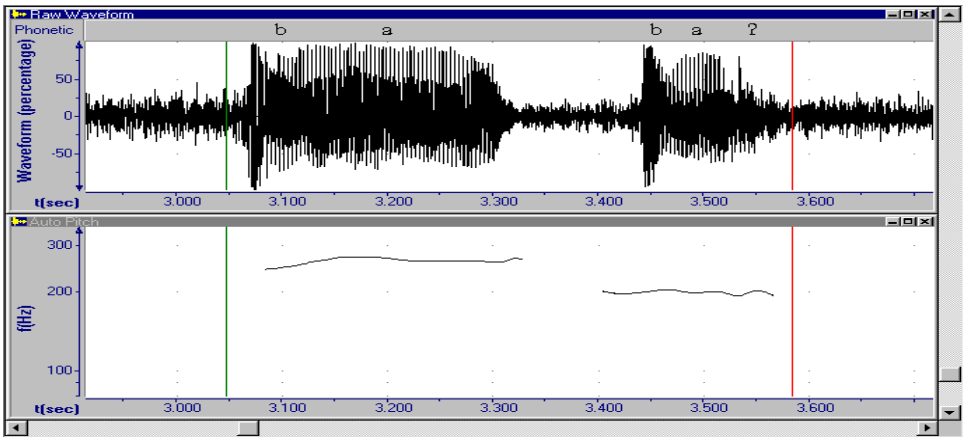


Figure 4: **bí á ´ bà'** → [**bá ↑bà'**] 'They are never careful'

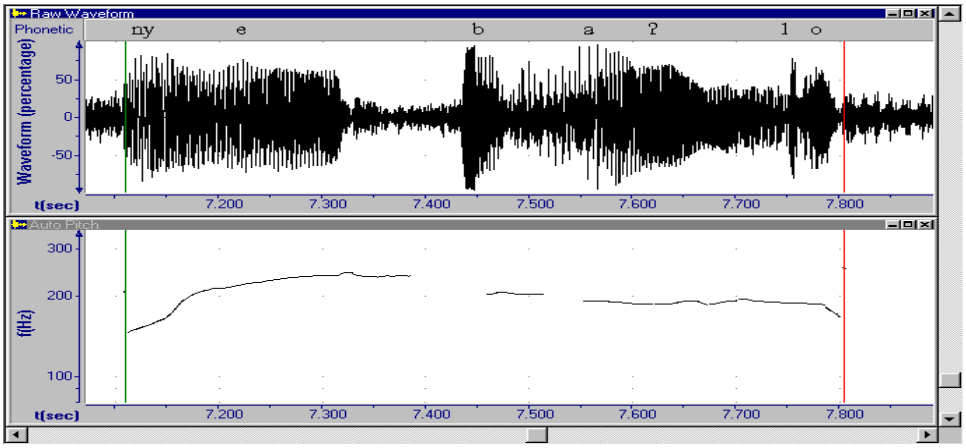


Figure 5: **ɲè é ´ bà'lò** → [**ɲě ↑bà'lò**] 'It's him who guides'

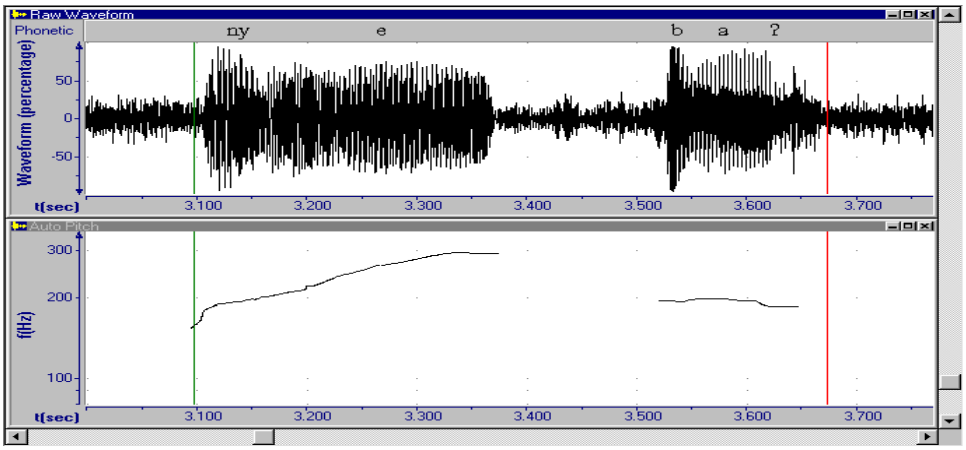


Figure 6: **ɲè é ´ bà'** → **[ɲě ↑bà']** 'It's him who is careful'

Figures 3-6 show that this informant realises the low tone on the first syllable around 160Hz, but realises the root low tone at about 185Hz. The cumulative mean frequency for the root tone in these four phrases as pronounced by the 3 women and 2 men is 174.8Hz, showing a significant raising of 23.4Hz. Since the root low tone is consistently higher in frequency than when it is said in isolation and also higher than the preceding low tone, the logical conclusion is that it has been upstepped.

The question that immediately comes to mind, and which will be addressed in §4, is, given that the *upstep* of low tone is real and well attested as illustrated above (see Akumbu 2006 for more data), how best can it be accounted for? This question can best find illuminating answers within the context of a review of recent research findings on the phenomenon of upstep.

2. RESEARCH FINDINGS AND CLAIMS ON UPSTEP

2.1 CLEMENTS' (1996) ASSERTION

Commenting on the phenomenon of *upstep*, Clements (1996:851-52) makes three essential claims to demonstrate that it is not symmetrical to *downstep*. The first is that upstep "is apparently restricted to H tones". Secondly, upstep "is not known to be lexically distinctive". Finally, "upstep is not known to apply recursively to create rising intonational staircases, at least in African languages". He concludes that the treatment of upstep remains a particularly difficult problem and suggests "any model allowing unbounded upstep must arbitrarily stipulate constraints that conspire to exclude two successive upsteps not separated by downstep" (page 852). A reaction to Clements' claims later came from Snider (1999a).

2.2 SNIDER'S FINDINGS AND COUNTER-CLAIMS

Language data documented in Snider (1999a:105-115) show an upstep system that closely mirrors downstep systems. He shows that, contrary to Clements' assertions, upstep is lexically distinctive and does apply recursively to create rising intonational staircases. He demonstrates, in line with Clements, that upstep is apparently restricted to H tones. He however, concludes that the counter-evidence provided against two of Clements' claims together with the facts put together by both of them on the nature of

tonal upstep, call for a theoretical framework that treats upstep in a manner similar to downstep, with binary features and phonological rules.

2.3 HIGH TONE UPSTEP IN THE LITERATURE

As mentioned earlier, upstep has been shown to involve mainly the H tone. This has been documented in some languages, including Krachi (Snider 1990), Cahi (Hyman 1993), Nkwen (Oyebade and Chumbow 1997, and Awambeng 2002), and Engenni (Snider 1999b). Some of the works (e.g., Hyman 1993) have made predictions about upstep of M and L tones but, to our knowledge, none has shown evidence of any.

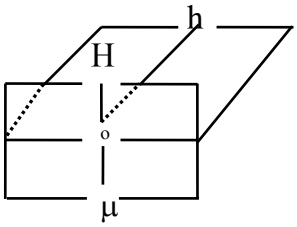
2.4 CLEMENTS' AND SNIDER'S CLAIMS WITH RESPECT TO FACTS OF NJYEM

The upstep of L tones in Njyem exemplified in 2a above with empirical evidence of pitch traces and documented further below, constitute, we believe, incontrovertible evidence that low tones also participate in upstep. This study shows that upstep is symmetrical to and mirrors typical downstep systems as well as shows, in line with Snider (1999a), that the binary features of RTT and phonological rules are both relevant to an insightful treatment of upstep. A sketch of the RTT framework in §3 precedes the analysis of the Njyem data in §4.

3. SKETCH OF REGISTER TIER THEORY AND ITS JUSTIFICATION

Register Tier Theory (RTT) (Inkelas 1987, Inkelas et al. 1987, Snider 1988, 1990, 1999a) recognises the following autosegmental features and tiers: the register features h and l on a REGISTER TIER, the tonal features H and L on a TONAL TIER, a TONAL ROOT NODE TIER (TRN), and a TONE-BEARING UNIT TIER (TBU). These tiers are geometrically arranged according to the configuration in (5) taken from Snider (1999a:23).

(5) Geometry of tone



Register tier

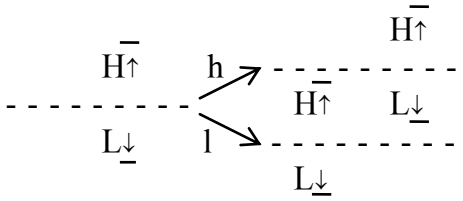
Tonal tier
Tonal root node tier

Tone-bearing unit tier

"Features on the Register tier and the Tonal tier are linked to structural nodes on the TRN. Geometrically, these tiers form a separate plane with respect to the TRN. Nodes on the TRN are, in turn, linked to moras (μ) on the TBU tier" (Snider 1999a:23).

The register features h and l are defined (Snider 1999a:25) as "Effect a register shift h=higher, and l=lower relative to the preceding register setting", and the tonal features H and L as, "Realize this TBU at H=high pitch, and L=low pitch relative to the current register." This is shown in (6), where the dotted lines represent registers and the solid lines represent tones.

(6) Register features and tonal features



The geometry in (5) and the features in (6) make it possible to specify up to four logically possible tonal distinctions, namely, a high tone on a high register, a high tone on a low register, a low tone on a high register, and a low tone on a low register. Notice, firstly, that the register feature of any given TBU is specified in relation to that of the preceding register. The register of the initial TBU for its part is construed to be higher than or lower than the reference point that native speakers usually have in mind when beginning an utterance. Secondly, the tonal feature associated to any given TBU specifies whether the tone is high or low in relation to the current register.

This theory can be justified on the basis that it allows for a unique representation of each tone phoneme. In this manner, it captures similarities between tone phonemes by assigning features to them in a way that phonemes that behave similarly share common features. The theory also accounts for the different types of tonal alternations that occur in languages. These include assimilation and dissimilation, register phenomena such as downstep and upstep, underlying toneless morphemes, and floating tones. It also adequately characterises the different types of contour tones found in languages. Finally the theory excludes from formal descriptions phenomena that never occur in natural language. For instance, it predicts that no language will have more than three possibilities for feature assimilation: assimilation of register, assimilation of tone, and assimilation of both register and tone.

4. UPSTEP OF LOW TONES IN NJYEM AND ITS ANALYSIS WITHIN RTT

To further illustrate upstep of low tones in Njyem from the vantage point of RTT, we now return to analyse the relevant data. As said earlier, the data in (7) initially presented in (2), with accompanying evidence of pitch traces and repeated here for convenience, demonstrate upstep of low tones.

(7a)

	L H H L L		LH ↑L L	
	ɲɛ a ba'lo	→	[ɲa ba'lo]	
	3s NEG CER guide		'He never guides'	
	L H H L L L L L		LH ↑L L L L L	
	ɲɛ a ba'lo be-kamlo	→	[ɲa ba'lo be-kamlo]	
	3s NEG CER guide C2-defender		'He never guides the defenders'	
	H H H L		H ↑L	

bi a ba' → [**ba ba'**]
3p NEG CER careful 'They are never careful'

H ↑L L H H
H H H L L H H 0‡ 0T 0T0˜0˜
bi a ba' be-kuma → [**ba ba' be-kuma]**
3p NEG CER careful C2-assessor 'They are never careful with the assessors'

LH ↑L L
L H H L L 07 0ꝊT
(b) **ɲɛ e ba'lo** → [**ɲe ba'lo**]
3s PSF CER guide 'It's him who guides'

LH ↑L L L L L
L H H L L L L L 07 0ꝊT0T0T0T0T
ɲɛ e ba'lo be-kamlo → [**ɲe ba'lo be-kamlo]**
3s PSF CER guide C2-defender 'It's him who guides the defenders'

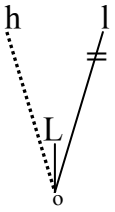
LH ↑L
L H H L 07 0T
ɲɛ e ba' → [**ɲe ba'**]
3s PSF CER careful 'It's him who is careful'

LH ↑L L H H
L H H L L H H 07 0T 0Ꝋ˜0˜
ɲɛ e ba' be-kuma → [**ɲe ba' be-kuma]**
3s PSF CER careful C2-assessor 'It's him who is careful with the assessors'

In these data, the low tone of the verb root is upstepped. This is well illustrated by the last example in (7b) which shows that both the L and H tones on **bèkúmá** 'assessors' that follow the raised L on **bà'** 'be careful' are realised at a higher level than the L and H tones on **ɲě** 'it's him who' that precede the raised L on **bà'** 'be careful'. This shows that the register has indeed gone up. In order to account for this upstep, it is assumed that there is a floating high tone, marking *certainty*, which occurs just before the low-toned verb roots. It should be noted that underlyingly, *certainty* is marked by a toneless morpheme and the floating tone is inserted following *tonal polarity*. The floating tone is low when it occurs before high tone roots and high when it occurs before low tone roots. In (7) therefore, the floating tone is high because it occurs with low tone roots. This tone spreads its high register feature to the verb root following the rule in (8) and subsequently delinks that following low register feature. This process conforms to the prediction made in Snider (1999a:54-55) that upstep of a low tone is caused by a *floating high register feature* that spreads as opposed to

downstep of a low tone caused by a *floating high register feature* that remains floating.

(8) Tone Rule: *h-spread and l-delink*



This rule says that a high register feature spreads to the following low register feature. The low register feature is delinked in a subsequent process. The high register (h) now firmly associated to the low tone causes it to be raised or upstepped. The tone that is produced is higher than a low tone but lower than a high tone. This tone is referred to as Mid_2 (Snider 1999a:24) since it is a low tone that is realised on a high register.

In addition to the rule in (8), Vowel Deletion formulated in (9), is required to account for these data.

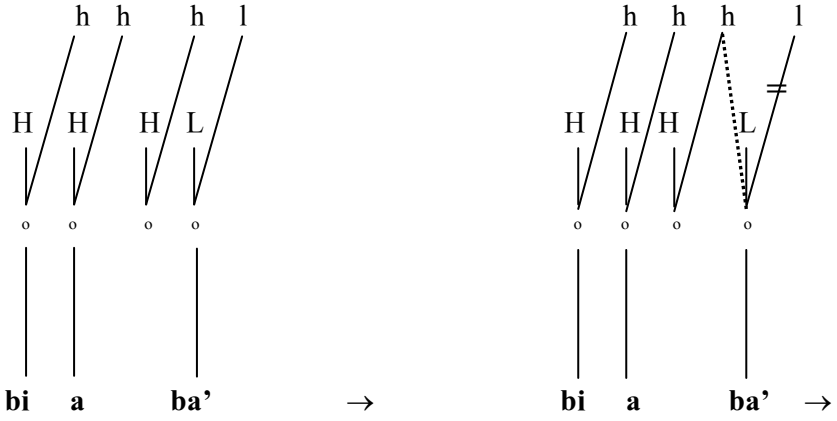
(9) Phonological Rule: *Vowel Deletion*

$$\begin{bmatrix} +\text{syll} \\ -\text{cons} \end{bmatrix} \rightarrow [ø] \,/\, \_\_ + \begin{bmatrix} +\text{syll} \\ -\text{cons} \end{bmatrix}$$

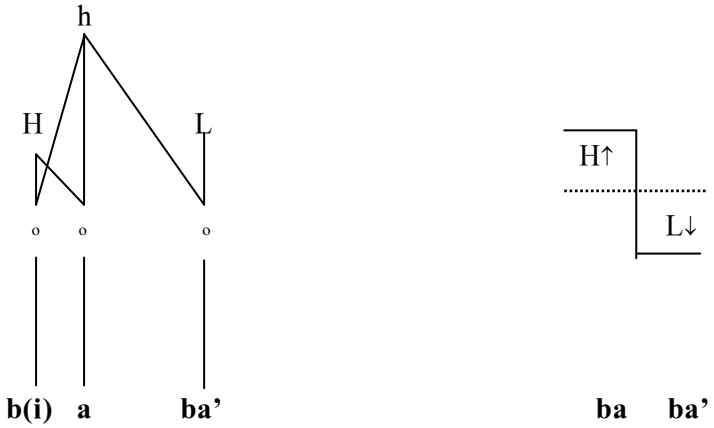
According to this rule, in a sequence of two vowels across a morpheme boundary the first is deleted (For more data on these processes, see Akumbu 2006).

The following derivation demonstrates the occurrence of upstep:

(10)



Vowel Deletion, Merger, Stray Erasure Phonetic Representation



This derivation demonstrates that the floating high register feature spreads to and delinks the following low register feature. It also shows that the vowel of the subject marker deletes according to the rule in (9). This allows the low tone to be realised on a higher register, causing upstep. Notice also that Stray Erasure applies to delete the unassociated H tonal feature.

It could be argued that the raising is local and is due to the *H* spreading rather than the *h*, so that the register of any tone that follows the raised low will be reset to a lower level. This equally signifies, for example, that the surface tone of any high tone that follows the raised low will be Mid_1 rather than Mid_2. Nevertheless, data like the following demonstrate clearly that it is indeed register raising that has taken place.

LH ↑L L L L L

L H H L L L L L

(11a) **ɲɛ a ba'lo be-kamlo** → **[ɲa ba'lo be-kamlo]**

3s NEG CER guide C2-defender 'He never guides the defenders'

H ↑L L H H

H H H L L H H

bi a ba' be-kuma → **[ba ba' be-kuma]**

3p NEG CER careful C2-assessor 'They are never careful with the assessors'

LH ↑L L L L L

L H H L L L L L

(b) **ɲɛ e ba'lo be-kamlo** → **[ɲe ba'lo be-kamlo]**

3s PSF CER guide C2-defender 'It's him who guides the defenders'

LH ↑L L H H

L H H L L H H

ɲɛ e ba' be-kuma → **[ɲe ba' be-kuma]**

3s PSF CER careful C2-assessor 'It's him who is careful with the assessors'

In these data both high and low tone nouns are added after the upstepped low. The high and low tone roots have an underlying low-toned prefix that immediately follows the upstepped low. The fact that all the tones that follow the raised low are realised at the previously raised level shows that the register has gone up. This actually confirms the assertion that the high register has spread and that the surface tone of the second raised low tone is indeed Mid_2 as shown in the following pitch traces.

(12) Figures 7-10: Upstep of low tones

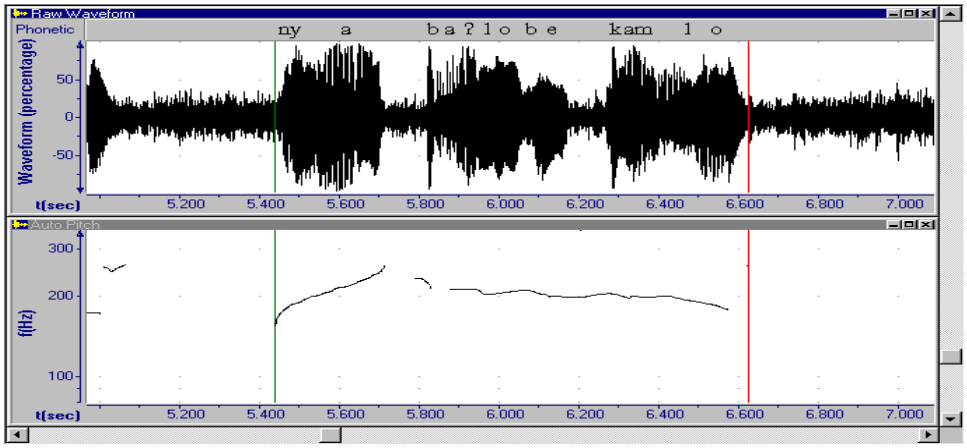


Figure 7: **ɲè á ´ bà'lò bè-kàmlò** → [**ɲǎ ↑bà'lò bè-kàmlò**] 'He never guides the defenders'

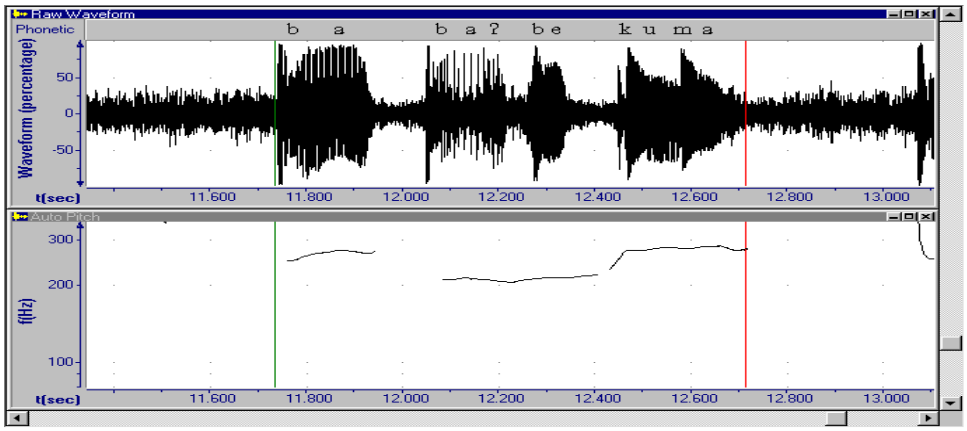


Figure 8: **bí á ´ bà' bè-kúmá** → [**bá ↑bà' bè-kúmá**] 'They are never careful with the assessors'

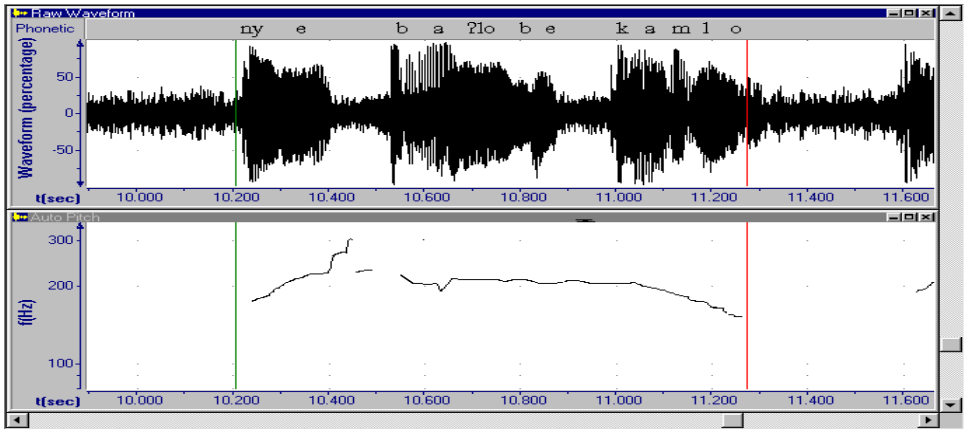


Figure 9: **ɲè é ´ bà'lò bè-kàmlò** → [**ɲě ↑bà'lò bè-kàmlò**] 'It's him who guides the defenders'

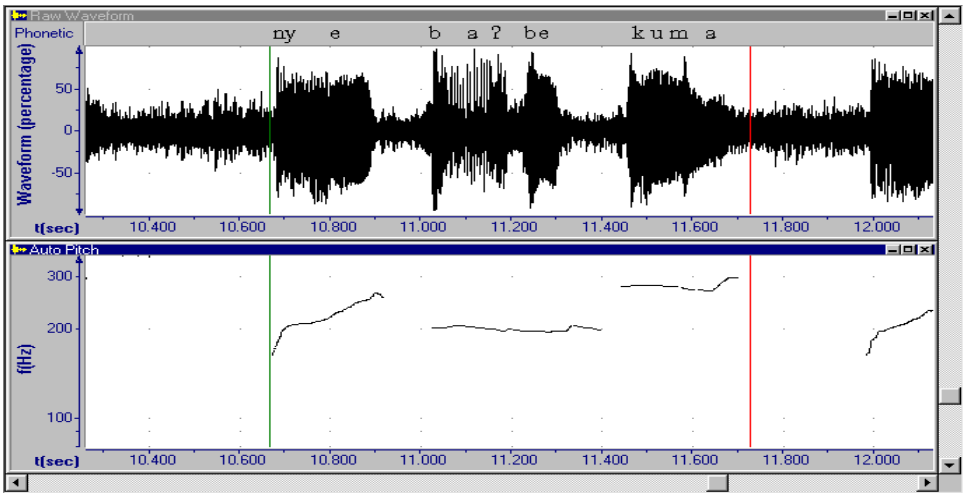


Figure 10: **ɲè é ´ bà' bè-kúmá** → [**ɲě ↑bà' bè-kúmá**] 'It's him who is careful with the assessors'

The root low tones in figures 7-10 are also raised to around 185Hz, in the same manner as the low tones in figures 3-6. Similarly, the high tones that follow the point of upstep are higher in frequency than those that precede that point. Figure 8 and 10 reveal that this informant realises the first high tone at about 260Hz but realises the second around 280Hz. This, again, shows that it is indeed upstep that has occurred.

It should be mentioned that the morphology of Njyem is less concatenative, making it difficult to show successive occurrences of upstep in the same utterance. Even though demonstrating recursion could have been more illustrative, it is difficult to organise data in such a way as to show it more evidently.

5. CONCLUSION

The occurrence of upstep of low tones as documented in this article demonstrates that there is a process in Njyem to the effect that when a low tone follows a floating high tone, it is upstepped. The analysis within the register tier theory model explains the process, in that, the floating high tone (H) spreads its register feature (h) to and delinks the following low tone's (L) low register feature (l) and the L tone is consequently raised by the acquired h register feature. It has also been shown in this article that all instances of high and low tones that follow the point of upstep are correspondingly higher than instances of their respective counterparts that occur prior to the point of upstep. Similarly, multiple syllables and tones following the point of upstep have been shown to be upstepped relative to those that precede that point, illustrating that the raising in the process of upstep is not locally confined to the immediately following syllable or tone.

Considering the fact that previous scholarship has demonstrated that the upstep of High and Mid tones can be accounted for within the RTT model, the facts of the upstep of Low tone evidenced in this paper and analysed within the same model leads to the observation (claim) that whatever the origin of upstep (H, M, or L) it can receive a unified, insightful and explanatory account within RTT.

The binary nature of features in RTT makes it possible to analyse this complex phenomenon. This is because the tonal and register features that are arranged geometrically occupy separate tiers and can behave independently of each other.

Upstep in Njyem also lends support to Snider's (1999a:23-24) prediction that the features and geometry of tone allow for the specification of up to four level tone phonemes in Language: High, Mid_1, Mid_2, and Low.

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