

CONSONANTS AND TONE IN KERA (CHADIC)

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The main aim of the present study is to explore the effect of word-initial consonants on the tone melody of Kera nouns which along with verbs are divided into classes based on the initial consonant of the word. These classes differ in the tone melodies which are permissible. The noun and verb systems will be discussed separately and then compared in order to observe the interesting parallels and contrasts between the two. Of particular note is the varied action of certain consonants which have a depressor function on tone in most cases, but which appear to have the opposite effect in others. The comparison of the noun and verb systems shows that we need to divide the consonants into groups. In nouns, one set of consonants raises the tone; in the verbs, another group of consonants lowers the tone. There is a third group of consonants that does not affect the tone in either nouns or verbs. This will lead to the conclusion that the consonants should be divided into three groups: depressor, raiser, and neutral consonants.

This study offers an explanation of these phenomena through the application of the register tier model proposed by Inkelas, Leben, and Snider. The study begins with a description of the relevant phonological features of Kera. An overview of this theory is given in §1. This is followed in §2 by an explanation of how the theory applies to Kera disyllabic nouns. The application of the theory is then developed to include multisyllabic and polymorphemic words. A discussion of the verbal system follows in §3. Section 4 discusses previous research on the language, and §5 includes a comparison between the nominal and verbal systems. The study concludes with a discussion on the phonetic motivation for the division of Kera consonants into three groups according to their effect on tonal melodies.

La présente étude vise principalement à examiner l'effet des consonnes initiales sur le schéma tonal des substantifs en kéra. Les noms et les verbes de cette langue se divisent en classes selon leur consonne initiale. Ces classes se distinguent par les schémas tonaux qu'elles admettent. Nous étudierons d'abord le système nominal puis le système verbal, pour ensuite les comparer, afin d'y observer les ressemblances et les contrastes les plus frappants. Le trait le plus saillant consiste en l'effet variable de certaines consonnes qui, le plus souvent, abaissent le ton, mais qui parfois semblent provoquer le contraire. Une comparaison entre les noms et les verbes fait ressortir la nécessité d'établir trois séries de consonnes. Dans les noms une de ces séries hausse le ton; dans les verbes une autre série l'abaisse. Une troisième série n'a aucun effet tonal, ni dans les noms, ni dans les verbes. De là l'utilité de diviser les consonnes en trois catégories: les rehaussantes, les abaissantes, et les neutres.

Notre étude cherche à expliquer ces phénomènes en y appliquant le modèle du registre des niveaux ('register tier') proposé par Inkelas, Leben, et Snider. Nous commençons par décrire les traits phonologiques pertinents du kéra, puis dans la première section nous résumons ledit modèle. Dans §2 nous expliquons comment cette théorie peut s'appliquer aux noms dissyllabés du kéra, avant de la développer pour inclure les mots polysyllabés et polymorphémiques en général. Un aperçu du système verbal en §3 est suivie en §4 d'une discussion sur les études précédentes de la langue. Dans §5 on compare le système nominal et le système verbal, puis nous concluons notre étude en discutant la justification phonétique pour la division des consonnes du kéra en trois séries, eu égard à leurs effets sur les schémas tonaux.

0. INTRODUCTION

For a number of Chadic languages, including Podoko, Masa, and Dangaleat, the consonants are divided into two groups based on the effects that these consonants have on the tone. A number of examples of this are documented in Wolff (1987). This article explains how the Kera consonants divide into three sets based on their behaviour in nouns and verbs. This subject will be treated by applying the register tier theory which is a model based on autosegmental theory.¹

In order to provide the setting for this discussion, we will firstly consider the classification of Kera and the segmental phonology which is relevant to the subject of the article. This will be followed by an overview of the tonal melodies found and the division of Kera consonants into three groups.

Kera is classified as an Eastern Chadic language in Wolff (1987). The majority of Kera speakers live in the southwest of Chad in the Mayo-Kebbi province. Other speakers live across the Cameroon border or in large towns in Cameroon and Chad. The data

¹ In writing this article I am grateful for the help received from Stephen Bird, Robert Hedinger, James Roberts, Keith Snider, and Ekkehard Wolff who each read the text and made helpful suggestions for improvements. My main language assistant was Mr. Andre Tong-Pa who also read the article and discussed the various tonal melodies in Kera. All errors remaining in the text are mine.

for this study is based on the Kera spoken in the region of Koupor and surrounding villages within the Kera community in the Mayo-Kebbi prefecture.

Syllable structure. The Kera syllabic structure can have the following forms: CV, CVC, CV:, CV:C. Additionally, word-initial syllables can have the following forms: V, VC, V: and word-final syllables can have the form N. Word-final syllabic nasals are rare. The syllable can include a long or short vowel as a nucleus. Vowel-initial words in isolation are pronounced with initial glottal stop but we can conveniently ignore this for the purpose of the present analysis.² In verbs, the glottal stop does appear occasionally in medial and final positions. Syllable types with examples are given in (1).

(1)	CV	dəmàl	drum	V	àvà	melon
	CVC	seská	star	VC	áská	fish
	CV:	bàaŋà	elephant	V:	èèlè	to weigh/be heavy
	CV:C	akáar	parents-in-law	N	dùgg	evening

Observe that in the first three lines of the table, the right-hand column has the same syllable structure as the one on the left except for the syllable onset. The fourth line, however, shows two syllable types having a limited distribution. CV:C is a rare pattern in Kera. CV: is not found word finally except in monosyllabic words. CV:C occurs only in word-final position in multisyllabic words implying extrasyllabicity. For more details on extrasyllabicity, refer to Kenstowicz (1994:274). The syllabic nasal only occurs in final position. It is not clear that this nasal segment should be analysed as a full syllable.

There are some restrictions on the combinations of syllable types in multisyllabic words, but they do not affect the present analysis of the noun tone. The transcription used in this article is phonemic IPA symbols except for vowel length which is represented by doubling the vowel and **j** and **c** which are voiced and voiceless palato-alveolar affricates. The mid tone is not marked, and long vowels are only marked with an accent on the first vowel, but the tone is the same for the duration of the long vowel.

Consonant distribution

(2) The Kera consonants

voiced obstruents	b d j g v z
glottals	? h
voiceless obstruents	p t c k f s
implosives	ɓ ɗ
trill	r
sonorants	m n ŋ l y w

In syllable-initial position, all of the above consonants except the glottal stop are attested. The consonant **h** only appears syllable initially. In syllable-final position, the consonant is normally sonorant, although other types of consonant are found in this position. In word-final position for nonverbs, only sonorants are attested.³ In mid-sentence, there is a consistent truncation of the final vowel in verbs and nouns which can cause a variety of consonants to appear word finally. The vowel is sometimes present in slow speech.

There is a tendency towards consonant harmony with respect to voicing at the word level. This tendency can be seen clearly in the comparison of singular and plural forms (plural: **k-** prefix and **-áw** suffix), e.g., **dàygà** / **gədàyáw** 'jug(s)', **taatá** / **kətaatáw** 'large pot(s)'. For further plural examples see (42).

² Exceptions are the locative particle **a** and the prefix **a-** used for animal names. In these two cases the glottal can be optionally dropped.

³ Exceptions are **gud** 'behind' and **akas** 'like' which do not appear to have an omitted vowel. Also ideophones can have a number of consonants in final position.

For word-internal consonants, voiced and voiceless consonants are sometimes in free variation. Ebert (1979a) has observed that after a long vowel or after a nasal, a consonant in the final syllable can optionally be voiced, e.g., **soope** / **soobe** 'three'.

Tone and grouping of consonants. There are three phonetic pitches in Kera: high (Hi), mid (M), and low (Lo). The surface melody of a word is influenced in two ways: (1) by the word-initial consonants or (2) by grammatical morphemes such as noun and verb affixes which can carry tone. In the following discussion we will consider first the effects of consonants on tones in nouns. A similar analysis will later be applied to verb consonants and affixes. Nouns have four possible underlying melodies: l, l h, h l, and h which are not predictable from the form of the word. Verbs, however, are underlyingly toneless.

The analysis of tone requires the division of the consonants into three groups. These groups are the depressor, raiser, and neutral consonants. The depressor consonants are the voiced obstruents **b g j d z v** and the glottal **h**. These consonants cause underlyingly toneless morphemes to be realised with Lo tone. Their effect in Kera is to depress the tone in the verbal system. The raiser consonants are the voiceless obstruents **p k c t s f**, the implosives **ɓ ɗ** and the trill **r**. These consonants cause underlyingly Lo-toned morphemes to be realised with M tone. Their effect in Kera is to raise the tone in the nominal system when in the word-initial position. For nouns with a vowel in word-initial position, the first consonant of the word is relevant for the tone. This consonant may be found at the beginning of the second syllable. Consonants other than the first consonant are not relevant for the tone of nouns. The neutral consonants are the sonorants **n m ŋ l w y**. These consonants do not affect the tone of nouns or verbs. The justification of this division of the consonants, shown in (3), will be discussed in §5.

(3)	depressor	b d j g v z h	depresses tone in verbs
	raiser	p t c k f s ɓ ɗ r	raises tone in nouns
	neutral	m n ŋ l y w	tone not affected

Having discussed the phonological features of Kera, we will now consider a theoretical model that can be applied to the data of disyllabic nouns. In the following two sections, this model will be developed for multisyllabic nouns and verbs. The previous research into Kera tone will be presented. We will then go on to discuss the phonetic motivation for dividing the consonants into three groups. This will include an investigation into similar phenomena found in other Chadic languages.

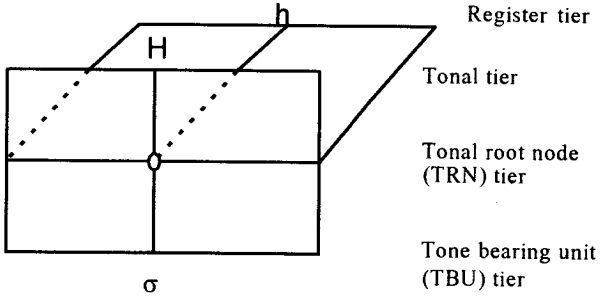
1. OVERVIEW OF REGISTER TIER THEORY (RTT)

1.1 GEOMETRY OF TONE

Register tier theory (RTT) is a particular model in autosegmental phonology which has been developed as a model for representing tone, advanced by Inkelas (1987, 1989), Inkelas and Leben (1991), Inkelas et al. (1987), Leben et al. (1989), and Snider (1988, 1990, and 1999). This model uses two separate tiers for the representation of tone which we will call the register tier and the tonal tier. Such models are popular for languages with downstep and terracing, but in this article we will demonstrate its usefulness to handle a new set of data concerning consonant-tone interference.

RTT provides a theoretical framework to analyse data. The model assumes a three-dimensional representation of tone features as illustrated in (4).

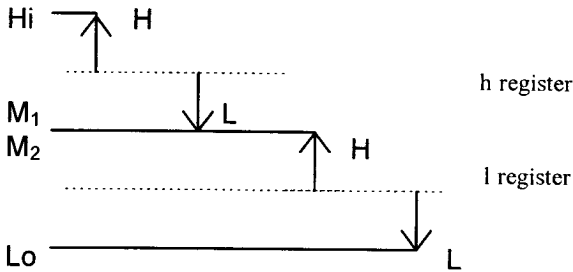
(4)



The model allows for two tones H and L on the tonal tier and two registers h and l on the register tier. These tiers intersect at the tonal root node tier which is linked to the tone bearing unit. In Kera the tone bearing unit (TBU) is taken to be the syllable σ . In many languages the TBU is taken to be the mora. In Kera, however, long vowels can carry only one tone, even though they consist of two morae, so the syllable rather than the mora is taken to be the TBU.

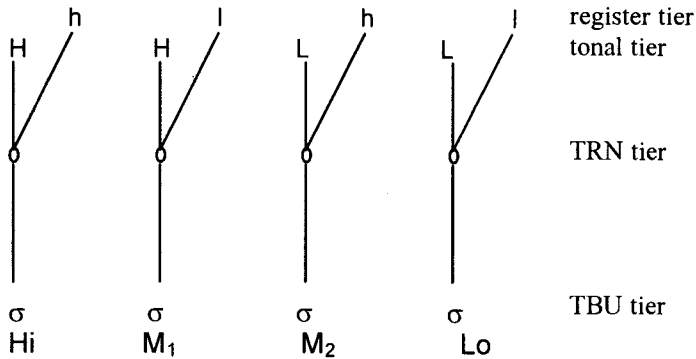
The model is based on two registers: h register and l register. Functionally the register provides the basic phonological shift from high to low. In the diagram in (5), the h and l registers are represented by the dotted lines. The model also allows two phonological static tones: H tone and L tone. The tonal features H and L are represented by arrows which show the derivation from the register. By combining the register features and the tone features, RTT can produce four contrastive pitch levels H_i , M_1 , M_2 , and L. The phonetic levels H_i , M_1 , M_2 , and L are indicated in the diagram by solid lines. In the case of Kera, the two mid tones M_1 and M_2 are realised at the same pitch, although M_2 can be higher than M_1 for some speakers. This is discussed in more detail in §2.4.3.

(5) RTT register and tone features



The two tones H and L are realised at a higher pitch if combined with an h register and a lower pitch if combined with an l register. The four possible phonetic pitches H_i , M_1 , M_2 , and L are created by the combinations of H and L with h and l as shown in (6).

(6) Combining the register and tonal tiers



In a given language, the M₁ and M₂ pitches can be realised on the same pitch, or they can be realised on different pitches. Assimilation processes are also possible on each plane. Refer to Snider (1990) for more details.

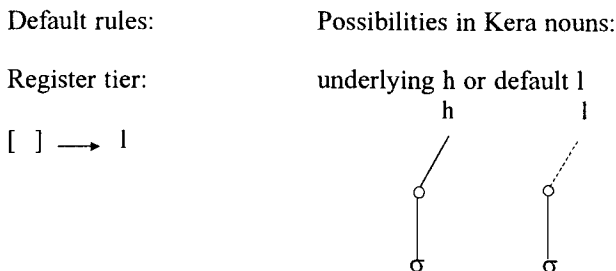
1.2 FEATURES OF TONE

The tonal features, H and L, realise the TBU at a pitch relative to the current register. The register features, h and l, effect a register shift up or down with respect to the preceding register.

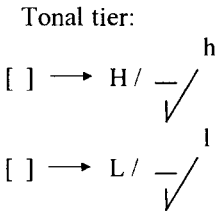
RTT assumes the standard view of underspecification that predictable information is not prespecified. Only unpredictable aspects of tone are represented directly in the underlying form; and then default features are assigned: first to the register tier and then to the tonal tier. Each TBU is associated to a tonal root node (TRN) in underlying form. The obligatory contour principle (OCP) is also applied after the default features have been assigned whose effect is to collapse adjacent identical features. It is true that not all linguists believe that the OCP is a universal principle; however, it is not controverted by the Kera data, and it will be invoked for its usefulness to the present analysis.

The default rules that can be applied to Kera nouns are as follows: On the tonal tier the default values match the feature on the register tier. The three possibilities are, therefore, an underlying H, a default H tone feature which enhances an h register feature, or a default L tone feature enhancing an l register feature. In Kera these default rules are sufficient to explain the various forms found in the data. The default rules are presented in the diagram in (7).

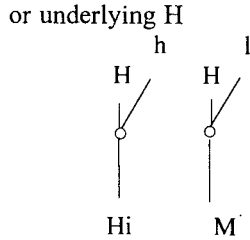
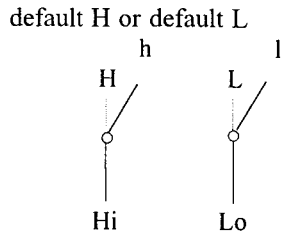
(7)



Default rules:

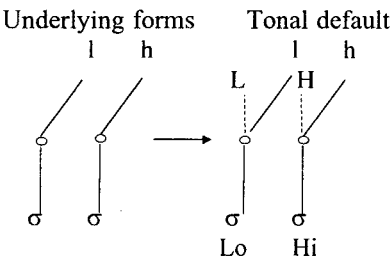


Possibilities in Kera nouns:

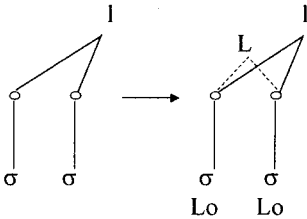


In (8) and (9) the above processes are illustrated with Kera nouns showing how RTT can be used to represent a sequence of tones.

(8)
Lo Hi **gùugúr** 'chicken'



(9)
Lo Lo **gàrdà** 'millet'



Example (8) represents a system where an h register contrasts with an l register for any given TBU. The default features on the tonal tier are then added following the rule that the default L will match an l on the register tier, and a default H on the register tier.

Example (9) illustrates the same rules in operation when there is an underlying l. In this example the OCP is applied to merge adjacent features where they are the same. Where appropriate, language-specific rules would also be introduced after the default features have been added and after the application of the OCP.

With certain suffixes Meeussen's rule applies. This is a dissimilation rule which changes an H to an L following an H. Examples of this are found in §2.4.3.

2. NOUN TONE

2.1 CLASS A AND CLASS B NOUNS

Kera nouns can have any number of syllables but the majority are disyllabic and these are representative of the basic patterns. Therefore, we will begin our discussion with disyllabic nouns and then consider nouns with greater or fewer syllables later. Disyllabic nouns are realised with seven surface melodies: LoLo, LoHi, HiLo, HiHi, MM, MHi, and HiM. The nouns can be divided into two classes based on the first consonant of the word. Examples are given in (10) and (11).

(10) Class A nouns

(a) Lo Lo	gàrdà	millet	mòomò	spirit
(b) Lo Hi	gùugúr	chicken	mòomó	grandfather
(c) Hi Lo	ágày	hoe	mésèw	adultery
(d) Hi Hi	wálká	fear	mántá	salt

(11) Class B nouns

(a) M M	kampa	leg	sukli	fence
(b) M Hi	kaskò	bird	saŋká	type of tree
(c) Hi M	kítir	moon	súngu	coin
(d) Hi Hi	kintí	monkey	séngé	mosquito net

The symbols Hi, M, and Lo are being used to signify the phonetic pitch. In each of the classes there are restricted tone patterns. Class A has all combinations of Lo and Hi, class B has all combinations of M and Hi. There are no M / Lo combinations. The nouns are divided into classes on the basis of the first consonant of the word shown in (12).

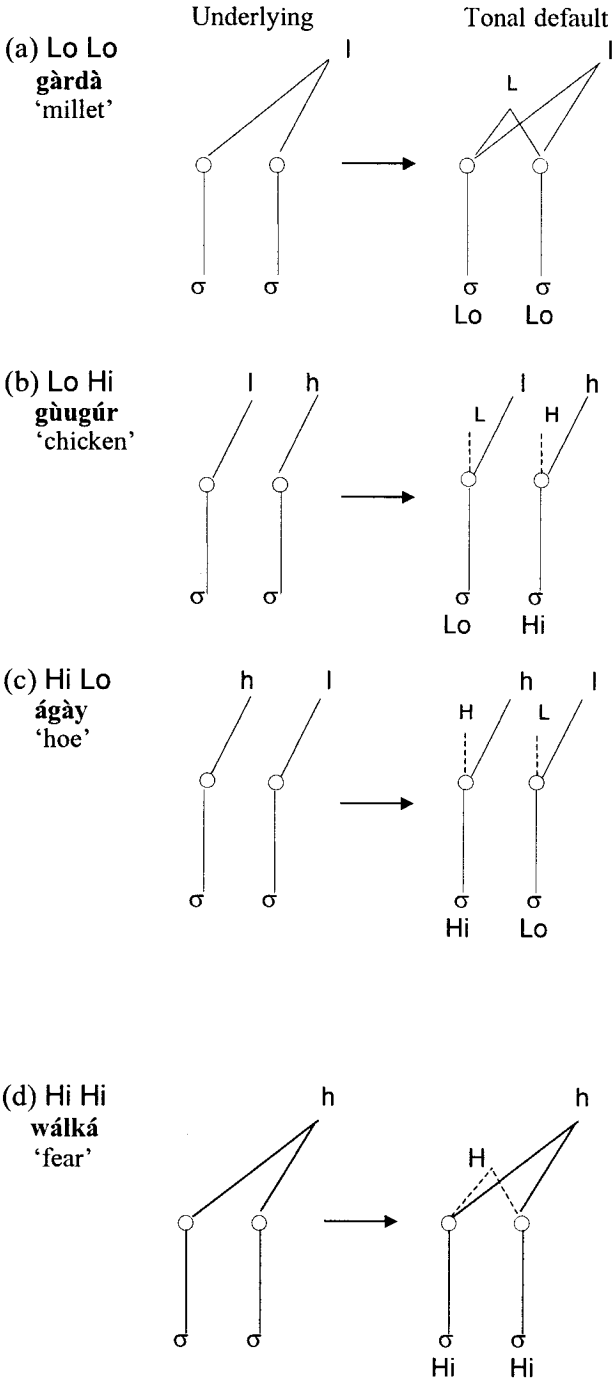
(12) Noun consonant classes

Class A consonants:	b d j g v z h m n ŋ l w y
Class B consonants:	p t c k f s ɸ ɗ r

Class A consists of the depressor and neutral consonants in Kera nouns: the obstruents **b g j d z v**, the sonorants **m n ŋ l w y**, and the glottal **h**.

The diagrams in (13) illustrate the derivation of the melodies described above with class A nouns. The derivation proceeds directly according to the principles outlined in the previous section.

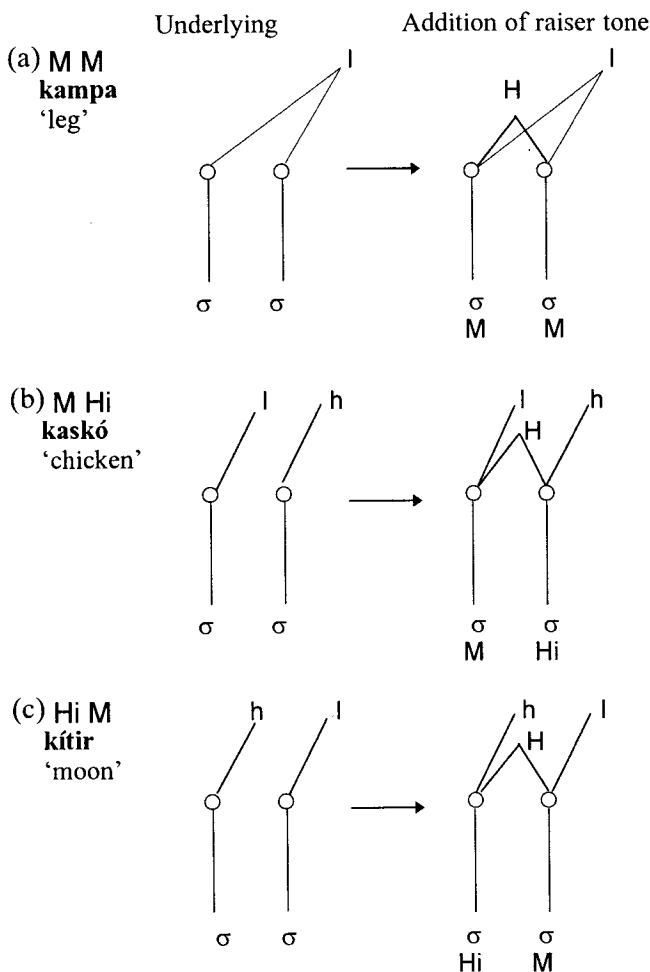
(13) Class A derivations:

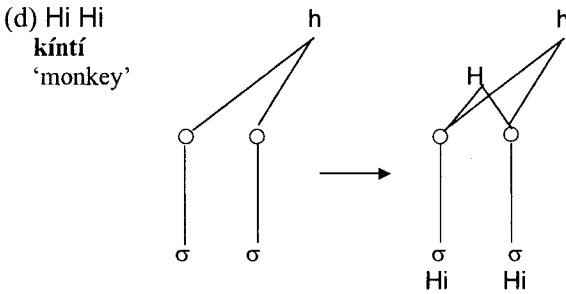


These class A examples represent the normal patterns which can be derived from the register tier features: l l, l h, h l, and h. The tone features L and H are added by default following l and h, respectively, for each TRN. When L is combined with l, Lo is produced; when H is combined with h, Hi is produced. The derivation of class B nouns actually involves these same four underlying melodies. What makes the surface tone patterns different is the effect of their initial raiser consonants.

The raiser consonants are the voiceless obstruents **p k c t s f**, the implosives **b d**, and the trill **r**. In the class B nouns in (11), the underlying tone melody corresponds to the underlying form of the class A nouns. However, the raiser consonant has the effect of introducing a new feature H on the tonal tier. The resultant tones on the TBU tier are given following the representations in (6).

(14) Class B derivations:





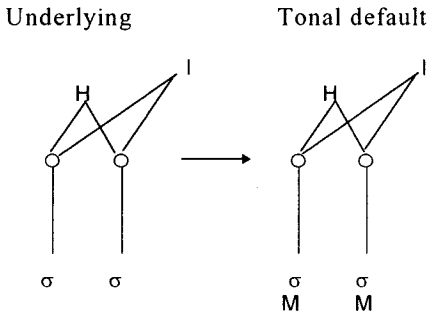
2.2 HYBRID NOUNS

There is one further group of nouns which we have not as yet examined. These are words with a first consonant chosen from the list of class A consonants but exhibiting the tonal melody MM which has been classified as a class B tonal melody. In the derivation they are considered as class A but with an underlying H tonal feature.

(15) Hybrid nouns

MM	jonjon	camel
MM	maswan	prostitute

(16) Derivation of hybrid nouns



In these nouns, a tonal feature H is specified as part of the underlying form. The H on the tonal tier cannot change the register tier features. H and l combine to give a surface melody M as shown in figure (6).

We see from this analysis that there are five possible surface melodies for nouns beginning with a depressor or neutral consonant: the four types in class A and the hybrid form. These melodies can be explained through combinations of tonal and register tier features. The surface melody of all the nouns can be derived from the register tier features: l l, l h, h l, h, with the addition of an underlying H for the hybrid forms. Class B nouns have the addition of an H tone in the underlying form. In this way we have been able to derive the surface melodies of all disyllabic nouns in Kera.⁴

⁴ One exception has been found: **sòlòy** 'money'. In this case the surface melody follows that of class A pattern (b), Lo Hi. However, the first consonant s is a raiser consonant whereas the derivation of class A (b) assumes a neutral or depressor consonant. Ebert (1979a) claims that historically in Kera there has been a shift towards devoicing of the consonants j, z, and v. This process is not complete, but it may explain the discrepancy in this case between the tone and the initial consonant.

We have been able to use the RTT model successfully to account for the derivations of all disyllabic nouns in Kera, but we now need to consider monosyllabic, multisyllabic, and polymorphemic nouns.

2.3 MONOSYLLABIC AND MULTISYLLABIC NOUNS

2.3.1 Monosyllabic nouns

The types of monosyllabic nouns found in Kera are shown in (17).

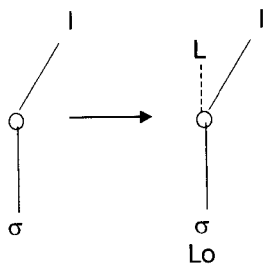
(17)	Class A	(a)	Lo	dol	hard ground	vew	bird trap
		(d)	Hi	nus	a bit		
	Class B	(a)	M	kan	water	cə	head
		(d)	Hi	soŋ	bucket		
	Hybrid		M	waj	angry	men	festival

Kera only has a limited number of monosyllabic nouns, but RTT can still give derivations which are consistent with disyllabic nouns. Class A(a) etc. refers to classification in (10) and (11). As tone glides are not possible, there are no examples of Lo Hi, Hi Lo, M Hi, or Hi M. For monosyllabic nouns, a depressor or neutral word-initial consonant will produce a surface melody of Lo or Hi, whereas a raiser consonant will give a surface melody of M or Hi. The derivations of monosyllabic nouns are given in (18) and (19) and hybrid nouns in (20).

(18) Class A

Type (a) Underlying form Tonal default

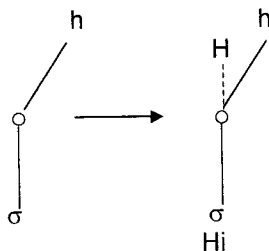
Lo
dol
'hard ground'



Type (d)

Underlying form Tonal default

Hi
nus
'a bit'



As with disyllabic nouns, class B monosyllabic nouns also have the addition of an H tone because of the raiser-initial consonant.

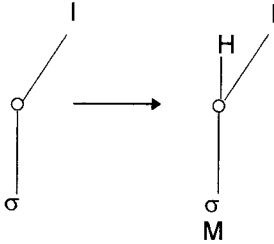
(19) Class B

Type (a) Underlying form Addition of raiser tone

M

kan

'water'



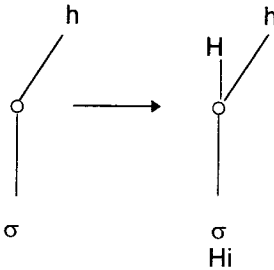
Type (d)

Underlying form Addition of raiser tone

Hi

soŋ

'bucket'



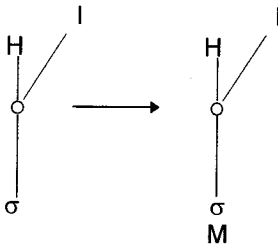
(20) Hybrid

Underlying form Tonal default

M

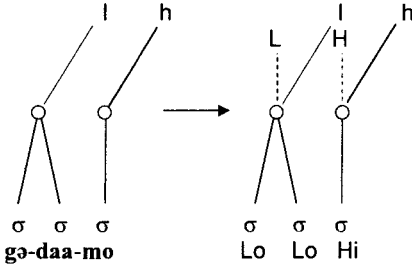
wag

'angry'

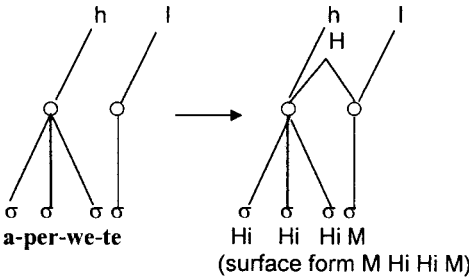


2.3.2 Multisyllabic nouns. For nouns of more than two syllables, the tone melodies are the same as for disyllabic nouns, except that the melody spreads throughout the word. The melody consists of at most two tones. All but the last syllable take the first part of the tone melody. The last syllable takes the second part. The only exception to this is that words cannot begin with three consecutive high syllables. Instead, the pitch on the first syllable drops to the equivalent of the M tone. I presume the existence of a late tone-lowering rule (perhaps ordered after tier conflation has taken place and possibly a variation of Meeussen's rule) which lowers a word-initial Hi to M in the presence of two following Hi tones. This represents a general restriction on the surface tone melody which is independently required. Derivations of multisyllabic nouns are given in (21) and (22).

(21) **gàdàamó** 'horse' (Lo Hi)



(22) **apérwéte** 'bracelet' (Hi M)



The tone melodies of three-syllable words are shown in (23).

(23)	Class A, neutral and depressor consonants				
	Lo Lo Lo	(i.e., Lo)	type (a)	dòrgòdì	granary
	Lo Lo Hi	(i.e., Lo Hi)	type (b)	gàdàamó	horse
	Hi Hi Lo	(i.e., Hi Lo)	type (c)	lólóki	stream
	M Hi Hi	(i.e., Hi)	type (d)	alúmá	market
	Class B, raiser consonants				
	M M M	(i.e., M)	type (a)	celeere	commerce
	M M Hi	(i.e., M Hi)	type (b)	kadəkáw	grass
	H H M	(i.e., Hi M)	type (c)	átóltom⁵	horn
	M Hi Hi	(i.e., Hi)	type (d)	kupúrkí	male goat
	Hybrid				
	M M M	(i.e., M)		bənwile	type of tree

The tone melodies of four-syllable words that have been attested are given in (24).

(24)	Class A, depressor and neutral consonants				
	Lo Lo Lo Lo	(i.e., Lo)	type (a)	gògòlògì	cock
	Lo Lo Lo Hi	(i.e., Lo Hi)	type (b)	àgòlògá	type of tree
	M Hi Hi Hi	(i.e., Hi)	type (d)	bakúdúrkí	type of bird

⁵ This is an example of a word beginning with a vowel where the first consonant is in front of the second syllable. It is still the first consonant which is relevant for the purposes of tone. In this case, t is the raiser.

Class B, raiser consonants

M M M M	(i.e., M)	type (a)	kaləmasi	shoes
M Hi Hi M	(i.e., Hi M)	type (c)	apérwéte	bracelet
M Hi Hi Hi	(i.e., Hi)	type (d)	atípíípá	rice
Hybrid				
M M M M	(i.e., M)		makurmusi	termites

For five or more syllables the same types of patterns are found. In compound words the original tone of the separate words is sometimes kept. Reduplication processes can affect the tone in a similar way. The treatment of these compounds and reduplicated forms is outside the scope of this article.

2.4 POLYMORPHEMIC NOUNS

2.4.1 Noun affixes. Kera noun affixes can carry high tone, low tone, or no tone. The affixes and tones are given in (25).

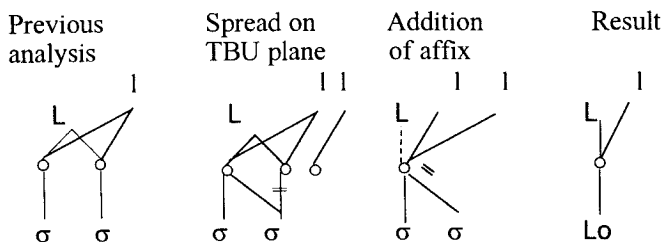
(25)	Noun affixes			tiinə-	forehead
	-n		1s possessive	tiinən	
	-m	+ low tone	2s m possessive	tiimim	
	-i	+ low tone	2s f possessive	tiini	
	-u		3s m possessive	tiinu	
	-a	+ low tone	3s f possessive	tiinə	
	-ə	+ low tone	used with áŋ, áre for 1p possessive	tiinə áŋ	
	-aŋ	+ low tone	2p possessive	tiinəŋ	
	-iy		3p possessive	tiiniy	
	-ŋ	+ high tone	definite article	kúrkíŋ	the bull
k-	-aw	+ high tone	plural	kadəkáw	grass

2.4.2 Inalienable possessives. The inalienable possessive affixes listed in (26) have the same morphological content as the object pronoun affixes on the verb. However, the tones are not always the same. The nouns which take inalienable possessives are mostly body parts, and they can be categorised according to the noun classes already discussed. The amount of body part data is limited so not all of the noun types are represented.

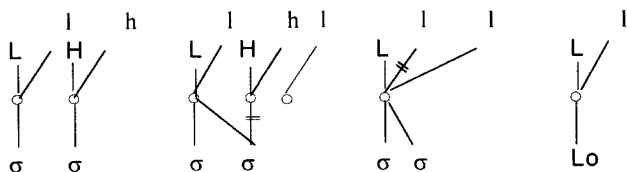
(26)	1s and 2s forms of inalienable possessives				
		1s form (-n)		2s form (-m, Lo)	
	Class A (a)	gəgəərən	my knee	gəgəərəm	your knee
	Lo → Lo	giidìn	my stomach	giidim	your stomach
	Class A (b)	dərən	my eyes	dərəm	your eyes
	Lo Hi → Lo				
	Class B (a)	tiinin	my forehead	tiimim	your forehead
	M → M	kosnon	my ear	kosnom	your ear
	Class B (d)	cəərən	my head	cəərəm	your head
	Hi → M	kúurən	my neck	kuurəm	your neck
		kún	my mouth	kum	your mouth
		káasən	my arm	kaasəm	your arm
		kámpárən	my leg	kamparəm	your leg

The affix for the first-person singular inalienable possessive is **-n**. The affix for the second-person inalienable possessive is **-m** with a low floating tone. In order to derive the second-person forms, the previous analysis of nouns is assumed. The low-tone affix is realised by the addition of an **l** feature on the register tier. The low tone then triggers a forward spread on the TBU plane which delinks the second node. The affix tone is then combined with the first node, and the previous feature is delinked. This process is shown in (27)–(30).

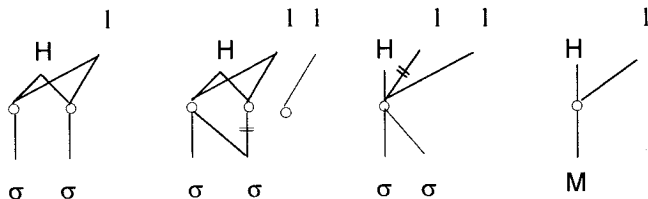
(27) **gùidim** ‘your (m) stomach’ $Lo \rightarrow Lo$



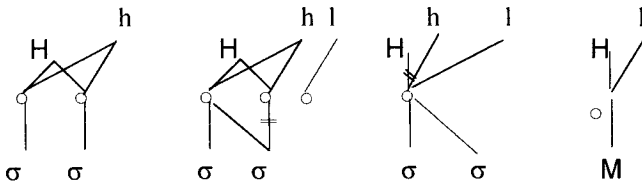
(28) **dàrà̀m** ‘your (m) eye’ $Lo Hi \rightarrow Lo$



(29) **tiinim** ‘your (m) forehead’ $M \rightarrow M$



(30) **cæ̀rəm** 'your (m) face' **Hi** → **M**



In (27)–(30), the principle of stray erasure is assumed, where features that have been delinked are removed. The above analysis explains the distribution of tone for all forms of the inalienable possessive suffix.

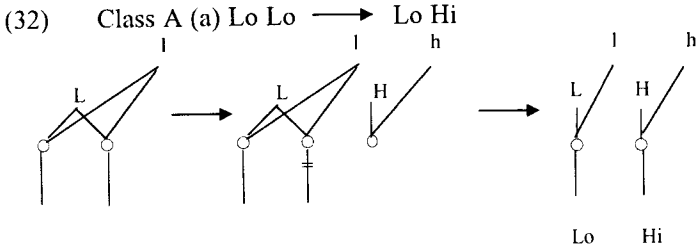
2.4.3 Definite article. The definite article is marked by a tone which is placed on the last vowel of the noun. On words which end in an open syllable, the noun also has an -ŋ suffix. The tone is realised by the feature *h* on the register tier and an *H* on the tonal tier of the final syllable, replacing the tone that was on this syllable. In the case of an *H* following an *H*, the affix then divides the word into two TBUs, and the feature on the tone tier of the second syllable is deleted and replaced with an *L*. This process is an example of Meeussen's rule as described by Goldsmith (1984). Meeussen's rule is a dissimilation rule which expresses that an *H* tone changes to *L* when another *H* precedes it. The result of this combination of features is sometimes an *h* feature combined with *L*. This produces a mid tone, *M*₂ which is illustrated in (6) of §1.1. This is not the same as the *M* which is referred to elsewhere in this article. For some speakers *M*₂ is realised at a pitch slightly higher than *M* so that generally it sounds like a mid tone but when adjacent to an *M* it sounds a little higher.⁶

(31) Definite article examples

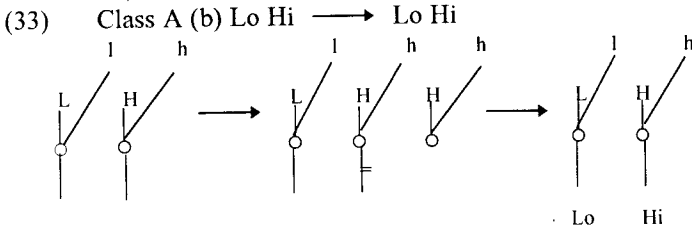
Class A (a)	bàaŋà	bàaŋáŋ	a / the elephant
Class A (b)	bòmbóm	bòmbóm	a / the sweet
Class A (c)	áŋà	áŋay	a / the hoe
Class A (d)	alúamá	alúma	a / the market
Hybrid	abalhē	abalhēŋ	a / the donkey
Class B (a)	kefter	kefter	a / the book
Class B (b)	seská	seskaŋ	a / the star
Class B (c)	árfe	árfeŋ	a / the tree (type)
Class B (d)	cúŋkúy	cúŋkuy	a / the spear

Examples (32)–(40) give the derivation for each noun type when a definite article is added. (Note that *HH* → *HL* following Meeussen's rule).

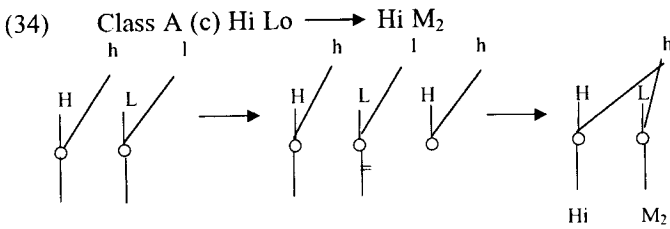
⁶ The tone for the definite article can differ from speaker to speaker, particularly in the pitch of *M*₂ which can vary from the pitch of *M* to the pitch of *H*. Also, for class A (b) the definite form can have a final tone marginally higher than the indefinite form. Some types include exceptions where one or both tones become high for the definite article form. These are all cases of the *M*₂ tone. Even for the same speaker, there is considerable variation on the pitch of this tone. This leads us to the conclusion that the *M*₂ tone is becoming less significant to Kera speakers and that a range of pitches are acceptable without any loss in comprehension. For a more complete list, see appendix 3. This list reflects the tone that was most frequently attested in each case, but every language helper gave a different combination of highs and mids on the *M*₂ tones.



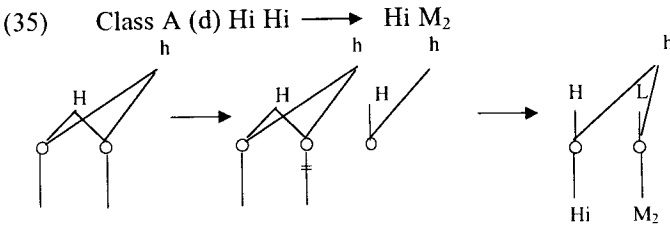
bàaṅà, bàaṅáṅ 'a, the elephant'



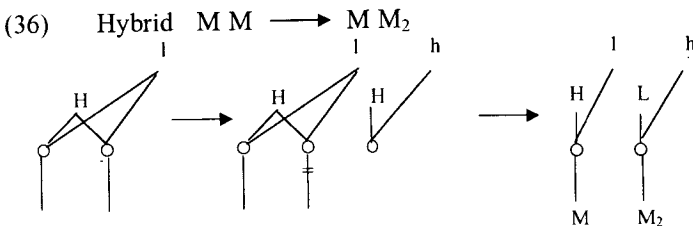
bòmóm, bòmóm 'a, the sweet'



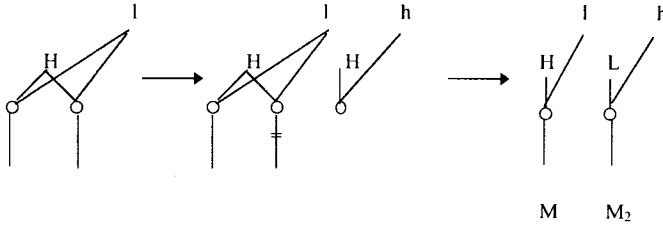
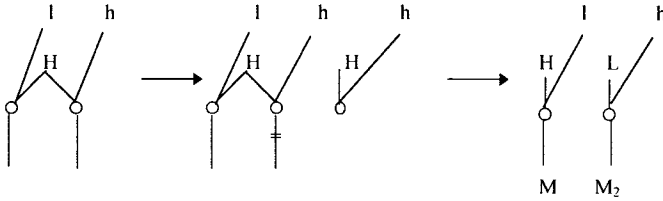
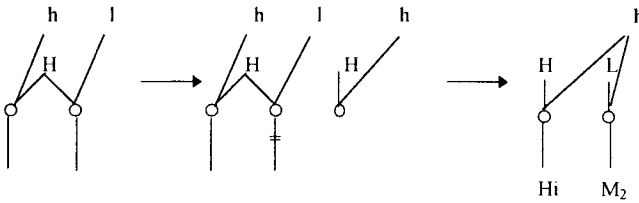
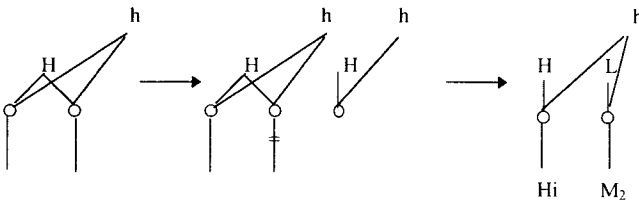
áḡà, áḡay 'a, the hoe'



alúma, alúmaṅ 'a, the market'



abalhě, abalhěj 'a, the donkey'

(37) Class B (a) $M M \rightarrow M M_2$ **kefter, kefter** 'a, the book'(38) Class B (b) $M Hi \rightarrow M M_2$ **seská, seskaŋ** 'a, the star'(39) Class B (c) $Hi M \rightarrow Hi M_2$ **árfe, árfeŋ** 'a, the (type of) tree'(40) Class B (d) $Hi Hi \rightarrow Hi M_2$ **cúŋkúy, cúŋkuy** 'a, the spear'

2.4.4 Plurals. Many nouns form the plural with no change from the singular form. Others introduce a completely new word. However, a small number form the plural with the addition of the prefix **k-**, the suffix **-aw**, and a high-register feature. The tone works in the same way as the definite article. The tone element of the plural affix is the addition of the feature **h** on the register tier and the feature **H** or **L** on the tone tier depending on the tone feature on the first syllable. Following Meeussen's rule, **HH** becomes **HL**. As with the definite article, the **M₂** tone can be pitched anywhere between **M** and **H**. As observed by Ebert (1979a), the added **k-** prefix tone is unpredictable between **M** and **H**. There are some morphological changes with words containing voiced consonants so that the **k-** prefix becomes **g-** with a low tone on the added vowel after the prefix. The **a**

vowel in the suffix can also have an effect on other vowels but this is not totally predictable. This does not affect tone.

(41)	Plural examples				
	Type (a)	dàygà	gədàyáw	jug(s)	Lo - Lo Hi
		jàaṅà	gəjàaṅáw	wooden stool(s)	
		gògòlògì	gàgàláw	cock(s)	
	Type (b)	hənjí	kàncáw	snake(s)	Lo Hi - Lo Hi
		gùugúr	gəgəgúr	chicken(s)	
	Type (c)	ágày	kəgəy	hoe(s)	Hi Lo - Hi M ₂
	Type (f)	kuuni	kəənuwaŋ	tool(s)	M - M M ₂
		koomom	kaamam	rat(s)	
	Type (g)	taatá	kətaataw	large pot(s)	M Hi - M M ₂
		saŋká	kəsaŋkaw	type of tree(s)	
	Type (h)	táasa	kətáasaw	bowl(s)	Hi M - Hi M ₂
	Type (i)	ďárká	kəďáraw	ant hill(s)	Hi Hi - Hi M ₂
		kóoyá	káaya	dog(s)	
		kúmná	kəkámnaŋ	chief(s)	
		kupúrkí	kəpáarkaw	male goat(s)	
		kúrkí	kərkəwaŋ	bull(s)	
		páká	kápkaw	sauce bowl(s)	
		táyá	kəyáw	bowl(s)	
		tártí	kətártaw	knife(s)	
		túrtí	kətártaw	canoe(s)	

3. VERB TONE

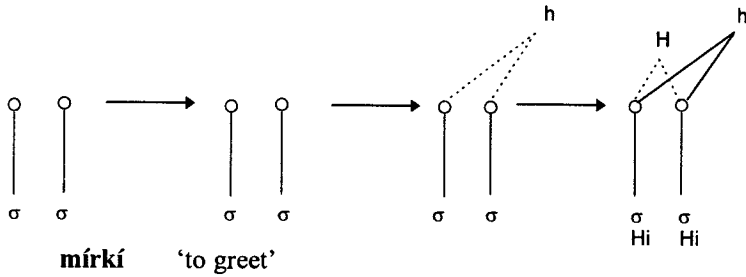
Kera consonants also affect the tone of verbs. Unlike the nouns, the surface tone patterns of verbs are completely predictable based on the consonants. Verbs have no underlying tone. There are three basic verb tone melodies: Hi, Lo, Lo Hi. For verbs, the depressor consonants **b d j g z v** and **h** have an effect on the tone. The feature **l** is introduced for words that begin with a depressor consonant, causing a Lo tone melody. In verbs with neutral or raiser consonants, a default feature **h** is added on the register tier. This gives the Hi tone melody for verbs with these consonants. The tone of vowel-initial verbs is not altered so these verbs also have the tone melody Hi.

The effect of a word-initial, depressor consonant is to change the register tier feature to **l** for the whole word, but if the second syllable also begins with a depressor consonant, or if the stem of the verb contains a consonant cluster, then the resulting pattern on the register tier will be **l h**. This gives the tone melody Lo Hi. The depressor consonant appears to raise the tone, but this process can be explained if we assume that the depressor consonant or consonant cluster causes the two nodes to be separated. Then the second register feature will be **h** following the obligatory contour principle described in §1.2. The default feature on the tonal tier will correspond to the register feature at the same node, as with nouns. Examples of the different verb types are given in (43) and the derivations of the basic verb tone melodies are given in (43)–(45).

(42)	Type (a)	Hi	mírkí	to greet
	Type (b)	Lo	gùni	to awaken
	Type (c)	Lo Hi	záldé	to hit

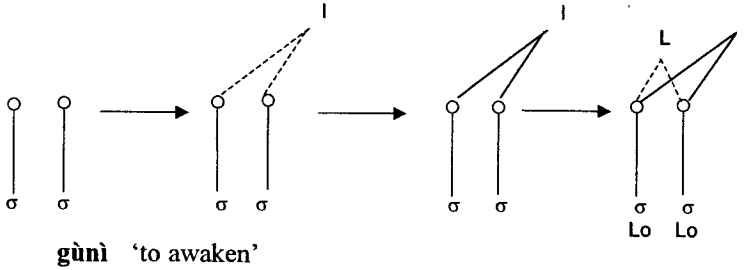
(43) First consonant neutral or raiser

Underlying form Consonantal tone Register default Tonal default



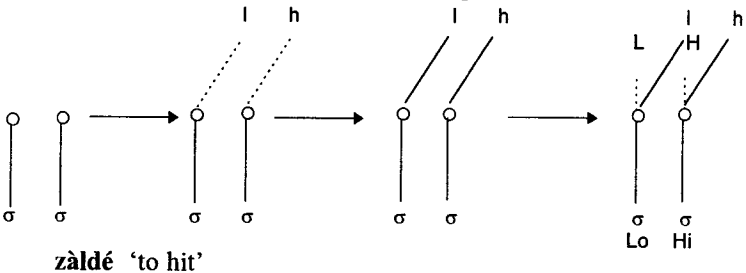
(44) First consonant depressor, second consonant neutral or raiser

Underlying form Consonantal tone Register default Tonal default



(45) First consonant depressor, second consonant depressor or consonant cluster

Underlying form Consonantal tone Register default Tonal default



3.1 THE ADDITION OF AFFIXES

Some verb affixes do not carry tone, but a number of direct and indirect object pronouns carry a low tone. This is realised by the addition of an l feature on the register tier.⁷

⁷ The analysis of verbs would also allow the affix tone to be interpreted as an L feature on the tonal tier, but if analysed as an l feature, the affix tone works in a consistent way on both verbs and nouns.

- (46) The basic verb affixes
- | | | |
|--------|------------|--|
| -n | + low tone | 1s direct object pronoun |
| -m | + low tone | 2s masculine direct object pronoun |
| -y(-i) | + low tone | 2s feminine direct object pronoun |
| -u | | 3s m direct object pronoun |
| -a | | 3s f direct object pronoun (vowel harmony rules can change this affix to -ə) |
| -ŋ | + low tone | 2p direct object pronoun |
| -y | | 3p direct object pronoun |
| -u | + low tone | 3s m indirect object pronoun |
| -a | + low tone | 3s f indirect object pronoun |
| -y | + low tone | 3p indirect object pronoun |
| -t- | | iterative |
| -ə | | imperfective, followed by 1p pronouns aŋ and are . Also following heavy stems (CVVC and CVVC) before a word break, e.g., in the imperative form. A low tone is normally present for verbs with depressor first consonants and heavy stems or depressor second consonants. ⁸ |
| -e | | imperfective with no pronouns |
| -ŋ | | perfective |
| -n- | | perfective in words containing pronouns |

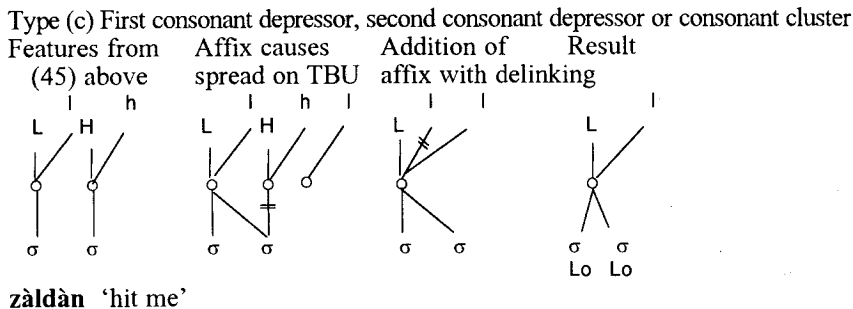
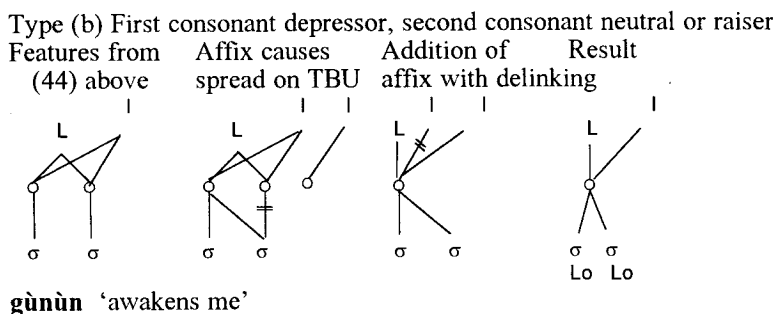
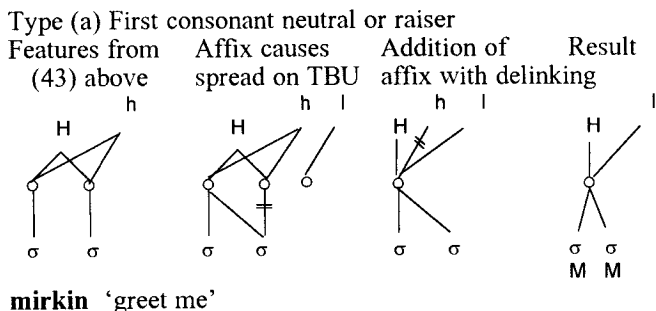
(47) Examples of basic verb forms

	Type (a)	Type (b)	Type (c)
	mírkí 'greet'	gùní 'awakens'	zàldé 'hit'
1	mirkin	gùnún	zàldàn
2m	mirkim	gùnúm	zàldàm
2f	mirkí(y)	gùní/gùnúy	zàldàý
3m	mírkú	gùnú	zàldú
3f	mírká	gùně	zàldá
1p inc	mirkə áŋ	gùně áŋ	zàldə áŋ
1p exc	mirkə áré	gùně áré	zàldə áré
2p	mirkíŋ	gùnúŋ	zàldàŋ
3p	mírkíy	gùnúy	zàldáy

As with the inalienable possessive affixes on nouns, the verb affix which carries a low tone will produce a total spread of the TBU features on the first syllable to all other syllables. This is followed by the addition of an l feature on the register tier delinking the register tier feature that is already there.

⁸ There are a few exceptions to this low tone rule: Some heavy stemmed verbs with a neutral or raiser first consonant still take a low tone (realised as M) with the -ə affix. These include, **mírkí** / **mírkə** 'to greet', **mánté** / **mantə** 'to call' and **waaté** / **waatə** 'to speak'. This could be because of the initial consonant being sonorant. Three monosyllabic verbs also take low tone with the -ə affix: **dé** / **dée** 'to go', **ké** / **kaa** 'to throw', **sé** / **saa** 'to drink'. (The variations in vowels in these examples reflect the root form of the verb). It could be relevant that all of these verbs end in -e but there is limited data for a firm conclusion. **hərsí** / **hərsá** 'construct' does not take a low tone with the -ə affix where one might be expected.

(48) Effect of a low tone affix (-n, 1s direct object)



With the derivations shown above for verbs with and without affixes that carry tone, all the major word-level tone melodies found in Kera verbs can be accounted for.⁹

4. EBERT'S ANALYSIS

Before making a comparison of the effect of consonants on tone in the Kera nominal and verbal systems, it is helpful to see what work has already been done by others. Karen Ebert studied the Kera language and wrote a phonology and grammar of Kera (Ebert 1979a) together with a lexicon, anthropological notes, and other papers on certain aspects of the language. Considering the limited time she had with Kera speakers, her

⁹ The tone of the verb can be affected by certain particles which appear in the clause, but that is beyond the scope of this article.

output has many comprehensive and valuable insights. However, some of her data do not match the data elicited for this article. That may be because of slight dialect differences. She refers to changes between voiced and voiceless consonants. The differences in data tend to be a question of voicing, tone, or length of vowel.

Certain aspects of Ebert's work are of particular interest to the present study. Her analysis involves three tones, H, M, and L, with several rules concerning the possible combinations of these tones. She offers minimal and analogous pairs of contrast between the tones although the case that she presents for a contrast between M and L is weak. In order to analyse the effect of consonants on tone, she divides the consonants into the three groups in (49).

(49)	a) voiced obstruents	b d j g v z	+ voiced –sonorant
	b) voiceless obstruents	p t c k ? ʃ f (s)	–voiced (–sonorant)
	c) sonorants	m n ŋ l r w y	+ sonorant (–voiced)

She claims that **h** acts as voiced and voiceless.

This is a helpful division of consonants for our analysis, but some changes do need to be made: Ebert considers **r** to be a sonorant, but in this article it is considered a flap and is not in the sonorant group of consonants. It behaves in the same way as the voiceless obstruents. In this article, **h** is placed with the voiced obstruent group.¹⁰ **s** has been found to be consistent with other consonants in the voiceless obstruent group. With these changes Ebert's group (a) can be renamed as depressor consonants, her group (b) as raiser consonants, and her group (c) as neutral in line with the analysis developed in this article. This division of consonants is particularly useful if group (a) is seen to affect the tone of verbs and group (b) the tone of nouns. Unfortunately, Ebert tries to make the same rules apply for both nouns and verbs, combining (b) and (c) as one group. This results in her being left with several exceptions to her rules.

Ebert's (1979a) analysis of consonants includes what she calls noun classes. She tries to make the system predictable but she has to concede a number of exceptions. It would be hard to argue for a system of tone that is totally predictable. Studies into the vowel quality or the heaviness of the syllable yield little fruit. The pairs of nouns in (50) show that it would be difficult to find any system which can predict all the surface melodies from the form of the noun. These words contrast the tones M and Hi.

(50)	Hi Hi	kókóy	bean	/	M M	kəkəy	path
	Hi Hi	páarám	scythe	/	M M	paara	oar
	Hi Hi	kókóy	bean	/	Hi M	ákay	viper
	M Hi	aká	field	/	Hi M	ákay	viper
	Hi Hi	áská	fish	/	M Hi	maská	the bush
	Hi Hi	kíntí	monkey	/	M Hi	kuntí	flour

Here we see that any analysis will need to include underlying tones or tone classes which are not predictable.

Ebert's analysis of the syllable structure includes her categories of C[+velar]+**ŋ** and C[+alveolar]+**n** as syllables. This becomes relevant as she claims that the syllabic nasal can carry a tone of its own which is different from the preceding vowel. My data does not seem to support this, and the best solution seems to be to treat the nasal as extrasyllabic. In the case where a nasal affix carries tone, that tone is transferred onto the preceding vowel.

In her analysis of verbs Ebert notes the influence of the consonants on the possible verb forms and this leads to the six tone patterns in (51).

¹⁰ There is only one word **háté** 'to teach' where **h** acts differently from other members of this group.

(51)			A	B
	Class	1	M(M)(M)	H(H)(H)
		2a	LL(L)	LH(H)
		2b	L(L)	L(L)

This analysis still stands, although Ebert does not explain clearly how to distinguish between verbs in 2a or 2b according to the consonants of the verb. B represents the standard forms of the verb, and this article analyses the A tone melodies as the results of the addition of an affix with tone. With slight alterations, Ebert's verb tone rules will produce the required results. Her rules are given in (52).

(52)	TON-R1	V	→	V / # C	—	C(C)V
		[-H]		[+H]		[-vd] [+H]
						[+son] ¹¹
	TON-R2	V	→	V / V C	—	
		[+H]		[-H] [-H]		[+son]
	TON-R3	V	→	V / # C	—	
		[-H]		[+L]		+vd
						-son
	TON-R4	V	→	V / V C(C)	—	
		[-H]		[-H] [-H]		
				αT αT		

These rules cannot be successfully applied to nouns as Ebert tries to do. She is forced to make the comment (Ebert 1979a) that many high tones within the range of the simple nominals are not explainable. Although the verb rules could stand largely unaltered, an autosegmental approach gives more insight into the processes involved and in particular, the model of tonal representation advocated by register tier theory can be used successfully for nouns, verbs, and affixes.

Ebert's rules become complicated for multisyllabic words where tone spreads from one syllable to another in certain circumstances only. In fact, the situation can be stated more simply: For noncompound nouns and all verbs there will be a maximum of two tones. For nouns the last syllable takes the second tone, for verbs the second and all subsequent syllables take the second tone. The one exception is in nouns of three or more syllables beginning with an H tone. Instead of three consecutive H tones, the first is lowered to an M tone.

Ebert describes in great detail the various forms of the inalienable possessives. She accounts for five tone melodies: M, H, MH, L, and LH. This article shows the need for other tonal melodies with nouns such as *súngu* 'coin' HM, *gégèl* 'basket' HL, and also H and M melodies with voiced obstruents such as *bályákí* 'type of bird' and *bənewle* 'type of bird'.

The above discussion has focused on aspects of Ebert's work which need more development in order to describe Kera tone adequately. However, it should be stated that her work provides a good foundation on which further study can be based. Her work on tone is just one aspect of a work that is informative and wide in its scope.

5. CONSONANTS AND TONE

We have seen in §§2 and 3 how nouns and verbs can be analysed using RTT. In both cases, a division of the consonants has been necessary. The division for nouns and

¹¹ [-son] would make more sense here. [-H] means M, or L if combined with [+L], but Ebert does not use the term M in her tone rules.

verbs is similar in some respects. It is the object of this section to consider the parallels and contrasts of the two systems and to discuss possible phonetic motivation for dividing the consonants.

5.1 COMPARISON OF NOMINAL AND VERBAL SYSTEMS

The comparison between nouns and verbs is best seen with the help of the table in (53).

(53)	Nouns	Verbs
	Class A (see (10)) Lo/Hi depressor consonants or neutral consonants	type (b) (see (43)) Lo depressor consonants lowers tone
	Class B (see (11)) M/Hi raiser consonants raises tone	type (a) (see (43)) Hi raiser consonants, neutral consonants, or vowel
	depressor consonants: neutral consonants: raiser consonants:	b d j g v z h m n ŋ l w y p t c k f s ɓ ɗ r

Class A nouns and type (b) verbs are similar in that the initial consonants are chosen from the voiced obstruents or **h**. Class A nouns can also begin with the sonorants. However, Class A nouns and type (b) verbs differ in that the tone of the noun is not effected by the consonants, while the verb tone is affected by the introduction of an **l** register feature which lowers the tone.

For Class B nouns and type (a) verbs, there is a similar correlation. Both groups take initial consonants from the voiceless obstruents, implosives, or **r**. Type (a) verbs can also begin with a sonorant or a vowel. The tonal melody cannot include a Lo tone. In this case however, the tone of Class B nouns is altered by the addition of an **H** tonal feature which raises the tone, while type (a) verbs remain unchanged.

From the above analysis we can see that there is a certain correlation in the effect of consonants on tone but that there are also contrasts between them. It needs to be remembered that nouns have underlying tones, whereas verbs do not. For the nouns the raiser consonants alter the tone. In the verbal system, the depressor consonants lower the tone. The fact that a different group of consonants is acting in the nominal system from the verbal system can be explained by looking again at the action of depressor and raiser consonants. Depressor consonants cause toneless TBUs to be realised with Lo tones. They therefore have no effect on nouns which already have underlying tones. The raiser consonants, on the other hand, cause Lo tones to be realised as M tones. They have no effect on toneless elements such as are found in verbs. If this is taken into consideration, the same system can be used to analyse verbs and nouns.

For type (c) verbs the depressor consonants do not always result in a low tone. In the second syllable, depressor consonants which would normally send tone down now result in high tone. This has been explained as the separation of the two nodes which then exhibit different tones following the obligatory contour principle (see §3).

(54)	Lo Hi	zògé	to push	hàgé	to cry
	Lo	zòorè	to sew	hàrè	to return

The inalienable possessives in the nominal system and the object pronouns in the verbal system both include an **l** register feature. The segmental material is the same for each person, and the tonal melody is largely the same. The similarity of the analysis for

the inalienable possessives and the object pronouns helps to support the argument for the analysis of verbs and nouns as presented in this article.

Having compared the two systems, we need to see the justification for dividing the consonants into three groups. In other Chadic languages where consonants affect tone, the consonants have been divided into two groups. A division into three groups is rare. However, it is hard to define the phonetic motivation for dividing the consonants into only two groups in Kera for the following reasons:

1. In nouns, tone is altered by the raiser consonants, whereas in verbs, the depressor consonants alter tone. It is, therefore, not possible simply to label one consonant group as affecting the tone.

2. Although voicing and nonvoicing can be used to determine the division of some of the consonants, other consonants do not always act in the same way.

3. The sonorants have no effect on the tone of nouns and verbs and cannot be placed in a 'high' or 'low' group. They are neutral.

For these reasons we cannot simply classify Kera consonants into two groups of depressor and raiser consonants as has been done in other Chadic languages. We can, however, divide them into three groups of depressor, raiser, and neutral consonants. We will consider the support for this division from other Chadic languages. We will also refer to other Chadic languages to find out if they also exhibit depressor consonants that seem to make the tone move both up and down.

5.2 EVIDENCE FROM CHADIC

In a number of Chadic languages, evidence has been presented of the influence of consonants on the tonal melody. In Podoko, for example, Anderson and Swackhamer (1980) offer an analysis of consonants as tone raising or tone lowering following the continuum constructed by Hyman and Schuh (1974). The continuum starts with implosives, through voiceless consonants, to sonorants, voiced obstruents, and breathy voiced consonants. Sonorants are considered to be neutral while the voiced obstruents and breathy voiced consonants lower the pitch. This continuum provides a useful argument for three consonant groupings in Kera: The implosives and voiceless consonants are raisers, the sonorants are neutral, and the voiced obstruents are depressors. Only **r** and **h** stand out as having unusual behaviour. **h** is presumably a depressor consonant because of its breathy nature. For Podoko it is argued that implosives, voiceless consonants, and sonorants are acting as neutral while the voiced obstruents lower the tone. Swackhamer (1991) sees Podoko verb tone as three phonetic tones which are analysed as two tones with depressor consonants. These consonants can change the tone register producing downstep in certain circumstances. Swackhamer (1989) shows that downstep in Podoko only affects low tones. Podoko and Kera show similarities in the number of tones and in the effect of voiced versus voiceless obstruents on the tonal system. According to Anderson and Swackhamer (1980) the nominal system has four underlying tone patterns of LL, HL, LH, and HH. This has parallels to the Kera nominal system.

It is not possible to say that all Chadic languages follow similar tone rules. In Mofu, for example, Barreteau (1988) analyses the high tone as an accent which may appear word initially, word medially, word finally, or not at all. There is no mention of consonants affecting the tone.

Schuh (1978) has observed the role of certain classes of consonants in determining tone. In Bade and Bolanci the Hi tone spreads except when the Lo syllable begins in a nonglottalized voiced stop. In Ngizim he concludes that a voiceless or glottalized obstruent in syllable-initial position prevents Lo spreading taking place. This could be used to support the case for raiser consonants.

Barreteau and Dieu (1984) have made some helpful observations on Masa tone. In Masa, the strong consonants correlate with a higher tone. The effect is that weak consonants correlate with L tone while strong consonants correlate with M tone as in Kera. The weak consonants include voiced plosives and fricatives while the strong consonants include all the others. In Kera, Ebert (1979b) also chose to divide the consonants in the

same manner naming the voiced obstruents as lenis and the others as fortis or sonorant. In this article we have seen that there are two different groups of consonants changing the tone for nouns and verbs and a third group that does not change tone so that terms such as weak and strong are best avoided when describing Kera.

It is helpful to compare the division of consonants in other Chadic languages with that suggested in Kera:

(55) Consonants in Chadic languages

Podoko (Swackhamer 1991)

Depressor consonants: **b d dz g gw mb nd ndz ng ngw v z ʒ**

Neutral consonants: **implosives, sonorants, and voiceless obstruents**

Masa (Barreteau and Dieu 1984, Wolff 1987)

Weak consonants: **b v d ʒ j z h**

Strong consonants: **p t c k f ṭ s h m n ŋ b dʔ r y w l**

According to Wolff 1987, nasal plosives are neutral

Dangaleat (Burke(1995)

Depressor: **b d j g b dʔ**

Neutral: **p t c k s z m n ŋ w y l r**

Ewe (non Chadic) (Welmers 1973)

A consonants (depressor in nouns): **b d dʔ dz g gb v̄ v z h**

B consonants (low tone with some prefixes): **t ts k kp ʃ f s x**

C consonants (nondepressor in verbs): **w l y y m n ŋ**

Kera

Depressor consonants: **b d j g v z h**

Neutral consonants: **m n ŋ l w y**

Raiser consonants: **p t c k f s b dʔ r**

Wolff (1987) documents fifteen Chadic languages that have consonant-tone interference and offers some similarities with the Kera system so that the idea of depressor, raiser, and neutral consonants is not too far removed from them. The Ewe consonant division shows that a three-way split is possible. A three-way split is also seen in Masa, Mesme, Musgu, and Lame according to Wolff.

We have considered the division of consonants into two or three groups. We also need to address the problem of depressor consonants that seem to cause a raising of the tone in the Lo Hi verbs. Podoko has an interesting variant in its verbal system: As Anderson and Swackhamer (1991) state, "The same consonant influence on tone register is also operative with verbs. What is striking about this correlation, however, is that syllables with a depressor consonant are realized on high tone (with downstep of low tone following) instead of the more expected low tone." We see from this that Kera is not the only Chadic language to have the depressor consonants affecting the tone in two directions.

Dangaleat has a system that differs from Kera in many respects, but Fedry (1974) has observed certain characteristics which are significant in the present discussion. As in Kera, the Dangaleat tone is more significant on a morphological level than on a lexical level. There are not many minimal pairs, and intonation can affect the tone. The surprising discovery in Dangaleat is that, in comparing two dialects, there is a systematic tonal divergence in all areas of the language and that the same morphological phenomena can be marked by tone in both cases but with the opposite mark. This observation gives further support for the consideration of Kera Lo Hi verbs where the tonal pattern seems to be the reverse of the normal pattern. The same consonants can at times send the tone up instead of down.

5.3 PHONETIC EVIDENCE

When consonants and tone interact there seems to be general agreement that the voiced obstruents have a tendency to lower the tone while other consonants are either neutral or raise the tone. We have seen that the choice of consonants in any given group is not consistent across all Chadic languages. We now consider the phonetic motivation for placing consonants in a particular group.

Many linguists have investigated how certain types of consonants can affect tone. Hyman and Schuh (1974), Hyman (1975), and Maddieson (1979) acknowledge that voiced obstruents can block the spreading of a H tone, and a voiceless obstruent can block the spreading of a L tone, with sonorants as neutral. Hyman (1976) states that "consonant types affect tone but tone does not affect consonant types." Ohala (1973) suggests that small pitch perturbations following certain consonants may develop over time into a major acoustic cue, even to the point where the tone distinction on the vowel becomes more important than the voicing of the preceding consonant. This is relevant to the loss of voicing contrast that occurs in final syllables of some Kera nouns.

Hombert (1978) has conducted experiments to explain why consonants can affect tone. He favours an explanation based on muscular tension. Hyman (1975) and Halle and Stevens (1971) also propose an explanation based on the tension of vocal cords, where high tone and voiceless obstruents have stiff vocal cords and low tone and voiced obstruents have slack vocal cords. Sonorants and mid tone are considered to have vocal cords in a neutral state. Hyman also offers other explanations such as the differences of larynx height or the rate of air flow through the glottis. Each of these proposals is offered to explain an observed distinction in several languages between the effect of voiced obstruents, sonorants, and voiceless obstruents on tone.

Greenberg (1970) considers the case for implosives, stating that they are "always less productive of tone lowering than the corresponding plain voiced stops." He claims that their effect is identical with or similar to that of voiceless consonants. Kaye (1981) concludes that implosives should be treated as liquids. Whichever of these views is accepted, there seems to be wide evidence that the implosives are to be placed in the group which is either neutral or raiser, contrasting with the voiced obstruents which regularly lower the tone. The Kera data appears to support the view that implosives are to be treated as voiceless obstruents.

In as far as Kera consonants divide along these lines, there is considerable backing for the analysis that has been presented. However, the phonetic motivation for the reverse effects in Lo/Hi verbs is hard to explain. A phonetic motivation for the fact that the consonant split is not the same in verbs and nouns is also difficult. This can only be explained in terms of different underlying forms for nouns and verbs. The flap *r* is also placed in an unexpected group. *h* can possibly be explained as acting like a voiced fricative. The glottal could be considered neutral or raiser, in line with the implosives. Data only exists to show that it is not a depressor consonant. From the point of view of a phonetic explanation, these questions remain unanswered.

6. CONCLUSION

In this study, we have seen that the tone of the vast majority of Kera nouns can be analysed effectively with the use of the register tier theory. To do this we have divided the consonants into three groups according to voicing and sonorance. It has been shown for nouns that there are four major tone melodies. The basic melodies have been derived from the underlying forms on the register tier of *h l*, *l h*, *l*, and *h*, as seen in class A nouns. In addition, this melody can be higher if the first consonant is a raiser consonant, forming four additional tone melodies for class B nouns. There is another tone melody for the nouns in the hybrid group which can be explained by an underlying tonal feature. Regardless of the number of syllables in the noun, this analysis can still be applied. For verbs there is no underlying form, but there are three surface melodies, Lo, Hi, and Lo Hi which result from the combination of consonants. An initial, depressor consonant will

lower tone, but two depressor consonants result in the Lo Hi tonal melody. This analysis has been developed to include affixes for nouns and verbs with affixes which carry a register tone feature. Questions have been raised concerning the phonetic motivation for the consonants in each group with reference to other Chadic languages, and the views of other linguists have been presented to support the conclusions that have been reached.

This article provides a new body of data for those who are interested in the correlation between consonant types and tone and a theory that could be helpfully applied to other similar languages. It is to be hoped that the analysis which has been offered will shed light on the tone systems of other Chadic languages and that the register tier theory will be applied to these languages.

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APPENDIX 1. NOUN DATA

DEPRESSOR OR NEUTRAL FIRST CONSONANT

Class A (a) - underlying form \emptyset , surface form Lo

1 syllable:

bàl	credit, debt	vèw	bird trap
dòl	hard ground	vòr	lake / river
		zàl	potion

2 syllables:

àbày	strong, rich man	gògò	lion / insect
àgəŋ	sling	gùdùl	song
àvà	melon	gùrgùm	gourd
àwàl	season - end of rain	gìsì	mat
bààŋà	elephant	gòdnòy	type of ant
bèebè	baby	gòorò	lump on back
bàəbù	thorn	gòrnòy	hyena
bəgàr	antelope	hòdì	big jug
bəŋàŋ	big hoe	hòynà	spirit / tamtam
bòobè	cold season	hùlùm	man
dàarə	friend	jàaŋà	stool, seat
dàygà	jug	làagà	type of knife
dəmàl	drum	làbì	enclosure
dòŋlòŋ	yellow millet	màanà	second wife
dòrdə	throat	màawày	bronze
dùglà	mouse	màrlà	vulture
gèdèl	mud, clay	màrvà	guilt
gòlòŋ	pond	mòomò	spirit

3 syllables:

àbəŋjì	type of plant	dòrgòdì	granary
àbùulùm	plant	gəjəmràw	plant
àdiidə	grandmother	gərgəwà	gourd
àgàmlà	ram	gòdòodò	water bird
àgèdè	plant	gùdùrgùm	indigenous salt
àgèjè	musical bells	gəgəər	knee
àgəyàm	chain	gùidə	stomach
àjèedà	frog	hòdòrò	car
àjùjùn	fable	màaŋbì	strong drink

àzàlnàm	hunt (in April)	màntàràw	pigment
dàmàèmmè	cloth	mòlòrò	nomads
dìdìgì	chest	zàwzàwnà	women's spirit
4 syllables:			
àgònògì	grudge	àhòrhòrò	type of bird
àgùlùurù	locust	àzìmzìmà	horn

Class A (b) - underlying form \emptyset h, surface form Lo Hi

2 syllables:

àbá	father	gùbú	jug
àgál	direction/part of	hàmé	food
àgáw	teacher, official	làkól	school
bìsíl	type of tree	làmbá	tax
bòmóm	sweet	làmsón	church
gèḡé	men in bush	lèmún	lemon
gèḡúr	new year	màská	the bush
gòḡgónḡ	barrel	mèsár	white person
gùḡbúl	tree stool	mìdí	miracle
gùugúr	chicken	mìndíl	head scarf
gùndí	harp	mòmó	grandfather
hàgè	funeral	nàaná	aunt (term of address)
hàrgá	goat	nèəní	uncle (term of address)
hèlḡá	woman	vèḡé	appearance
hènḡí	snake	vìigím	bellows
bòomé	game	wàynó	bread like roll
gòoró	cola	zèbúl	soap

3 syllables:

àdèegá	wild onion	dèbèḡgá	cold
àgùmgúm	type of plant	dèbèrgá	hen
àdìglá	type of tree	gèḡàamó	horse
àgòomó	type of tree	gìḡiwgí	thorny tree
àgùrá	warrior	nèrtítí	devil

4 syllables:

àbàwàrká	type of tree	àgòlògá	type of tree
àbèdèfí	light soil	gògòlògí	cock
àdèràpká	mud in dry pond		

Class A (c) - underlying form h \emptyset , surface form Hi Lo

2 syllables:

ábày	sacrifice to spirit	lógòm	humidity
ágày	hoe	máahùr	low flute
ágùm	spy	máalàḡ	crab
áwàl	end of rainy season	mésèw	adultery
gégèl	basket	zógòy	exorcism
lámjà	lamp		

3 syllables:

lólóki stream
mántáhàn sack
má láagà belt of war

múlúfi pasture
wácíyà sneeze

5 syllables:

máécókmáécóki poison

Class A (d) - underlying form h, surface form Hi

1 syllable:

nús a bit

2 syllables:

lésé suffering
lóoné big jug
mántá salt

wáalé joy
wálká fear
wéldé lightning

3 syllables:

ábáagú dove
álúmá market
ávété hare
ázáaná matchstick

bályákí type of bird
gúdúudú type of bird
lákérlé key
má yfáatá dried carp

4 syllables:

ágárgará type of bird

bákúdíkrí type of bird

Hybrid - underlying form Ø on register tier, H on tonal tier, surface form M

1 syllable:

men festival
waj anger

yaw pelican

2 syllables:

jonjon camel
laawe sadness

lewlew summit
maswan prostitute

3 syllables:

abalhē donkey
adidil musical instrument
agerhē donkey
agorhōy small stone for game

bānewle type of bird
muryuki temporary shelter
yakorte machete

4 syllables:

makurmusi termites

RAISER FIRST CONSONANT**Class B (a) - underlying form Ø, surface form M**

1 syllable:

kan water
kil charcoal

son oil
tay hunger

kor blood
pur boy
so ball of porridge

tər girl
tim big drum
tum bee

2 syllables:

ḃəraw type of bird
ḃooro bow and arrows
kaanə people of
kefter book
kelew horn
kəkəw oven
kəkəy path
kəlam basket
kolor type of tree
koŋkoŋ type of tree
koomom rat
kormə child
kosi shoulder
kuli house
kulur turtle dove
kuuni pot / tool
paŋe river
paara paddle / oar

paatal needle
paawar type of tree
parway flute
pasi type of antelope
pəru rainy season
pəyaw guinea fowl
saama rope
siwga termite hill
sodi dirt
sooto soldier
sukli fence
takla hammer
tərnə daughter
tiilim heart
tilmə darkness
titir drum
tukur flat basket

3 syllables:

acecew type of tree
aceera type of bird
acuuci type of ant
ataaya kitchen

celeere commerce
kurmuɣu his son
səbaki power
tatakam tool

4 syllables:

acakadi forked branch
akockoco shaker
akorkoro duck

akurkutu plant
kaləmasi shoes

5 syllables:

atəkorkora shell used as spoon

Class B (b) - underlying form Ø h, surface form M Hi

2 syllables:

aká field
akáar parents-in-law
kalsóŋ shorts / pants
karmán thing
karót carrot
kaskó bird
kaykó dry season
kəmkám twins
kəsdám pottery tool
kolbóy sesame
kuntí flour
saŋká type of tree

seeká type of plant
seŋká earth
seská star
sərkó maliciousness
siḃí dusk
siipó yeast
taatá large jug
teḃká type of tree
temlé granary
tetkér tomb
təsú stem
tiikó squirrel

3 syllables:

kaðəkáw	grass	pærəŋkí	old man
keserðéŋ	type of bush	səəmərəká	type of tree
kəmaará	divination	sətərəká	small bird
kəraŋkáw	fishing nets	təkərəká	plant
kocómčóm	hedgehog	tələŋká	hole
koocé	snail		

Class B (c) - underlying form h Ø, surface form Hi M

2 syllables:

ákay	viper	péɛŋel	plant
árfe	type of tree	Pépeŋ	God
fárta	wrap around skirt	púugul	type of plant
kérlew	bowl	séɛŋe	plant
kájəm	thorns	súŋgu	coin
kópaŋ	tree	táabul	table
kítir	moon / month	tákra	porridge
kóslom	laziness	tátkam	handle of hoe
kúmli	type of tree	tápay	thunder
páklam	handcuffs	tósoŋ	sore
párdəŋ	foreigners	tóʔos	custom

3 syllables:

átəmu	type of bird	kórófi	place for animals
átərləw	type of plant	kóyóki	catfish
átóltom	horn	kúŋúdí	axe
kəkábi	peace	pədəki	light
kəsáabo	grasshopper	púráanul	young man
kódósi	millet shell	sáatəraw	cat

4 syllables:

ápérwéte	bracelet	áfúlfúla	type of tree
ápéptéte	cooking tool	átáaləwa	flute
ápələncew	type of bird		

5 syllables:

áfétáféti	fan for fire
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Class B (d) - underlying form h, surface form Hi

1 syllable:

sóŋ	bucket
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2 syllables:

áská	fish	kóoyá	dog
cúŋkúy	spear	kópé	prostitution
ðárká	ant hill	kóróy	ashes
káarəŋ	goats	kúrkí	bull
káasáw	millet	kúmná	chief
kéeré	sacrifice	páarám	scythe
kéŋkéŋ	small bowl	pəŋáy	jaw
kəcəcəŋ	cows	pərkí	mountain

káḏwáy	festival	sárdá	type of tree
káḓtí	judgment	séngé	mosquito net
káḓwá	fishing basket	súlkú	guinea fowl
kákál	brain	támká	slave
kákáw	flies	tálká	termite hill
kámár	children	tómóḡ	type of millet
kámsí	ashes and water	tórtí	knife
káráḡ	women	tárwá	dust
kásár	veins / roots	tíiwá	white clay
kásáy	wood at entrance	títí	corpse
kásáw	sauce	tóomá	type of big snake
kásóḡ	teeth	tótká	papaya
káskáḡ	bones	túkúr	woven tray
kíirí	beans	túrtí	boat
kíntí	monkey	túuní	hippopotamus
kókóy	nut / bean		

3 syllables:

ácúkúr	enemy
átémé	onion
átíktíw	grain
kákámná	chief
kárkówá	bull

kásárpáḡ	placenta
kúkúyú	orphan
kúpúrkí	male goat
télééré	drum / plant

4 syllables:

ácéḡléere	plant
átípíipí	rice

ápáḡḡí	type of bird
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APPENDIX 2. SELECTED VERB DATA

Note: There are a number of vowel harmony rules governing verb forms. It is beyond the scope of this article to include them here. For more details refer to Ebert (1979a). The listing given here is according to tone. A hundred representative verbs have been selected. Verbs are given with their stems and translation.

Out of the verbs given below only one does not fit the analysis presented in this article: **háte** 'to teach'. **h** would normally imply low tone.

HH					
ámé	am-	to guard	lé	laa-	to hit
ásé	as-	to know	lébé	laḡ-	to die of starvation
áwé	aw-	to fall	lépé	lap-	to weave rope
áyé	ay-	to give	lóḏé	loḏ-	to dampen
ḡélé	ḡal-	to nail	mánté	mant-	to call
céwé	caw-	to arrange hair	mélé	mal-	to place
écé	ec-	to grind	mí	məə-	to wait
ántí	ənt-	to tie up	mírkí	mirk-	to greet
épé	ep-	to pound	náaké	naak-	to disintegrate
ḏé	ḏee-	to go	pété	pet-	to pluck
ḏélé	ḏal-	to provoke	pí	pəə-	to remove
ḏí	ḏuu-	to draw water	sé	saa-	to drink
ḏíki	ḏək-	to think	séelé	seel-	to pour

dóké	dok-	to manage
dóoté	doot-	to touch
faaké	faak-	to rest
félé	fal-	to find
fúulí	fuul-	to blow on fire
háté	hát-	to learn/teach
ískí	ask-	to tie up
ké	kaa-	to throw repeatedly
kédé	kaɗ-	to cultivate
kélé	kal-	to go beyond
kí	kuu-	to burn
kóoré	koor-	to leave
kósé	kos-	to approach
kó?é	ko?-	to winnow sesame
kúlí	kul-	to wrap up

sépé	sep-	to satisfy
sété	sat-	to wipe
táaké	taak-	to leave
téké	tak-	to gather nuts
tésé	tas-	to break by hitting
téwé	taw-	to finish
tópé	top-	to fish
túukí	tuuk-	to arrive
tú?í	tu?-	to hit millet
wáaté	waat-	to speak
wédé	wad-	to prepare porridge
wélé	wal-	to lighten
wéré	war-	to dry in sun
wítí	wæt-	to winnow
yáaké	yaak-	to leave

LL

bèlè	bal-	to love
bì	bəə-	to come
bìŋi	bəŋ-	to open
bòomè	boom-	to amuse
dè	doo-	to grab
dèfè	daf-	to prepare
dèrè	dar-	to put on
dèyè	day-	to grow
gè	gaa-	to throw/send
gèyè	gay-	to tire
gòlè	gol-	to look at
gùnì	gun-	to awaken
gùsì	gus-	to buy
hàmè	ham-	to eat
hàrè	har-	to return

hè	haa-	to pick up
hì	həə-	to spend the night
hòlè	hol-	to skin
hùmì	hum-	to carry
jè	jaa-	to break
jèèrè	jeer-	to write
jègè	jag-	to attach
jèmè	jam-	to cut
jèŋè	jen-	to break
jì	jəə-	to do
jò?è	jo?-	to sow seeds
vèrè	var-	to choose
zèlè	zal-	to cook
zòorè	zoor-	to sew

LH

bàadé	baad-	to wash
bàrgé	barg-	to break off
bàkɗí	bəkɗ-	to dig
bèsé	bas-	to eliminate/hurt
bìdí	bəd-	to unattach
gèlgé	gelg-	to tickle
gòldé	gold-	to seek
hàgé	hag-	to cry
hàrwé	harw-	to sweep

hàydé	hayɗ-	to roll
hèrdé	herɗ-	to eat raw food
hàrgí	hərg-	to dance
hàrsí	hərs-	to construct
hàrtí	hərt-	to crawl
jèbré	jebr-	to listen carefully
vàəgí	vəəg-	to pardon
zàldé	zald-	to hit
zògé	zog-	to push

APPENDIX 3. DEFINITE ARTICLE DATA

Class A (a):	àgègáy bàaṅà bəgàr bənàṅ dəbərgə dòṅlòṅ dùglà gàrdà gèdèl gòrnòy hòdì hùlùm	àgègáy bàaṅáy bəgàr bənáy dəbərgáy dòṅlón dùgláy gàrdáy gèdél gòrnóy hòdíṅ hùlúm	a stone / the stone an elephant / the elephant an antelope / the antelope a hoe / the hoe a chicken / the chicken millet / the millet a mouse / the mouse millet / the millet mud / the mud a hyena / the hyena a jug / the jug a man / the man
Class A (b):	bòmbóm gòṅgón gùbú gùdbúl gùugúr həlgə hənjí lèmún sòlòy wəynó	bòmbóm gòṅgón gùbúṅ gùdbúṅ gùugúr həlgón hənjíṅ lèmún sòlón wəynón	a sweet / the sweet a drum / the drum a jug / the jug a tree stool / the tree stool a chicken / the chicken a woman / the woman a snake / the snake a lemon / the lemon money / the money a bread-like roll / the bread-like roll
Class A (c):	ágày lámpan mulúfi	ágay lámpan mulúfiṅ	a hoe / the hoe a lamp / the lamp pasture / the pasture
Class A (d):	alúamá azáaná lésé mántá mayfáatá wáalé wáalká <i>exceptions:</i> abáagú wéldé	alúman azáanaṅ léseṅ mántaṅ mayfáataṅ wáaleṅ wáalkaṅ <i>exceptions:</i> abáagáy wéldéṅ	a market / the market a matchstick / the matchstick suffering / the suffering salt / the salt a dried carp / the dried carp joy / the joy fear / the fear a cat / the cat lightning / the lightning
Hybrid:	abalhě bənewle makurmusi maswan <i>exceptions:</i> ɓərəw joṅjoṅ wəṅ	abalhěṅ bənewleṅ makurmusiṅ maswan <i>exceptions:</i> ɓərəw jónjón wáy	a donkey / the donkey a bird (type) / the bird (type) termites / the termites a prostitute / the prostitute a bird (type) / the bird (type) a camel / the camel anger / the anger
Class B (a):	ataaya celeere kefter	ataayan celeereṅ kefter	a kitchen / the kitchen commerce / the commerce a book / the book

kinin	kinin	a tablet / the tablet
kuli	kuliŋ	a house / the house
<i>exceptions:</i>		
ḡooro	ḡooróŋ	a bow and arrows / the bow and arrows
koomom	koomóm	a rat / the rat
tarna	tarnáŋ	a plant (type) / the plant (type)
paara	paaráŋ	an oar / the oar
paatal	paatál	a needle / the needle

Class B (b):	seská	seskaŋ	a star / the star
	kadəkáw	kadəkaw	grass / the grass
	kalsóŋ	kalsoŋ	pants / the pants
	kaskó	kaskoŋ	a bird / the bird
	sanjá	sankaŋ	a tree (type) / the tree (type)

Class B (c):	árfé	árfəŋ	a tree (type) / the tree (type)
	akórkóro	akórkóroŋ	a duck / the duck
	apérwéte	apérwéteŋ	a bracelet / the bracelet
	fáрта	fártəŋ	a wrap-around skirt / the wrap-around skirt
	kérlew	kérlew	a bowl / the bowl
	kəbaŋ	kəbaŋ	a tree / the tree
	kítir	kítir	a month / the month
	kúmlí	kúmlíŋ	a plant (type) / the plant (type)
	kúŋúdí	kúŋúdíŋ	an axe / the axe
	púugul	púugul	a plant (type) / the plant (type)

Class B (d):	cúŋkúy	cúŋkuy	a spear / the spear
	kéŋkéŋ	kéŋkeŋ	a small bowl / the small bowl
	kəkáw	kəkaw	an oven / the oven
	kəsáw	kəsaw	a sauce / the sauce
	kókóy	kókoy	a bean / the bean
	kóoyá	kóoyəŋ	a dog / the dog
	lóoné	lóoneŋ	a big jug / the big jug
	páaram	páaram	a scythe / the scythe
	sáldé	sáldəŋ	sugar cane / the sugar cane
	táklá	táklaŋ	a hammer / the hammer
	táməŋ	táməŋ	millet / the millet
	tártí	tártíŋ	a knife / the knife
	tóomá	tóomaŋ	a python / the python