Underlying Word-final Plosives in Caning, a Nilo-Saharan Language of Sudan

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1 Introduction

Caning, or Shatt, is a Nilo-Saharan, Eastern Sudanic language of the Nuba Mountains in Sudan. It is closely related to Daju and Logorik. Caning is endangered in that only 30,000 people speak the language, and many indigenous languages of the region have undergone significant language shift to Arabic.

Little has been written about Caning. However, Boyeldieu describes what he calls 'modified forms' of Caning nouns. He writes about them in their morpho-syntactic context, and compares them with equivalent forms in Daju and Logorik. This paper discusses the morphological alternations of these modified forms and determines the underlying form of word-final plosives.

The data for this paper were collected during a grammar/orthography training workshop in August in Yida, South Sudan. About 650 nouns were collected among other words.

In Caning, all word-final plosives surface as voiceless and unreleased. This in itself is not evidence for underlying word-final voiceless plosives, because at least one Eastern Sudanic language has voiceless unreleased word-final plosives that are underlyingly *voiced*. Gaahmg is analyzed to have devoiced unreleased dental plosives that are underlyingly voiced in word-final position.

In Caning, when morphemes follow stem-final plosives, the plosives surface as either voiced or voiceless, depending on the morpheme. In (1), the same morphemes follow two different nouns. In 'stupid person' there is sometimes a voicing alternation for the root-final plosive, but not in 'house' for the root-final fricative.

(1) Word-final t/d̥ˀ and x

[aɓa**t**/**d̥**ˀ]	'stupid person'	[a**x**]	'house'
[aɓa**d**iɲ]	'stupid people'	[a**x**iɲ]	'houses'
[aɓa**t**ani]	'there is a stupid person'	[a**x**ani]	'there is a house'
[aɓa**t**anaŋ]	'this is a stupid person'	[a**x**anaŋ]	'this is a house'
[aɓa**d**ɔŋ]	'this stupid person'	[a**x**ɔŋ]	'this house'
[aɓa**d**əma]	'his stupid person'	[a**x**əma]	'his house'

In addition, a root-final plosive does not alternate the same way in all nouns before these morphemes. The root-final plostive of 'stupid person' is [d] before some morphemes and [t] before others, but in 'bowl' alway surfaces as [t].

(2) Word-final t/d̥ˀ

[aɓa**t**/**d̥**ˀ]	'stupid person'	[sa**t**/**d̥**ˀ]	'bowl'
[aɓa**d**iɲ]	'stupid people'	[sa**t**u]	'bowls'
[aɓa**t**ani]	'there is a stupid person'	[sa**t**ani]	'there is a bowl'
[aɓa**t**anaŋ]	'this is a stupid person'	[sa**t**anaŋ]	'this is a bowl'
[aɓa**d**ɔŋ]	'this stupid person'	[sa**t**ɔŋ]	'this bowl'
[aɓa**d**əma]	'his stupid person'	[sa**t**əma]	'his bowl'

So the question to be answered in this paper, using other evidence, is "Are word-final plosives underlying voiced, voiceless or either?" My answer will be that there is sufficient evidence to claim that all word-final plosives are underlying voiceless. We begin with consonant phonology, including the main evidence in support of underlying word-final voiceless plosives. Later, we'll return to the data of (2) and propose underlying forms that result in their surface forms. Throughout the presentation, all data is

written in the proposed underlying form unless in brackets which indicate the surface form. You will notice there are no tone markings. That's because Caning is a stress language, rather than a tone language. In Caning, stress is contrastive, but there are few if any stress minal pairs, and I have not marked stress in the data.

The 23 consonant phonemes of Table 1 are found in Caning. Note that there are both voiced and voiceless alveolar and velar plosives, but there are only voiceless labial and palatal plosives. Also note that the phonetically voiced alveolar flap can be analyzed as a voiceless approximant, since it functions as a voiceless consonant in roots and across morpheme boundaries.

Table 1: Consonant phonemes

	Labial	Alveolar	Palatal	Velar
Voiceless plosives	p	t	c	k
Voiced plosives		d		g
Implosives	ɓ	ɗ	ʄ	
Prenasalized plosives		ⁿd		ᵑg
Voiceless fricatives	f	s		x
Voiced fricative		z		
Nasals	m	n	ɲ	ŋ
Voiceless approximant		r		
Voiced approximants	w	l	y[1]	

Now we look at the main evidence for word-final voiceless plosives. First we need to determine if the initial plosive of the plural suffix in (3) is voiced or voiceless. That way, we know how the morphological environment is affecting the root-final plosives.

The plosive of the suffix is voiced when attached to root-final voiced consonants such as in (a), or when attached to vowels such as in (b). However, the plosive of the suffix is voiceless when attached to root-final voiceless consonants such as in (c), and also when attached to root-final /r/ as in (d). So, we can assume the plural suffix is underlying *–ta* and not *–da*, since it assimilates in voice to the preceeding segment, with the exception of /r/. If the suffix were underlying *–da*, it would not likely change to [ta] following /r/, since this would be dissimalation. So, it is reasonable to assume that the initial segment of the plural suffix is underlyingly voiceless and not voiced.

Now we determine whether the root-final plosives of (f) and (g) are underlying voiced or voiceless. We compare these root-final plosives with other root-final consonants that are unambiguously voiced or voiceless in the underlying form. We would expect underlying root-final *voiced* plosives to surface as voiced, because the root-final /l/ in (a) and /r/ in (d) both surface as voiced. On the other hand, we would expect underlying root-final *voiceless* plosives to surface as voiceless, because the root-final /c/ in (c) surfaces as voiceless. We know the root-final /c/ must be underlyingly voiceless, because there is no phonemic voiced palatal plosive. We find that the root-final plosives in (f) and (g) surface as voiceless, just as the unambiguous voiceless plosive of (c). So, we can claim that root-final plosives are underlying voiceless.

The k-t sequence of (g) is heard in slow speech. However, at normal speed, the root-final /k/ assimilates to the suffix-initial /t/, and the resulting t-t sequence then becomes degeminate. The t-t sequence of (f) also becomes degeminate. We'll discuss these assimilation and degeminate processes further in a few minutes.

[1] The symbol /y/ is used for the palatal approximant instead of the IPA symbol /j/.

(3) Evidence for underlying root-final voiceless plosives before plural suffix -ta

	Root-final	Singular	Plural		
(a)	**l**	kal	kal-**t**a	[kal-**d**a]	‘room, hut’
(b)	**a**	kaɗa	kaɗa-**t**a	[kaɗa-**d**a]	‘fishing net’
(c)	**c**	rac	rac-**t**a	[rac-**t**a]	‘trick, deception’
(d)	**r**	cəɓur	cəɓur-**t**a	[cəɓur-**t**a]	‘mountain, hill’
(e)	**s**	mas	mas-**t**a	[mas-**t**a]	‘fire’
(f)	**t**	ɔt	ɔt-**t**a	[ɔ-**t**a]	‘place’
(g)	**k → [t]**	kələk	kələk-**t**a	[kələk-**t**a], [kələ-**t**a]	‘amulet, idol’

We now discuss plosive distribution and contrasts in roots. In (4), there are four word positions labeled with capitol letters on the left side: B for the begining of words, V for in-between vowels, G for geminates, and E for end of words. At the beginning of words, we see that four alveolar consonants are contrastive. In-between vowels, /t/ or /d/ is contrastive with implosive /ɗ/ and prenasalized /ⁿd/. However, the contrast between /t/ and /d/ is neutralized in this intervocalic position, as indicated by dashes. An X indicates an environment where a phoneme does not occur. The phonetic representation is given between brackets when it differs from the underlying representation. Only voiceless plosives occur as underlying geminates, or at the end of words. Although the underlying form of the alveolar plosive could be /t/ or /d/ in-between vowels, it is transcribed as /t/ in this environment throughout the data.

(4) /t/, /d/, /ɗ/, /ⁿd/ distribution and contrast in roots

	Voiceless plosive		Voiced plosive		Implosive		Nasalized plosive	
B	**t**ɛnɛ	‘dry season’	**d**ɛŋ	‘cow’	**ɗ**ɛrɛm	‘tree type’	**ⁿd**ɛⁿdɛŋ-ic	‘feather’
V	ɓa**t**an [**d**]	‘palm’	-----		ka**ɗ**a	‘fish net’	ma**ⁿd**arna	‘snake type’
G	a**tt**apikɛ [**t**][2]	‘spear type’	X		X		X	
E	sa**t**	‘calabash’	X		X		X	

In (5), three velar consonants are shown to be contrastive at the beginning of words, and /k/ or /g/ is contrastive with /ᵑg/ in-between vowels. Like the alveolar plosives, the contrast between /k/ and /g/ is neutralized in-between vowels, and only /k/ occurs at the end of words. There is no velar implosive.

(5) /k/, /g/, /ᵑg/ distribution and contrast in roots

	Voiceless plosive		Voiced plosive		Implosive	Prenasalized plosive	
B	**k**al	‘room’	**g**aw	‘hawk’	X	**ᵑg**a	‘mother’
V	mə**k**əx [**g**]	‘buffalo’	-----		X	tə**ᵑg**əx-sic	‘louse’
G	zə**kk**attas [**k**][3]	‘barren land’	X		X	X	
E	ɛ**k**	‘giraffe’	X		X	X	

In (6), /p/ is shown to be contrastive with implosive /ɓ/ at the beginning of words and between vowels. However, only /p/ occurs as geminate, after a nasal, and at the end of words. There is no voiced bilabial plosive phoneme /b/.

(6) /p/, /ɓ/ distribution and contrast in roots

	Voiceless plosive		Voiced plosive	Implosive	
B	**p**a	‘homestead’	X	**ɓ**ac	‘upper arm’
V	xa**p**a [**b**]	‘spear type’	X	ta**ɓ**a	‘tobacco’

[2] a**tt**apikɛ [a**t**abigɛ] ‘spear type’
[3] zə**kk**attas [zə**k**atas] ‘barren land’

G	ta**pp**a [**p**]	‘rock’	X	X
N	kəm**p**a [**b**]	‘axe’	X	X
E	ɔ**p**	‘young man’	X	X

Palatal consonants are similar to bilabials: /c/ and implosive /ƒ/ are contrastive at the beginning of words and between vowels, but only /c/ occurs as geminate, after a nasal and at the end of words. There is no voiced palatal plosive phoneme /ɟ/.

(7) /c/, /ƒ/ distribution and contrast in roots

	Voiceless plosive		Voiced plosive	Implosive	
B	**c**ɛri	‘basket’	X	**ƒ**ɛnic	‘season’
V	apɔ**c**ɔ [**ɟ**][4]	‘hare’	X	ŋɔ**ƒ**ɔx	‘blind person’
G	ra**cc**a [**c**]	‘necklace’	X	X	
N	maɲ**c**ɛl [**ɟ**]	‘sickle’	X	X	
E	ɓa**c**	‘upper arm’	X	X	

There is no contrastive phonetic length of consonants in Caning. That is, no consonants surface as phonetically longer than other segments that otherwise have the same features. On the other hand, there is contrastive phonemic length of consonants in intervocalic position. That is, underlying voiceless plosives can be single units or geminates. In intervocalic position, single plosives become voiced and geminate plosives become single voiceless plosives through a degemination process.

(8) Underlying contrastive consonant length

p – pp	xa**p**a [**b**]	‘spear type’	ta**pp**a [**p**]	‘rock’
t - tt	ɓa**t**an [**d**]	‘palm’	a**tt**apikɛ [**t**][5]	‘spear type’
c - cc	a**c**aya [**ɟ**]	‘branch’	ra**cc**a [**c**]	‘necklace’
k - kk	ɓa**k**aki [**g**][6]	‘snake type’	da**kk**aɓuk [**k**]	‘groundnut’

In Caning, consonant sequences are nearly always composed of adjacent consonants in separate syllables, rather than at the beginning or end of words. In (9), the number of roots attested with each consonant sequence is listed along with the sequences. Either the first or second consonant can be voiced or voiceless, sonorant or obstruent, and oral or nasal. Further, both can be voiced or voiceless, sonorant or obstruent, or oral.

(9) Consonant sequences

Voiced-voiced				Voiced-voiceless[7]			
6	**mp [mb]**	ka**mp**əŋ [**mb**]	‘left-over food’	1	**rk**	tu**rk**as	‘quiver’
1	**ms**	gi**mz**i	‘rock, mountain’	1	**rt**	lɔ**rt**ɔ	‘grasshopper’
3	**ɲc [ɲɟ]**	maɲ**c**ɛl [**ɲɟ**]	‘sickle’				
2	**rƈ**	ka**rƈ**ɛk	‘hoe scrapper’				
3	**rn**	pa**rn**ik	‘hat’				
1	**rl**	ta**rl**ɔstək	‘ceremony type’	Voiceless-voiced			
1	**rg**	apə**rg**ɛnw-ɛc[8]	‘bat’	1	**xn**	ta**xn**uxu	‘once (ADV)’

[4] apɔ**c**ɔ[abɔ**ɟ**ɔ] ‘hare’
[5] a**tt**apikɛ [a**t**abigɛ] ‘spear type’
[6] ɓa**k**aki [ɓa**g**agi] ‘snake type’
[7] In addition, there are the words ***alk**adis* ‘cat’ (bw. Arabic), ***amk**adad* ‘chisel’ and ***tumsag**u* ‘unfermented sorghum’, with voiced-voiceless sequences, at least one of which is borrowed.
[8] apə**rg**ɛnwɛc [abə**rg**ɛnwɛc] ‘bat’

1	**rⁿd**	atɔ**rⁿd**ɔri[9]	‘fox’	2	**sm**	a**sm**ɛx	‘moon’
2	**lt [ld]**	mɛ**lt**ə [**ld**]	‘air pump, bellow’				
1	**lx [lɣ]**	ci**lx**aya [**lɣ**]	‘snail’				
1	**lp [lb]**	du**lp**us-ic [**lb**]	‘cancer, tumor’	Voiceless-voiceless			
1	**lɓ**	kacɛ**lɓ**uk-ic[10]	‘intestine’	4	**xs**	ka**xs**e	‘fruit pit’
1	**lk [lg]**	tɛ**lk**ɛtəŋ [**lg**][11]	‘fall (v)’	4	**xt**	mo**xt**a	‘horse’
2	**yt [yd]**	a**yt**a [**yd**]	‘in-law’	4	**xk**	a**xk**a	‘bird type’
2	**yk [yg]**	mɛ**yk**ɛ [**yg**]	‘winter season’	3	**sk**	kɛ**sk**aw	‘dawn (ADV)’
1	**wt [wd]**	ɔ**wt**a [**wd**]	‘weather’	1	**st**	nə**st**irɛ	‘truely (ADV)’
2	**gw**	a**gw**aŋ	‘name’				

We now discuss consonant alternations. Plosives undergo the voicing process of (10)—they become voiced between vowels in words, either in roots or across morpheme boundaries.

(10) Plosive voicing
Plosives become voiced in-between vowels in words.

As shown in (11), single unit plosives are voiced in-between vowels in roots.

(11) Plosive voicing in roots

/p/ →	[b]	xa**p**a	[xa**b**a]	‘spear type’
/t/	[d]	ɓa**t**an	[ɓa**d**an]	‘palm’
/c/	[ɟ]	apɔ**c**ɔ	[abɔ**ɟ**ɔ]	‘hare’
/k/	[g]	mə**k**əx	[mə**g**əx]	‘buffalo’

In (12), we see the process applying across morpheme boundaries. The four word-final plosives become voiced when vowel-initial suffixes are added.

(12) Plosive voicing across morpheme boundaries

		Singular	Plural		
/p/ →	[b]	ɔ**p**	ɔ**p**-iɲ	[ɔ**b**-iɲ]	‘young man’
/t/	[d]	kuli**c**	kuli**c**-iɲ	[kuli**ɟ**-iɲ]	‘sesame seed’
/c/	[ɟ]	aɓa**t**	aɓa**t**-iɲ	[aɓa**d**-iɲ]	‘stupid person’
/k/	[g]	ɛ**k**	ɛ**k**-iɲ	[ɛ**g**-iɲ]	‘giraffe’
/s/	[s]	turka**s**	turka**s**-iɲ	[turka**s**-iɲ]	‘quiver’

In addition, the plosives /p, c/, and only the plosives /p, c/, become voiced in-between vowels across word boundaries in a phrase or clause.

(13) Plosive voicing in a phrase
/p, c/ become voiced in-between vowels in a phrase or clause.

As shown in (14), stem-final /p/ and /c/ become voiced before a vowel-initial word, but /t/ and /k/ do not.

[9] atɔ**rⁿd**ɔri [adɔ**rⁿd**ɔri] ‘fox’
[10] kacɛ**lɓ**uk-ic[kaɟɛ**lɓ**ugic] ‘intestine’
[11] tɛ**lk**ɛtəŋ [tɛ**lg**ɛdəŋ] ‘fall (v)’

(14) Plosive voicing across word boundaries

/p/ →	[b]	ɔ**p** anaŋ	[ɔ**b**anaŋ]	‘there is a young man’
/c/	[ɟ]	kuli**c** anaŋ	[kuli**ɟ**anaŋ]	‘there is a sesame seed’
/t/	[d]	aɓa**t** anaŋ	[aɓa**t**anaŋ]	‘there is a stupid person’
/k/	[g]	ɛ**k** anaŋ	[ɛ**k**anaŋ]	‘there is a giraffe’
/s/	[s]	turka**s** anaŋ	[turka**s**anaŋ]	‘there is a quiver’

There is a second alternation that I call voicing assimilation. As stated in (15), plosives and the fricative /s/ become voiced following a voiced consonant. For this rule, /r/ functions as a voiceless consonant, and so is analyzed as such. This process also occurs both in roots and across morpheme boundaries.

(15) Voicing assimilation
Plosives and /s/ become voiced following a voiced consonant.

In (16), four plosives and /s/ are voiced following several voiced consonants, whereas the plosives /t/ and /k/ are not voiced following /r/.

(16) Voicing assimilation in roots

/p/ →	[b]	/ C ___	dul**p**us-ic	[dul**b**us-ic]	‘cancer, tumor’
/t/	[d]	[+ voice]	mɛl**t**ə	[mɛl**d**ə]	‘air pump, bellow’
/c/	[ɟ]		maɲ**c**ɛl	[maɲ**ɟ**ɛl]	‘sickle’
/k/	[g]		mɛy**k**ɛ	[mɛy**g**ɛ]	‘winter season’
/s/	[z]		gim**s**i	[gim**z**i]	‘rock, mountain’
/t/ →	[t]	/ r ___	lɔr**t**ɔ	[lɔr**t**ɔ]	‘grasshopper’
/k/	[k]		tur**k**as	[tur**k**as]	‘quiver’

In (17), we see the same process applying across morpheme boundaries. The suffix-initial plosives /t/ and /k/ as well as /s/ become voiced when following stem-final voiced consonants, but not when following /r/. For comparison, the same suffixes which undergo voicing when following voiced consonants are also shown to remain voiceless when following other voiceless consonants.

(17) Voicing assimilation across morpheme boundaries

/t/ →	[d]	/ $C_{[+\ voice]}$ ___	pɛn-**t**ɔŋ	[pɛn-**d**ɔŋ]	‘wound-this’
			bul-**t**i	[bul-**d**i]	‘drum-PL’
/k/	[g]		mɛm-**k**ɔŋ	[mɛm-**g**ɔŋ]	‘milk.PL-these’
/s/	[z]		dɛrɛm-**s**ɔŋ	[dɛrɛm-**z**ɔŋ]	‘tree.type-this’
/t/ →	[t]	/ r ___	ɲiɓər-**t**i	[ɲiɓər-**t**i]	‘tongue-PL’
/k/	[k]		səpər-**k**ɔŋ	[səbər-**k**ɔŋ]	‘cob.PL-these’
/t/	[t]	/ $C_{[-\ voice]}$ ___	azaf-**t**ɔŋ	[azaf-**t**ɔŋ]	‘palm.tree-this’
/s/	[s]		kətuɓəx-**s**ɔŋ	[kəduɓəx-**s**ɔŋ]	‘trap-this’
/k/	[k]		pax-**k**ɔŋ	[pax-**k**ɔŋ]	‘miscarriage.PL-these’

A third alternation is the degemination process of (18). It states that two of the same adjacent consonants become a single consonant unit. Again, this process applies both in roots and across morpheme boundaries.

(18) Degemination
Two of the same adjacent consonants become a single consonant unit.

The intervocalic voiceless geminate consonants of (19) are single voiceless segments in the surface form.

(19) Degemination in roots

/pp/ → [p]	ta**pp**a	[ta**p**a]	‘rock’
/tt/ [t]	a**tt**apikɛ	[a**t**abigɛ]	‘spear type’
/cc/ [c]	ra**cc**a	[ra**c**a]	‘necklace’
/kk/ [k]	da**kk**aɓuk	[da**k**aɓuk]	‘groundnut’

The morphological data of (20) give further support for this degemination process. The plural noun ‘place’ surfaces with the single plosive [t]. This indicates the underlying plosive is geminate, because a single underlying alveolar plosive between vowels would surface as [d]. So, the root-final /t/ and the initial /t/ of the plural suffix *–ta* undergo degemination resulting in the single segment [t]. After assimilation pocessess are applied, the same degemination process occurs for geminate /cc/ in ‘upper.arm’ and geminate /kk/ in ‘divorce’. For comparison, the same suffixes are shown to attach to some nouns with degemination and to other nouns without degemination.

(20) Degemination across morpheme boundaries

	Underlying representation	Assimilation	Degemination	Surface representation	
/tt/ → [t]	ɔ**t-t**a		ɔ-**t**a	[ɔ**t**a]	‘place-PL’
/cc/ [c]	ɓa**c-s**ɔŋ	ɓa**c-c**ɔŋ	ɓa-**c**ɔŋ	[ɓa**c**ɔŋ]	‘upper.arm-this’
/kk/ [k]	sax-a**t-k**ɔŋ	saxa**k-k**ɔŋ	saxa-**k**ɔŋ	[saxa**k**ɔŋ]	‘divorce-these’
	dɔ**x-t**a			[dɔ**xt**a]	‘mud-PL’
	kətuɓə**x-s**ɔŋ			[kəduɓə**xs**ɔŋ]	‘trap-this’
	pa**x-k**ɔŋ			[pa**xk**ɔŋ]	‘miscarriage.PL-these’

Having discussed consonant phonology, we are now able to posit underlying root-final voiceless plosives in the nouns of (2) from the beginning of the presentation. The noun ‘stupid person’ has a vowel-initial plural suffix that causes the root-final /t/ to become voiced. The noun ‘bowl’ has a consonant-initial plural suffix which degeminates and surfaces as a single voiceless [t]. Now look at the middle two lines. The initial vowels of the copular morphemes in these lines do not cause the word-final /t/ in either noun to become voiced. Remember that voicing across word boundaries only applies to the plosives /p, c/. As for the last two lines, we do not yet have a reason that the same stem-final /t/ appears to have more than one alternation when attaching demonstrative or possessive suffixes. In ‘studid person’, final /t/ becomes [d] before these suffixes, but in ‘bowl’ remains [t]. We will now discuss how this difference in alternation results from different modifier suffixes.

(2) Word-final t

‘stupid person’		‘bowl’		
aɓa**t**	[aɓa**t**/**d̰**ˀ]	sa**t**	[sa**t**/**d̰**ˀ]	
aɓa**t**-iŋ	[aɓa**d**iŋ]	sa**t-t**u	[sa**t**u]	‘X-PL’
aɓa**t** ani	[aɓa**t**ani]	sa**t** ani	[sa**t**ani]	‘there is an X’
aɓa**t** anaŋ	[aɓa**t**anaŋ]	sa**t** anaŋ	[sa**t**anaŋ]	‘this is an X’
? ? ?	[aɓa**d**ɔŋ]	? ? ?	[sa**t**ɔŋ]	‘this X’
? ? ?	[aɓa**d**əma]	? ? ?	[sa**t**əma]	‘his X’

Boyeldieu explains that Caning nouns have both simple and modified forms. Most modified forms of nouns have a consonant suffix to indicate it is modified by the following word. In (21a), the noun ‘cloth’

has the modifier suffix –n attaches before the qualifier connector –a. The modifier suffix shows the noun is modified by the following word 'be.wet'. However, in (b), the simple noun form without a modifier suffix is used because 'be.wet' modifies the verb 'dried' and not the noun 'cloth'.

(21) From Boyeldieu (2009:13)

(a) (cɛ) cəkəmasə ta^{n}də-**n-a** tudi
(she) dried cloth-M-QUAL.CON be.wet
'She dried a wet cloth.'

(b) (cɛ) cəkəmasə ta^{n}də tudi
(she) dried cloth be.wet
'She dried a cloth in a wet way (or with a wet result).'

In (22), simple and modified forms of the noun 'palm tree' are compared. Both the singular and plural forms of this noun have a simple and modified form. The simple forms of the noun are shown on the left, followed by copulas. The modified forms of the noun are shown on the right, followed by possessive pronouns and demonstratives.

(22) Modifier suffixes

Simple singular		Modified singular	
azaf	'(palm) tree'	azaf-**t**-aŋ	'tree-M-my'
azaf anaŋ	'this is a tree'	azaf-**t**-əma	'tree-M-his'
azaf ani	'threre is a tree'	azaf-**t**-ɔŋ	'tree-M-this'
		azaf-**t**-iyi	'tree-M-that'
		azaf-**t**-ə ɓukuniŋ	'tree-M-of chief'

Simple plural		Modified plural	
azaf-iɲ	'(palm) tree-PL'	azaf-iɲ-**k**-aŋ	'tree-PL-M-my'
azaf-iɲ akkaŋ	'these are tree-PL'	azaf-iɲ-**k**-əma	'tree-PL-M-his'
azaf-iɲ akki	'there are tree-PL'	azaf-iɲ-**k**-ɔŋ	'tree-PL-M-these'
		azaf-iɲ-**k**-iyi	'tree-PL-M-those'
		azaf-iɲ-**k**-ə ɓukuniŋ	'tree-PL-M-of chief'

Although the majority of Caning nouns have a modifier suffix, there are different modifier suffixes for different singular nouns. The suffixes are not readily predictable as to which stem-final segment they attach, or according to the semantics of the stem. So, nouns can be analyzed as being in different clauses according to which singular suffix they attach. On the other hand, the plural modifier suffix –k attaches to all plural modified nouns.

(23) Modifier suffixes

Simple singular			Modified singular	
ɲara	'cousin'	**-n**	ɲara-**n**-ɔŋ	'cousin-M-this'
azaf	'(palm) tree'	**-t**	azaf-**t**-ɔŋ	'tree-M-this'
kətuɓəx	'trap'	**-s**	kətuɓəx-**s**-ɔŋ	'trap-M-this'
xɔŋ	'sun'	**-Ø**	xɔŋ-**Ø**-ɔŋ	'sun-M-this'

Simple plural			Modified plural	
azaf-iɲ	'(palm) tree-PL'	**-k**	azaf-iɲ-**k**-ɔŋ	'tree-PL-M-these'

As shown in (24), the modifier suffix *-n* always attaches to a vowel in singular nouns.

(24) Singular modifier suffix **–n-**ɔŋ '-M-this'

Stem-final	Suffix	Singular Noun	'this X'		
a	**-n**	ɲara	ɲara**-n-**ɔŋ	[ɲara**n**ɔŋ]	'cousin'
ə		salə	salə-**n-**ɔŋ	[salə**n**ɔŋ]	'sword'
u		lukku	lukku-**n-**ɔŋ	[luku**n**ɔŋ]	'pool'
e		mɛkɛ	mɛkɛ-**n-**ɔŋ	[mɛgɛ**n**ɔŋ]	'wind, air, storm'
i		asmat-ti	asmat-ti-**n-**ɔŋ	[asmati**n**ɔŋ]	'dry.food-SG'

The modifier suffix *-t* attaches to at least the stem-final consonants of (25) in singular nouns. In accordance with the voicing assimilation rule, the modifier suffix *–t* becomes [d] following voiced consonants, but is unchanged following voiceless consonants. And in accordance with the degemination rule, in 'bowl', stem-final /t/ and modifier suffix –t surface as a single voiceless /t/.

(25) Singular modifier suffix **-t-**ɔŋ '-M-this'

Stem-final	Suffix	Singular Noun	'this X'		
n	**-t → [d]**	pɛn	pɛn-**t-**ɔŋ	[pɛn**d**ɔŋ]	'wound, sore'
ɲ		maraɲ	maraɲ-**t-**ɔŋ	[maraɲ**d**ɔŋ]	'scar'
l		ɓul	ɓul-**t-**ɔŋ	[ɓul**d**ɔŋ]	'big drum'
t	**-t**	sat	sat-**t-**ɔŋ	[sa**t**ɔŋ]	'bowl, calabash'
f		azaf	azaf-**t-**ɔŋ	[azaf**t**ɔŋ]	'palm tree'

The modifier suffix *–s* attaches to at least the stem-final consonants of (26) in singular nouns. The suffix *–s* becomes [z] following voiced consonants, but is unchanged following voiceless consonants.

(26) Singular modifier suffix **-s-**ɔŋ '-M-this'

Stem-final	Suffix	Singular Noun	'this X'		
m	**-s → [z]**	ɗɛrɛm	ɗɛrɛm-**s-**ɔŋ	[ɗɛrɛm**z**ɔŋ]	'tree type'
ŋ		ɲaŋ	ɲaŋ-**s-**ɔŋ	[ɲaŋ**z**ɔŋ]	'crocodile'
w		gaw	gaw-**s-**ɔŋ	[gaw**z**ɔŋ]	'hawk'
y		tisiy	tisiy-**s-**ɔŋ	[tisiy**z**ɔŋ]	'ladder'
t	**-s**	amkatat	amkatat-**s-**ɔŋ	[amkadat**s**ɔŋ]	'chisel'
k → [g]		ɛk	ɛ**k-s-**ɔŋ	[ɛ**gs**ɔŋ]	'giraffe'
s → [z]		ayis	ayi**s-s-**ɔŋ	[ayi**z**ɔŋ]	'goat'
x		kətuɓəx	kətuɓəx-**s-**ɔŋ	[kəduɓəx**s**ɔŋ]	'trap'
c	**-s → [c]**	ɓac	ɓa**c-s-**ɔŋ	[ɓa**c**ɔŋ]	'upper arm'

There is no modifier suffix in some singular nouns following the stem-final consonants of (27). As predicted by the plosive voicing rule, stem-final /p/, /t/ and /k/ become voiced in the intervocalic position resulting when the vowel-intial suffix is attached.

(27) Singular modifier suffix -Ø-ɔŋ '-M-this'

Stem-final	Suffix	Singular Noun	'this X'		
p → [b]	**-Ø**	ɔp	ɔ**p-Ø-**ɔŋ	[ɔ**b**ɔŋ]	'young man'
t → [d]		lɛt	lɛ**t-Ø-**ɔŋ	[lɛ**d**ɔŋ]	'dance type'
k → [g]		kələk	kələ**k-Ø-**ɔŋ	[kələ**g**ɔŋ]	'amulet, idol'

s		tizəs	tizəs-**Ø-ɔŋ**	[tizəsɔŋ]	‘floor’
x		ax	ax-**Ø**-ɔŋ	[axɔŋ]	‘hut’
ŋ		xɔŋ	xɔŋ-**Ø**-ɔŋ	[xɔŋɔŋ]	‘sun’
r		ɲiɓər	ɲiɓər-**Ø**-ɔŋ	[ɲiɓərɔŋ]	‘tongue’

As shown in (28), the modifier suffixes are not predictable. All modifier suffixes except *–n* overlap in which stem-final segments they attach.

(28) Comparison of nouns with singular modifier suffixes –t, -s, **-Ø**

Stem-final	Suffix	Singular Noun	‘this X’		
t	**-t**	sat	sat-**t**-ɔŋ	[sa**t**ɔŋ]	‘bowl, calabash’
t	**-s**	amkatat	amkata**t-s**-ɔŋ	[amkada**ts**ɔŋ]	‘chisel’
k → [g]		ɛk	ɛ**k-s**-ɔŋ	[ɛ**gs**ɔŋ]	‘giraffe’
s → [z]		ayis	ayi**s-s**-ɔŋ	[ayi**z**ɔŋ]	‘goat’
x		kətuɓəx	kətuɓə**x-s**-ɔŋ	[kəduɓə**xs**ɔŋ]	‘trap’
ŋ		ɲaŋ	ɲa**ŋ-s**-ɔŋ	[ɲa**ŋz**ɔŋ]	‘crocodile’
t → [d]	**-Ø**	lɛt	lɛ**t**-ɔŋ	[lɛ**d**ɔŋ]	‘dance type’
k → [g]		kələk	kələ**k**-ɔŋ	[kələ**g**ɔŋ]	‘amulet, idol’
s		tizəs	tizə**s**-ɔŋ	[tizə**s**ɔŋ]	‘floor’
x		ax	a**x**-ɔŋ	[a**x**ɔŋ]	‘hut’
ŋ		xɔŋ	xɔ**ŋ**-ɔŋ	[xɔ**ŋ**ɔŋ]	‘sun’

Again, as shown in (29), all plural nouns attach the modifier suffix –k. The suffix *–k* becomes [g] following a root-final voiced consonant or a vowel, but is unchanged following /r/ and voiceless consonants.

(29) Plural modifier suffix -**k**-ɔŋ ‘-M-these’

Stem-final	Suffix	Plural Noun	‘these X’		
m	**-k → [g]**	mɛm	mɛm-**k**-ɔŋ	[mɛm**g**ɔŋ]	‘milk’
n		ag-wan	ag-wan-**k**-ɔŋ	[agwan**g**ɔŋ]	‘face-PL’
ɲ		ɔp-iɲ	ɔp-iɲ-**k**-ɔŋ	[ɔpiɲ**g**ɔŋ]	‘young.man-PL’
y		ay	ay-**k**-ɔŋ	[ay**g**ɔŋ]	‘life’
a		maraɲ-ta	maraɲ-ta-**k**-ɔŋ	[maraɲda**g**ɔŋ]	‘scar-PL’
u		culu	culu-**k**-ɔŋ	[culu**g**ɔŋ]	‘charcoal’
e		lɛt-tɛtɛ	lɛt-tɛtɛ-**k**-ɔŋ	[lɛtɛdɛ**g**ɔŋ]	‘dance type-PL’
i		ɓul-ti	ɓul-ti-**k**-ɔŋ	[ɓuldi**g**ɔŋ]	‘drum-PL’
r	**-k**	səpər	səpər-**k**-ɔŋ	[səbər**k**ɔŋ]	‘cob’
s		as	as-**k**-ɔŋ	[as**k**ɔŋ]	‘fish’
x		pax	pax-**k**-ɔŋ	[pax**k**ɔŋ]	‘miscarriage’
t → [k]		sax-at	sax-a**t-k**-ɔŋ	[saxa**k**ɔŋ]	‘divorce (refuse-VN)’
k → [g]		ya-tək	ya-tə**k-k**-ɔŋ	[yadə**gk**ɔŋ]	‘meat-PL’

We need two futher processesses to describe the alternations in these data with modifier suffixes—a dissimilation rule and a complete assimilation rule.

This assimilation process of (30) states that stem-final /k/ completely assimilates to a suffix-initial /t/, and also the reverse, that stem-final /t/ completely assimilates to a suffix-initial /k/. It also states that suffix-initial /s/ completely assimilates to stem-final /c/ or /z/.

(30) Complete consonant assimilation

(a)	/k/ → [t] / ___ t	kuɓu**k**-**t**ic	[kuɓutic]	‘wing-SG’
		ŋɛyi**k**-tɛtɛ	[ŋɛyi**t**ɛdɛ]	‘funeral-PL’
(b)	/t/ → [k] / ___ k	saxa**t**-**k**-ɔŋ	[saxa**k**ɔŋ]	‘divorce-M-these’
(c)	/s/ → [c] / c ___	ɓa**c**-**s**-ɔŋ	[ɓa**c**ɔŋ]	‘upper.arm-M-this’
(d)	/s/ → [z] / z ___	ayi**s**-**s**-ɔŋ	[ayi**z**ɔŋ]	‘goat-M-this’

[The modifier suffix –s- assimilates to stem-final /c/ in *ɓac-s-ɔŋ* [ɓacɔŋ] ‘upper.arm-this’ before undergoing degemination. If only the suffix -ɔŋ were attached to *ɓac* ‘upper arm’, the stem-final /c/ would become voiced in the surface form (*[ɓaɟɔŋ]). Because the surface form is [ɓacɔŋ], the underlying segments must be geminate /cc/, and the suffix must contribute an initial consonant such as /s/ in order for the stem-final /c/ to become geminate. Thus, it is reasonable to posit that suffix-initial /s/ becomes [c] following stem-final /c/, as claimed in the assimilation rule (c).]

The dissimilation rule of (31) states that stem-final /k/ becomes [g] before a suffix-initial /k/ or /s/. The rule also states that stem-final /s/ becomes [z] before a suffix-initial /s/. If you look at the bottom of (29), you see that stem-final /t/ as in ‘divorce’ assimilates to suffix-initial /k/ before undergoing degemination. Now then, stem-final /k/ as in ‘meat’ would also result in a degeminate /k/ if it were not for the dissimation rule that requires stem-final /k/ to dissimilate to [g] before suffix-intial /k/. In other words, this part of the dissimilation process is so that after affixation, stem-final /k/ will still be distinguished from stem-final /t/.

[The stem-final /k/ also dissimilates to [g] before suffix-initial /s/ as in ‘giraffe’. Further, the stem-final /s/ dissimilates to [z] before suffix-initial /s/ in ‘goat-this’. Because the root-final /s/ does not become voiced in the intervocalic position resulting when the suffix *–ɔŋ* is attached in *tizəs-ɔŋ* [tizə**s**-ɔŋ] ‘floor-this’, we can assume the suffix in ‘goat-this’ is not *-ɔŋ* (**ayis-ɔŋ* [ayiz-ɔŋ]). On the other hand, because the suffix-initial /s/ of *–sɔŋ* does become voiced when following a stem-final voiced consonant in *dɛrɛm-sɔŋ* [dɛrɛm-**z**ɔŋ] ‘tree.type-this’, we may instead posit that after /s/ dissimilates to [z] preceding suffix-initial /s/ (such as *ayiz-sɔŋ*), the suffix-initial /s/ subseqently assimilates to [z] (such as *ayiz-zɔŋ*) and then undergoes degemination (resulting in [ayi-zɔŋ]). Thus, in (31b) we claim that stem-final /s/ dissimilates to [z] before suffix-initial /s/, and in (30d) we claim that suffix-initial /s/ assimilates to stem-final /z/.]

(31) Consonant dissimilation

(a)	/k/ → [g] / ___ + k, s	ya-tə**k**-**k**-ɔŋ	[yadə**g**kɔŋ]	‘meat-PL-M-this’
		ɛk-**s**-ɔŋ	[ɛ**gs**ɔŋ]	‘giraffe-M-this’
(b)	/s/ → [z] / ___ + s	ayi**s**-**s**-ɔŋ	[ayi**z**ɔŋ]	‘goat-M-this’

We can now posit underlying noun forms for the remaining data in (2) from the beginning of this presentation. We claim that both nouns of (2) have underlying root-final /t/, but they differ in affixation. The noun ‘stupid person’ has a vowel-initial plural suffix and does not attach a modifier suffix, whereas ‘bowl’ has a consonant-initial plural suffix and attaches the modifier suffix –t.

(2) Word-final t

‘stupid person’		‘bowl’		
aɓa**t**	[aɓa**t**/**d̰**ˀ]	sa**t**	[sa**t**/**d̰**ˀ]	
aɓa**t**-iŋ	[aɓa**d**iŋ]	sa**t**-**t**u	[sa**t**u]	‘X-PL’
aɓa**t** ani	[aɓa**t**ani]	sa**t** ani	[sa**t**ani]	‘there is an X’
aɓa**t** anaŋ	[aɓa**t**anaŋ]	sa**t** anaŋ	[sa**t**anaŋ]	‘this is an X’
aɓa**t**-Ø-ɔŋ	[aɓa**d**ɔŋ]	sa**t**-**t**-ɔŋ	[sa**t**ɔŋ]	‘this X’
aɓa**t**-Ø-əma	[aɓa**d**əma]	sa**t**-**t**-əma	[sa**t**əma]	‘his X’

In summary, all word-final plosives are underlying voiceless. Alveolar and velar plosives have a voicing contrast in word-initial position, whereas labial and palatal plosives are only ever voiceless. In-between vowels, underlying geminate plosives surface as single voiceless plosives through degmination, whereas single plosive units are voiced, and /p/ and /c/ are even voiced across word boundaries. Plosives and /s/ assimilate in voice to preceding voiced consonants, where /r/ functions as a voiceless consonant. Most nouns have both simple and modifier forms. Singular nouns attach one of three different modifier suffixes, whereas all plural nouns attach the same modifier suffix. Stem-final plosives can surface as either voiced or voiceless before the same demonstrative or possessive suffixes. However, the difference in voicing is not caused by different underlying stem-final plosives, but by different modifier suffixes that attach according to the noun class.

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