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CONSONANT ALTERNATION IN FULA[1]

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1. Introduction

The suffixes that are added to nouns in Fula occur in pairs. For example, the noun stem ƭummu 'calabash' takes the suffix pair (de,ɗe).[2] The singular form of this noun is formed by suffixing de to the noun stem, giving ƭummude. The plural form of this noun, ƭummuɗe, is formed by adding the other suffix, ɗe, to the noun stem. A given noun stem can only occur with a given pair of suffixes, so that ƭummu always occurs with the suffix pair (de,ɗe) and never with a pair such as (gol,ɗi). The noun stem ƭādor 'belt', on the other hand, occurs with this pair; ƭādorgol is the singular form, ƭādorɗi is the plural form. Of course, ƭādor never takes any other suffix pair besides (gol,ɗi).

Some of the suffixes have semantic content. For example, the suffix pair (ɗo,ɗe) always occurs with nouns that refer to human beings, such as jaggoƭō 'servant', lāmī 'king', maccu 'slave', and so on. Another suffix pair (gel,kon) has a diminuative sense. Thus, from the stem peɗir 'head', we have peɗirgel 'a small head' and peɗirkon 'small heads'.

With certain nouns the initial consonants of the suffixes vary. This variation is referred to as suffix alternation. Similarly, the initial consonants of stems can vary, depending on the suffix added to the stem. This type of variation is referred to as stem alternation. Traditional analyses of consonant alternation in the Fula noun system have implicitly calimed that suffix alternation is different from stem alternation. Suffix alternation appears to consist of four types or grades: a

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[1]I would like to thank Herb Stahlke for his helpful comments on this paper.

[2]The data used in this article is from Klingenheben [1963]. His work is a description of the Adamawa dialect of Fula. Klingenheben represents pre-nasalized consonants with the form ᶇ. This notation is used throughout this paper. Klingenheben also uses ɟ and c to represent the voiced and voiceless palatal stops in Fula.

continuant grade, a stop grade, a nasal grade, and a zero grade. The initial consonant of the suffix can appear in four different forms, depending on the stem to which the suffix is attached. In the zero grade, the initial consonant of the suffix has been deleted. In stem alternation, the zero grade does not appear; the initial consonant of the stem can take the other three grades, but the initial consonant is never missing as in suffix alternation.

In this paper I will argue that suffix alternation is indeed the same as stem alternation and that the suffixal zero grade is really a form of the continuant grade. Traditional analyses have also postulated that the continuant grade is the basic, underlying grade. I will argue, to the contrary, that the stop grade is the basic grade and that the continuant grade is derived from the stop grade. Finally, having shown that suffix and stem alternation are essentially the same, I will consider how morphemes in Fula should be specified for consonant alternation.

2. Suffix alternation

Depending upon the particular stem, the suffix may take a zero grade, a continuant grade, a stop grade, or a nasal grade. Consider the pair of suffixes (de,ɗe). These suffixes take the following forms for each of the given grades:

(1)	zero	re	e
	continuant	re	je
	stop	de	ɗe (~le)
	nasal	ⱥe	ɗe (~le)

The stems new and ʼyoy take the zero forms of de and ɗe:

(2a)	new-	'palm (of the hand)'	newre	newe
	ʼyoy-	'craftiness'	ʼyoyre	ʼyoye

Examples of stems taking the continuant form of the suffixes are:

(2b)	ƭapā-	'cliff'	ƭapāre	ƭapāje
	dūjƬ-	'owl'	dūjƬre	dūjƬje
	jammō-	'surname'	jammōre	jammōje

With this pair of suffixes we can distinguish between those stems taking the stop form de and those taking the nasal form ɲde. First, some examples of stems taking de:

(2c)	ʈummu-	'calabash'	ʈummude	ʈummuδe
	durdu-	'pasturage'	durdude	durduδe
	jaŋɲgir-	'school'	jaŋɲgirde	jaŋɲgirδe
	naŋɲgar-	'peat for religious washings'	naŋɲgarde	naŋɲgarδe
	ɲal-	'24-hour day'	ɲalde	ɲalδe
	lōʈir-	'soap'	lōʈirde	lōʈirδe
	ɓirdu-	'milking pail'	ɓirdude	ɓirduδe

Now some examples taking the nasalized form ɲde:

(2d)	ʈī-	'forehead'	ʈīɲde	ʈīδe
	dar-	'position'	darɲde	darδe
	lay-	'forest'	layɲde	layδe
	ɓer-	'heart'	ɓerɲde	ɓerδe
	ʔin-	'name'	ʔinɲde	ʔinδe

For some speakers, there is a variant le of the plural suffix δe; for example, stems taking the nasal grade of the suffix sometimes take this variant form:

(3)	ɲamā-	'debt'	ɲamāɲde	ɲamāle
	ʔiyē-	'rain'	ʔiyēɲde	ʔiyēle

There are a large number of singular suffixes which occur with the plural suffix δe or with the variant δi, which is apparently replacing the older δe.[3] The plural suffix δi alternates just like δe:

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[3]For example, with the singular suffix go, " ... in älteren Formen nach der δe- und in jungeren meist nach der δi-Klasse" [Klingenheben 1963:73]. In words taking the singular suffix gol, the plural suffix δi is found in continuous speech, the archaic form δe in the pronunciation of the isolated word [Klingenheben 1963:88].

(4)	zero	i
	continuant	ji
	stop	δi (~li)
	nasal	δi (~li)

The singular suffix goi occurs with the plural suffix δi. We have the following examples of each of the grades:

(5a)					
	zero	lēɓ-	'butter'	lēɓoi	lēɓi
		mah-	'wall'	mahoi	mahi
	continuant	bilē-	'large feather'	bilēwoi	bilēji
		mētalē-	'turban'	mētalēwoi	mētalēji
	stop	tādor-	'belt'	tādorgoi	tādorδi
		bin̰dir-	'pen'	bin̰dirgoi	bin̰dirδi
	nasal	goŋ-	'tears'	goŋ̰goi	gonδi[4]
		dāŋ-	'tether for calf'	dāŋ̰goi	dānδi

From these examples, we notice that goi alternates as follows:

(6)	zero	oi
	continuant	woi
	stop	goi
	nasal	g̰oi

A couple examples of where li replaces δi are:

(7)				
	cūm-	'snout'	cūmgoi	cūmli
	jomor-	'tax'	jomorgoi	gomorli

Now consider the pair of suffixes (δo,ɓe), which alternate as follows:

(8)	zero	o	ɓe
	continuant	jo (~wo)	ɓe
	stop	δo	ɓe
	nasal	δo	ɓe

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[4]The velar nasal is assimilated to the initial implosive of the suffix.

The suffix ɓe is invariable for all of the grades. Consider the stem ɓur 'director'. This stem takes suffixes in the zero grade. Thus, the singular form is ɓuro and the plural is ɓurɓe. Examples of stems taking the continuant grade of suffixal alternation are as follows:

(9a)	ʔalajī-	'pilgrim to Mecca'	ʔalajījo	ʔalajīɓe
	nayē-	'old man'	nayējo	nayēɓe
	sōbā-	'friend'	sōbājo	sōbāɓe

If a stem that takes the continuant grade of the suffix ɗo ends in ō, then wo is added instead of jo:

(9b)	defō-	'cook'	defōwo	defōɓe
	jaŋgi̱nō-	'teacher'	jaŋgi̱nōwo	jaŋgi̱nōɓe
	ƭigō-	'merchant'	ƭigōwo	ƭigōɓe
	lōƭō-	'washerwoman'	lōƭōwo	lōƭōɓe
	ɲōƭō-	'tailor'	ɲōƭōwo	ɲōƭōɓe
	ɓa̱rō-	'murderer'	ɓa̱rōwo	ɓa̱rōɓe

A couple of stems ending in ā also take wo instead of jo:

(9c)	sōbirā-	'friend'	sōbirāwo	sōbirāɓe
	hammirā-	'older brother'	hammirāwo	hammirāɓe

Examples of stems taking the stop grade ɗo are as follows:

(10)	jaggoƭō-	'servant'	jaggoƭōɗo	jaggoƭōɓe
	lāmī-	'king'	lāmīɗo	lāmīɓe
	maccu-	'slave'	maccuɗo	maccuɓe

For this particular pair of suffixes the nasalized grade is indistinguishable from the stop grade.

Without giving any more examples, consider the alternations that the other suffixes can take:

(11)	zero	ru	e	o	o	al	i	ol	um	ri
	continuant	ru	ye	wo	ho	wal	hi	hol	jum	ri
	stop	du	ge	go	ko	gal	ki	kol	ɗum	di
	nasal	ḏu	g̱e	g̱o	ko	g̱al	ki	kol	ɗum	ḏi

zero	a	a	u	a	am	el	um	al	on
continuant	wa	wa	wu	ha	jam	yel	wum	hal	hon
stop	ga	ba[5]	gu	ka	ɗam	gel	gum	kal	kon
nasal	g̃a	b̃a	g̃u	ka	ɗam	g̃el	g̃um	kal	kon

We can summarize the alternations of the suffixes in terms of the initial consonant of the suffix:

(12)								
zero	-	r	-	-	-	ɓ	-	
continuant	w	r	w	y	h	ɓ	j	(~w)
stop	b	d	g	g	k	ɓ	ɗ	(~l)
nasal	b̃	d̃	g̃	g̃	k	ɓ	ɗ	(~l)

g alternates with w if the vowel of the suffix is a back vowel; g alternates with y if the vowel of the suffix is a front vowel. Thus, the suffixes ge and gel have the continuant forms ye and yel. The continuant forms of the suffixes go, gal, gol, ga, gu, and gum all begin with w. In addition, we notice that only voiced stops can be nasalized; the voiceless stop k and the implosives ɓ and ɗ cannot be nasalized.

One interesting distributional fact is that if a stem ends in a nasal that is homorganic to the initial stop of the suffix, then the suffix will end up in the nasalized grade instead of the stop grade. For example:

(13)				
ʔen-	'breast'	ʔend̃u	ʔenɗi
ʔin-	'name'	ʔind̃e	ʔinɗe
goŋ-	'tears'	goŋg̃ol	gonɗi
dōŋ-	a type of load	dōŋg̃al	dōŋle
ƭeŋ-	'louse'	ƭeŋg̃u	ƭenɗi
dāŋ-	'tether for calf'	dāŋg̃ol	dānɗi
ƭon-	'lip'	ƭond̃u	ƭonɗi

The stem-final nasal does not necessarily assimilate to the suffix-initial stop. In such cases, the stem can take suffixes in the stop grade. For example:

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[5]An older singular suffix ba is still found in western dialects of Fula. This form is the remnant of an older class of words [Klingenheben 1963:100].

(14)	lim-	'number'	limgal	limle
	cūm-	'snout'	cūmgol	cūmli
	jaŋ-	'lesson'	jaŋde	jaŋle

But of course stems like these can appear in the nasal grade too, just like stems ending in non-nasal segments:

(15)	ɓem-	'tongue'	ɓemgal	ɓemɓe
	dim-	a type of load	dimgal	dimle
	tī-	'forehead'	tīde	tīɓe

In other words, there are many stems that take the nasalized form of the suffix without any phonetic condition. But stems ending in a nasal homorganic to the initial consonant of the suffix may take suffixes in the nasal grade because of a phonetic rule of nasalization:

(16) $\begin{bmatrix} +\text{cons} \\ -\text{cont} \\ +\text{vcd} \\ \alpha F \end{bmatrix} \rightarrow [+\text{nasal}] \; / \; \begin{bmatrix} +\text{nasal} \\ \alpha F \end{bmatrix} + \_\_$

Within morphemes voiced stops following nasals must be nasalized, even if the segments are non-homorganic:

(17)	jambō-	'betrayer'
	jaŋginō-	'teacher'
	kandond-	'chain'
	ɲāmdu-	'food'
	?injin-	'machine'

Thus the nasal assimilation is more general within morphemes:

(18) $\begin{bmatrix} +\text{cons} \\ -\text{cont} \\ +\text{vcd} \end{bmatrix} \rightarrow [+\text{nasal}] \; / \; [+\text{nasal}] \; \_\_$

Finally, let us consider the zero grade. Nearly all those that have investigated Fula have claimed that the zero grade is an independent grade. But if we consider what kinds of stems take the zero grade of the suffix, we note that they all end in a consonant:

(19)

ɓur-	'director'
new-	'palm (of the hand)'
ƴoy-	'craftiness'
lēb-	'butter'
mah-	'wall'

Nearly all the stems taking the continuant grade of the suffix end in a vowel:

(20)

?alajī-	'pilgrim to Mecca'
nayē-	'old man'
sōbā-	'friend'
defō-	'cook'
jaŋgi̦nō-	'teacher'
ŧigō-	'merchant
lōŧō-	'washerwoman'
ɲōŧō-	'tailor'
b̰arō-	'murderer'
sōbirā-	'friend'
hammirā-	'older brother'
ŧapā-	'cliff'
dūjī-	'owl'
jammō-	'surname'
bilē-	'large feather'
mēŧalē-	'turban'

Except for the alternation of the implosive ɓ, the only difference between the zero grade and the continuant grade is that a glide (w, y, or h) has been deleted in the zero grade. The sonorant r occurs in both grades. Let us postulate a rule that will delete glides when preceded by a stem-final consonant:

(21) $\begin{bmatrix} -\text{cons} \\ -\text{syll} \end{bmatrix} \rightarrow \emptyset \; / \; [-\text{syll}] \; + \; \_\_\_$

Now we can claim that there are actually only three grades in suffix alternation and that the zero grade arises because of a rule deleting a glide preceded by a stem-final consonant.

There are some exceptions to this generalization. Consider a stem like yakatab, a type of shoe, which takes the continuant form of the suffix pair (go,δe), or a stem like pampam 'empty peanut shell', which takes the continuant form of the suffix pair (gu,δi):

(22) yakatabwo yakatabje
pampamwu pampamji

We do not get the expected forms *yakatabo and *yakatabe, or *pampamu and *pampami. Perhaps the w fails to delete in this environment because the preceding consonant (b or m) is labial. There are a few examples where j has failed to delete before a consonant, as in:

(23) merlem- a type of frog merlemru merlemji

rather than *merlemi. Nonetheless, it is a fact that every stem that does take the zero grade ends in a consonant, while the great majority of stems taking the continuant grade end in a vowel.

The alternation of the implosive δ is highly irregular. Although the other implosive, ɓ, never alternates, δ does. In addition, δ alternates in the continuant grade with a palatal stop, j, rather than with a continuant. We did notice, however, that with stems taking the singular suffix δo and ending in a back vowel (ō and sometimes ā), the back glide w showed up instead of j. This peculiar behavior of δ suggests that the dental implosive actually alternates with a front glide, and that this front glide can be changed to the back glide w in the environment of two back vowels, as in the examples:

(24) defō + δo ==⇒ defōwo
sōbirā + δo ==⇒ sōbirāwo

If the continuant form of δ actually is a glide, we can also explain why the zero grade of δ is null. According to our rule of glide deletion, a glide produced from δ could be deleted before a stem-final consonant. The glide would remain if the stem taking the continuant form of δ ended in a vowel. In this case, the glide would be realized as the palatal stop j unless it occurred between two back vowels. Note that

this glide would be voiced and palatal. The crucial change then would be to simply make a stop out of the glide y.

In summary, every stem takes a certain pair of suffixes. A stem will be marked for taking the continuant, the stop, or the nasal form of the suffix. If a stem ends in a consonant and takes the continuant form of the suffix, the initial continuant of the suffix will be deleted if it is a glide. There are only three grades of suffix alternation, not four.

3. Stem alternation

Not only does the initial consonant of the suffix alternate, but in a similar way, the initial consonant of the stem itself can alternate, depending on the suffix that is added to the stem. Just as there are stems that always take the continuant (or zero) grade of the suffix, there are suffixes that take stems beginning with a continuant. Similarly, there are suffixes that occur with stems having stops in initial position. For example, consider the pair of suffixes (de,ðe). The singular suffix de takes stems in the continuant grade. The other suffix, ðe, takes stems in the stop form. Consider the following alternations of stems that take this pair of suffixes:

(25)	f ~ p	fijirde	pirjirðe	'playground; game'
	w ~ b	wawarde	bawarðe	'shield'
	r ~ d	ramde	damðe	'billy goat'
	s ~ c	sāgorde	cāgorðe	'forearm'
	y ~ j	yardude	jarduðe	'drinking place'
	h ~ k	harɓāde	karɓāðe	'hip joint'
	y ~ g	yettōre	gettōje	'gratitude'
		yimre	gime	'song'
		yelemre	geleme	'calf (of the leg)'
	w ~ g	wāyre	gāye	'itch'
		wonorde	gonorðe	'home'
		wamrude	gamruðe	'dancing place'
		wasarde	gasarðe	'mine'

Like the suffix alternation of g, the stem-initial g alternates with the front glide y if the following vowel is a front vowel; g alternates with the back glide w if the following vowel is a back vowel.

Similarly, there are suffixes that take stems with nasalized initial consonants. For example, consider some stems that occur with the pair of suffixes (gu,ɗi); the singular suffix gu takes stems in the nasalized grade and ɗi takes stems in the stop grade:

(26)	b̰ ~ b	b̰irīwu	birīji	'peanut'
	d̰ ~ d	d̰ūɓu	dūɓi	'year'
	j̰ ~ j	j̰agāwu	jagāji	'lion'
	g̰ ~ g	g̰il̰gu	gilɗi	'worm'

Voiceless stops, on the other hand, cannot be nasalized:

(27)	p ~ p	puccu	pucci	'horse'
	ƭ ~ ƭ	ƭeŋgu	ƭenɗi	'louse'
	c ~ c	cirgu	cirɗi	'leopard'
	k ~ k	kaywāwu	kaywāji	'leather sack'

We also noticed that the suffixes beginning with a voiceless stop were never nasalized by suffix alternation.

Suffix alternation never applied to the implosive consonant in the suffix ɓe. Likewise, stem alternation never affects words beginning with ɓ. The continuant form of ɓ is also ɓ:

(28)	ɓirdu-	'milking pail'	ɓirdude	ɓirduɗe
	ɓer-	'heart'	ɓer̰de	ɓerɗe

Likewise, the nasalized grade of ɓ remains unchanged:

(29)	ɓog̰-	'mosquito'	ɓog̰u	ɓog̰i

There are, in fact, other consonants that do not alternate. For example, the voiceless dental stop, ƭ, does not alternate with a continuant form:

(30)	ƭ ~ ƭ	ƭiŋg̰ē-	'onion'	ƭiŋg̰ēre	ƭiŋg̰ēje
		ƭummu-	'calabash'	ƭummude	ƭummuɗe
		ƭī-	'forehead'	ƭḭ̄de	ƭīɗe

Glottal stops, nasals, liquids, nasalized stops, and implosives are also not affected by stem alternation:

(31)

continuant	stop				
ʔ	ʔ	ʔin-	'name'	ʔinde	ʔinɗe
m	m	maccu-	'slave'	maccuɗo	maccuɓe
n	n	naŋgar-	'peat for religious washings'	naŋgarde	naŋgarɗe
ɲ	ɲ	ɲal-	'24-hour day'	ɲalde	ɲalɗe
l	l	lōtir-	'soap'	lōtirde	lōtirɗe
ɓ	ɓ	ɓarō-	'murderer'	ɓarōwo	ɓarōɓe
ɗ	ɗ	ɗowtā-	'obedience'	ɗowtāre	---
ʼy	ʼy	ʼyoy-	'craftiness'	ʼyoyre	ʼyoye

(32)

nasal	stop				
ʔ	ʔ	ʔasgum-	'cock'	ʔasgumri[6]	ʔasgumje
m	m	mōʔ-	'termite'	mōʔu	mōʔi
n	n	nor-	'crocodile'	norwa[6]	norji
ɲ	ɲ	ɲākurē-	'small horse-fly'	ɲākurēwu	ɲākurēji
l	l	lel-	'gazelle'	lelwa	lelji

Thus the only segments that alternate are the simple stops p, b, d, k, and g. All of the simple stops except t may alternate with a corresponding continuant, and only voiced simple stops may alternate with a nasalized stop.

In those stems in which stem alternation takes place, what is the underlying initial consonant? Klingenheben [1963:12,25], Arnott [1970:48], and Sapir [1970:69] have noted that the alternation can in general be accounted for if underlying continuants rather than underlying stops are postulated for those stems that alternate. The basis for this claim is that Fula contains a large number of stems whose initial stops, like t, do not alternate. For example:

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[6]The singular suffixes di and ga take stems in the nasalized grade.

(33)	battā-	'leather box'	battāru	battāji
	defō-	'cook'	defōwo	defōβe
	dūjī-	'owl'	dūjīre	dūjīje
	jammō-	'surname'	jammōre	jammōje
	jūlir-	'mosque'	jūlirde	jūlirδe
	kurfu-	'boot'	kurfuwo	kurfūji[7]

Suppose that the continuants are underlying in stems that are affected by stem alternation, and that we postulate a rule that will change continuants to stops depending on the type of suffix added to the stem. Then we could claim that in such words as tiŋge, battā, defō, jammō, and kurfu the stops were all underlyingly present. In this case, the rule of stem alternation would not affect underlying stops, only underlying continuants; and thus stems with underlying stops would never alternate.

However, there are also a number of exceptions with continuants as well. Non-alternating continuants do show up where stops should occur; for example:

(34)	sōbā-	'friend'	sōbājo	sōbāβe
	sōbirā-	'friend'	sōbirāwo	sōbirāβe
	hammirā-	'older brother'	hammirāwo	hammirāβe
	hamilā-	'sword belt'	hamilāwol	hamilāji
	yakatab-	a type of shoe	yakatabwo	yakatabje
	sōro-	a type of house	sōrowol	sōrōji
	suka	'small young man'	sukayel	sukahon

In addition, there are loan words that have initial continuants that do not alternate:

(35)	suley-	'shilling'	suleyre	suleyje
	sōje-	'soldier'	sōjējo	sōje?en
	hayru-	'luck'	hayru	hayrūji
	hakīka-	'truth'	hakīka	hakīkāji
	fōto-	'photograph'	fōto	fōtōji

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[7] V --> V̄ / ___ j .

Such words generally do not add any singular suffix, but do have the continuant form occurring with the plural suffix ði, which is supposed to occur with stems in the stop grade. There are a large number of re-analyzed nouns in the language which fit into this pattern. For example, consider the noun saɓɓo 'nest' which originally had the plural form caɓɓe. Re-analysis has taken place, and a new plural saɓɓōji has replaced the older form caɓɓe. Other examples show that such nouns can begin with continuants as well as stops:

(36)			
	'palace'	fāda	fādāji
	'game'	waɲɲo	waɲɲōji
	'end'	ragare	ragarēji
	'hour'	sā?a	sā?āji
	'hope'	yela	yelāji
	'wonder'	hayðēgam	hayðēgamji
	'word'	kalma	kalmāji
	'farm in suburbs'	ciraka	cirakāji
	'luck'	barka	barkāji
	'trick'	dabare	dabarēji
	'ability'	gikku	gikkūji
	'wrong'	jambaa	jambāji
	'pencil'	pensur	pensurji
	'plague'	ƭorra	ƭorrāji

There is another pattern of suffixes that admits underlying continuants as well as stops. This is exemplified by sōje 'soldier', a loan word from English. The singular form is sōjējo, the plural is sōje?en. Again, both unalternating continuants and stops can fit into this pattern:

(37)				
	fādawa-	'courtier'	fādawājo	fādawa?en
	wajīri-	'minister'	wajīri[8]	wajīri?en
	sarāki-	'official'	sarākījo	sarāki?en
	yaƭīme-	'orphan'	yaƭīmējo	yaƭīme?en
	hawsa-	'Hausa'	hawsājo	hawsa?en

[8]Sometimes the jo suffix is deleted.

gāji	'youngest one'	gāji/gājījo	gāji?en
jāwar-	'widow'	jāwarjo	jāwar?en
ƭalaka-	'poor person'	ƭalakājo	ƭalaka?en
bigawla-	'chief slave'	bigawla/ bigawlājo	bigawla?en
derke-	'child'	derke/derkējo	derke?en
kila-	'smith'	kila/kilājo	kila?en

All of these examples indicate that the tendency in Fula is to eliminate stem alternations. There are a large number of stems beginning with both stops and continuants that do not alternate. Recent loan words do not alternate. The rule that is responsible for stem alternation must be an exceptional rule in the sense that a stem must be marked as [+ STEM ALTERNATION] in order for alternation to occur, and that the unmarked or expected case in Fula is that stems are [- STEM ALTERNATION]. In any event, we cannot use the lack of consonant alternation in certain words to account for the type of underlying consonants in words that do show alternation.

One especially striking fact is that if a stem does alternate for a given pair of suffixes, then one of the forms must be in the stop grade. Thus, we can find the following types of alternation:

(38)

singular	plural	example pair of suffixes
stop	continuant	(ɗo,ɓe)
continuant	stop	(de,ɗe)
nasal	stop	(gu,ɗi)
stop	nasal	(gel,kon)

But we never find in noun stems an alternation between the continuant and the nasal form. In other words, if a stem alternates, the stop form always shows up. With some suffix pairs, the other form of the stem will be in the continuant grade. With other suffixes, it will be a nasalized stem. But the stop form will always manifest itself in a surface form.

Let us postulate then two simple rules, one to change stem-initial stops to continuants when they occur with certain suffixes (continuant-producing suffixes), and the other to nasalize voiced stops when they

occur with certain other suffixes (nasal-producing suffixes):

(39) $\begin{bmatrix}+\text{cons}\\-\text{cont}\\+\text{vcd}\end{bmatrix} \rightarrow [+\text{nasal}] \;/\; [\_\_X]_{\text{stem}} + \text{N-suffix}$

(40) $\begin{bmatrix}+\text{cons}\\-\text{cont}\end{bmatrix} \rightarrow [+\text{cont}] \;/\; [\_\_X]_{\text{stem}} + \text{C-suffix}$

The rule of stem alternation that produces continuants can explain the alternation of g. As we have seen, g --> w occurs before back vowels and g --> y before front vowels. We also have the unconditioned alternations b --> w and j --> y irrespective of the following vowel. If the stops b, g, and j are postulated as the underlying segments, we can easily predict which glide will alternate with which stop. But if the glides are the underlying segments, one cannot wholly predict which stops alternate with a given glide. For example, w can alternate with g or b if w is followed by a back vowel:

(41)	'shield'	wawarde	bawarðe
	'mine'	wasarde	gasarðe

The verb is also affected by stem alternation. For example, after the first person plural pronoun miN 'we', a verb in the past tense will begin with a nasalized stop, but after the first person singular pronoun mi 'I', the verb will be in the continuant grade:

(42)	bōð-	'to be pretty'	mi wōði	mim ᵬōði
	gar-	'to come'	mi wari	miŋ g̃ari
	jeh-	'to go'	mi yehi	miɲ j̃ehi
	gett-	'to thank'	mi yetti	miŋ g̃etti
	dem-	'to plough'	mi remi	min d̃emi
	piδ-	'to shoot'	mi fiδi	mim piδi
	com-	'to be tired'	mi somi	miɲ comi
	keɓ-	'to receive'	mi heɓi	miŋ keɓi

According to Klingenheben [1963:12], there is a nasal assimilation rule in Fula that will change a continuant to either a voiced nasal stop or a voiceless non-nasal stop. Klingenheben postulates that the continuous

segments are underlying and that his nasal assimilation rule will convert, for example, y --> j in the stem yeh 'to go', but with the stem yett 'to thank', y --> g. Since in both stems the vowel following the front glide is a front vowel, there is no way to predict which rule, y --> j or y --> g, should apply to these given stems. Thus Klingenheben is forced to indicate which stop alternates with the glide for some stems with an initial glide.[9] But if we postulate underlying stops, the glides are completely determined by our rule of stem alternation. We simply say that the rule of stem alternation that produces continuants applies to the verb stem in the first person singular past tense. The fact that in the first person plural the verb stem takes initial stops in the nasalized grade can be explained by our more general nasalization rule. The final nasal in miN 'we' is first made homorganic to the initial consonant of the verb stem:

(43) $[+\text{nasal}] \rightarrow [\alpha F] \; / \; \_\_\_ + \begin{bmatrix} +\text{cons} \\ \alpha F \end{bmatrix}$

and then voiced stops are nasalized across the morpheme boundary:

(44) $\begin{bmatrix} +\text{cons} \\ -\text{cont} \\ +\text{vcd} \\ \alpha F \end{bmatrix} \rightarrow [+\text{nasal}] \; / \; \begin{bmatrix} +\text{nasal} \\ \alpha F \end{bmatrix} + \_\_\_$

This rule is the same rule that accounts for the suffix alternation of stems ending in a nasal homorganic to the suffix-initial consonant (cf. rule (16)). The fact that the stem-initial stop of the verb stem in mim b̰oδi is nasalized can be accounted for by a very general nasalization rule.

Our rules of stem alternation are, in fact, the same rules that we need to account for suffix alternation. We have seen that suffix alternation consists of three basic grades instead of four, that the zero grade is really derived from the continuant grade by a glide-deletion

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[9] "Angesichts dieser Verschiedenheiten empfiehlt es sich, bei der Anführung von mit w und y anlautenden Wurzeln durch hinzugesetztes b, g, oder j anzudeuten, zu welcher Permutationsreihe sie gehören...." [Klingenheben 1963:25]. For a similar solution, cf. Arnott [1970:48].

rule (rule (21)). In fact, the same three grades are found in stem alternation. Except for the dental implosive, ɗ, all the suffix alternations are exactly the same as the corresponding stem alternations:

(45)

continuant	w	r	w	y	h	ɓ
stop	b	d	g	g	k	ɓ
nasal	b	d	g	g	k	ɓ

But ɗ is invariable in stem alternation, but not in suffix alternation:

(46)

continuant	ɗ	j
stop	ɗ	ɗ
nasal	ɗ	ɗ

Except for this anomaly, we can postulate a single set of alternation rules that will account for the consonant alternation of both suffixes and stems.

4. Lexical specification in Fula

We have noticed that each given suffix always occurs with stems in a certain grade. For example, the suffixes ɓe and de always take stems in the continuant grade. The suffixes di and kon take stems in the nasalized grade. On the other hand, the suffixes ɗo, ɗe, ɗi, and gel always take stems in the stop grade. Let us say that suffixes such as ɗo, ɗe, ɗi, and gel are unmarked for an alternation rule; that is, they do not cause alternation in the stem. Suffixes like ɓe and de will be marked as [+AC] since only stems in the continuant grade can occur with these suffixes. This means that the alternation rule that changes stops to continuants will apply to a stem attached to such a suffix. Suffixes like di and kon will be marked as [+AN] since only stems in the nasalized grade can occur with these suffixes.

In addition, each given stem always occurs with suffixes in a certain grade. For example, stems like new 'palm (of the hand)' and ƭapā 'cliff' always take suffixes in the continuant grade. So these stems will be marked as [+AC]. Stems like ƭī 'forehead' and dar 'position' always take nasalized suffixes. Hence, these stems will be marked as [+AN]. Stems that take suffixes in the stop grade will be left unmarked

for an alternation rule. Thus we note that every morpheme, whether a suffix or a stem, may be marked as either [+AC] or [+AN]. It's also possible that a morpheme can be left unmarked. But more importantly, the rule marking does not mean that the rule will apply to the morpheme itself, but rather to the other morpheme that co-occurs with that morpheme. As an example, consider the morpheme birT 'peanut' which occurs with the suffix pair (gu,δi). Now birT is marked [+AC] and gu is marked [+AN], but δi is unmarked. Thus, we have the following derivations:

(47)	birT + gu	birT + δi
	[+AC] [+AN]	[+AC]
	b̰irTwu	birTji

The order of rule application is not important. birT can only co-occur with suffixes in the continuant grade and so gu is converted to wu and δi is converted to ji. And gu itself can only occur with stems in the nasalized grade and so birT is changed to b̰irT. But δi does not affect the underlying initial stop in the stem and so the underlying stem birT remains in the plural.

Of course, there are numerous stems with underlying stops that will not alternate even though they may occur with a suffix that is marked as occurring with an alternating stem. For example:

(48)	battā + du	batta + δi
	[+AC] [+AC]	[+AC]
	battāwu	battāji

Although the suffixes are altered, the stem is not, even though the suffix du requires a stem to be in the continuant grade. We do not get *wattawu. We noticed that there are a large number of stems, especially borrowed and re-analyzed words that the alternation rules never apply to. Stem alternation will therefore be considered exceptional and the natural case is for stems to be minus alternation (or [-A]). If a stem does alternate, then it must be marked so. Hence, battā is not only [+AC] (that is, it occurs only with suffixes in the continuant grade), but it is [-A]. Even though the suffix du is marked as [+AC], the fact that battā is [-A] means that consonant alternation will be blocked from

applying to battā. The stem birī will be marked as [+A]. In other words, the speaker must memorize that birī alternates. Hence, an alternation rule can apply to a stem only if the stem is marked as [+A]. If it is not, then the stem is never affected by alternation.

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