Form and meaning in Fulfulde: a morphophonological study of Maasinankoore

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Part I

Phonology

Chapter two
Speech sounds

2.1 FULFULDE SPEECH SOUNDS

The vowel inventory of the Fulfulde of Maasina is represented in the following table.

			–round –back +front	–round –back –front	+round +back –front
+high	–low	+ATR	**i**		**u**
–high	–low	+ATR	**e**		**o**
–high	–low	–ATR	**ɛ**		**ɔ**
–high	+low	–ATR		**a**	

Nasalized vowels, voiceless vowels, and laryngealized vowels occur in Fulfulde too. They can be predicted from underlying phonological structures. The consonant inventory of the Fulfulde of Maasina is represented in the table below.

	labial	labiovelar	alveolar	palatal	velar	glottal
voiceless stop	**p**		**t**		**k**	
voiced stop	**b**		**d**		**g**	
voiceless affricate				**c**		
voiced affricate				**j**		
voiced lateral			**l**			
voiced trill			**r**			
voiceless fricative	**f**		**s**			
voiced approximant		**w**		**y**		
voiceless approximant						**h**
laryngealized stop	**ɓ**		**ɗ**			
laryngealized affricate				**j̰**		
glottal stop						**ʔ**
nasal stop	**m**		**n**	**ɲ**	**ŋ**	
prenasalized stop	**ᵐb**		**ⁿd**	**ⁿj**	**ᵑg**	

The speech sounds are represented by their orthographic symbols. The symbol [**c**] represents the phonetic affricate sequence [**cʃ**]. The symbol [**j**] represents the phonetic affricate sequence [**dʒ**]. The symbol [**j̰**] represents the phonetic affricate sequence [**d̰ʒ̰**]. The phonetic realization of laryngealization is represented with a tilde under the segment [̰].

Several issues have been raised in the discussion about the phonemic status of the above consonants and vowels in the Fulfulde literature. The description of length, the status of the

prenasalized consonants, and the nature of the affricates have been interpreted in different ways. All three phenomena: length, prenasalization, and the complex structure of affricate segments are related to the organization of features in time within a phoneme. The analysis of these time related issues are discussed in section 2.3 in an autosegmental framework.

2.2 THE PHONOLOGICAL FEATURES

The Fulfulde speech sounds are analyzed as bundles of features (organized on autosegmental tiers). The features are binary except for the acoustic feature of sonority which is placed on a hierarchical scale (see section 4.4). The six distinctive places of articulation used to describe consonants consist of the bundling of the following feature values.

	labial	labiovelar	alveolar	palatal	velar	glottal
coronal	–	–	+	+	–	–
anterior	+	+	–	–	–	–
high	–	+	–	+	–	–
back	–	+	–	–	+	–
front	–	–	–	+	–	–
round	–	+	–	–	–	–
low	–	–	–	–	–	+

The place features for the vowels are slightly different from those of consonants. There are four feature tiers that are common for both consonants and vowels: [high], [back], [round], and [low]. The tiers specifying [coronal] and [anterior] are only specified for consonants, not for vowels. The autosegmental feature tier ATR is only linked to vowels, not to consonants. There is no separate consonant tier and vowel tier but the anterior and coronal tier are only linked to consonants and the ATR tier is only linked to vowels. The following figure gives the place feature specification of vowels in Fulfulde.

	a	**ɛ**	**e**	**i**	**ɔ**	**o**	**u**
high	–	–	–	+	–	–	+
back	–	–	–	–	+	+	+
round	–	–	–	–	+	+	+
front	–	+	+	+	–	–	–
low	+	–	–	–	–	–	–
ATR	–	–	+	+	–	+	+

The occurrence of both vowels and consonants on the feature tiers [high], [back], [round], and [low] is necessary for the explanation of phonological changes where vowels influence the place features of adjacent consonants.

The instructions to the vocal cords are represented by the autosegments [constricted], [voice], and [spread]. Constricted means that the arytenoids are brought tightly together so that the vocal cords cannot vibrate (either fully or partially). Spread means that the vocal cords are apart (either fully or partially) allowing for the air to pass freely. Voice means that the vocal cords are vibrating, either over the full length or only the ligamental part. The

consonant [**h**] is whispered, i.e. the vocal cords are together or narrowed except between the arytenoids (Ladefoged 1971:8). The feature [–voice] is realized as whisper for the consonant [**h**]. The following figure gives the possible configurations of the voice features.

	voiced	voiceless	laryngealized	glottal stop
voice	+	–	+	–
spread	–	+	–	–
constricted	–	–	+	+

The feature [+nasal] occurs in nasal and prenasalized stops and in nasalized vowels. Nasalized vowels are (often optional) phonetic realizations of a vowel-nasal sequence in word final position.

The different manners of articulation of consonants are described with the features [continuant], [lateral], [vibrant], and [strident]. Vowels have the same autosegmental representation as approximants. Voiced approximants (glides) and vowels only differ in sonority, a scaled feature that is described in section 4.4. The following figure shows the values of the manner features of a number of phonological categories.

	vowel	approximant	trill	lateral	fricatives	obstruents
continuant	+	+	+	–	+	–
lateral	–	–	–	+	_	–
vibrant	–	–	+	–	_	–
strident	–	–	–	–	+	–

The obstruents can be divided into several categories. Obstruents can be voiced, voiceless, laryngealized, glottal, nasal, prenasalized, and affricate in Fulfulde. They differ from each other according to the type of voicing, the absence and presence of nasality, and their temporal structure. Prenasalized consonants and affricates are obstruents with a complex time structure. They are analyzed with a sequence of two different values on one tier during one time slot.

	affricate obstruents			prenasalized obstruents
	c	**j**	**ɟ**	{^{m}**b**, ^{n}**d**, ^{n}**j**, ^{n}**g**}
nasal	–	–	–	+–
continuant	–+	–+	–+	–
lateral	–	–	–	–
vibrant	–	–	–	–
strident	+	+	+	–
voice	–	+	–	+
spread	+	–	–	–
constricted	–	–	+	–

Affricates are marked by the sequence [–continuant][+continuant] within one time slot. Prenasalized consonants are analyzed with a [+nasal][–nasal] sequence within one time slot. The combinations of the different feature specifications of the consonants and vowels

in Maasina are listed in Appendix 1. Also included in the appendix are the consonants [ɥ], [β], [ʃ], and [ʒ]. The consonant [ɥ] is in complementary distribution with [w] in Maasina. The bilabial fricative [β] occurs in dialects spoken in Cameroon, i.e. in Aadamaawa and in the dialects of the Dageeja and the Ringimaaji. In Maasina, the palatal fricatives [ʃ] and [ʒ] only occur as the final parts of a palatal affricate. The voiceless palatal fricative [ʃ] occurs in Gombe and Ringimaaji and corresponds in a regular manner to the affricate [c] in other dialects such as Maasina.

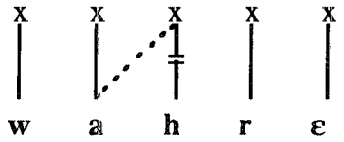
2.3 REPRESENTATION OF SEGMENTS WITH TEMPORAL STRUCTURE

2.3.1 VOWEL LENGTH

A long vowel is represented as a bundle of features linked to two time slots. The following figure gives the autosegmental representation of a long vowel.

Length is not considered as a feature of the vowel itself but it follows from the organization of the vowel features on the timing-tier over two time slots, thus indicating a longer realization in time.

A long vowel can already be long in the underlying structure of the morpheme. Sometimes a long vowel is the result of a phonological derivation whereby the feature bundle of a certain vowel is linked to an adjacent time slot that has been delinked from its underlying content.

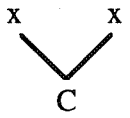


The word **waarɛ** 'beard' is derived from the morphemes ***wah** and ***rɛ** that are stored in the lexicon with their underlying features and time slots. At the surface, the consonant [**h**] cannot occur adjacent to another consonant and it cannot occur in syllable final position. When the consonant [**h**] is delinked because it occurs in syllable final position, the time slot of the consonant [**h**] will be linked to the preceding vowel . Thus the vowel [**a**] is lengthened because it fills the time slot underlyingly linked to [**h**] in the morpheme ***wah**.

The representation of a long vowel as one bundle of autosegments linked to two time slots does not only describe the length of a vowel, it also gives insight into the genesis of the long vowels in such phonological derivations as demonstrated above. Vowel length is written as a sequence of two identical vowels in the orthographic representation of Fulfulde.

2.3.2 LONG OR GEMINATE CONSONANTS

A long or geminate consonant is represented as a bundle of features linked to two time slots. The following figure shows the autosegmental representation of a long consonant.

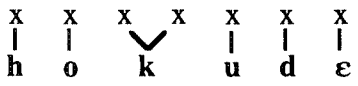


Consonants that have in their realization a closure in the oral or nasal or pharyngeal cavity can occur as long consonants. Length is realized phonetically by prolonging the time of the closure before the release of the (obstruent) consonant. Fricatives and approximants can occur as geminate consonants but such [+continuant] geminates are rare in Fulfulde. The following table shows the consonants which can be long in Maasina.

	labial/labiovelar		alveolar	palatal	velar/glottal
voiceless stop	**pp**	**tt**	**cc**	**kk**	
voiced stop	**bb**	**dd**	**ɟɟ**	**gg**	
laryngealized stop	**ɓɓ**	**ɗɗ**	**ʄʄ**		
nasal stop	**mm**	**nn**	**ɲɲ**	**ŋŋ**	
prenasalized stop	**m^mb**	**n^nd**	**$ɲ^ɲ$ɟ**	**$ŋ^ŋ$g**	
voiced lateral stop		**ll**			
not frequent, rare:					
voiced trill		**rr**			
glottal stop				**ʔʔ**	
voiced continuant	**ww**		**yy**		

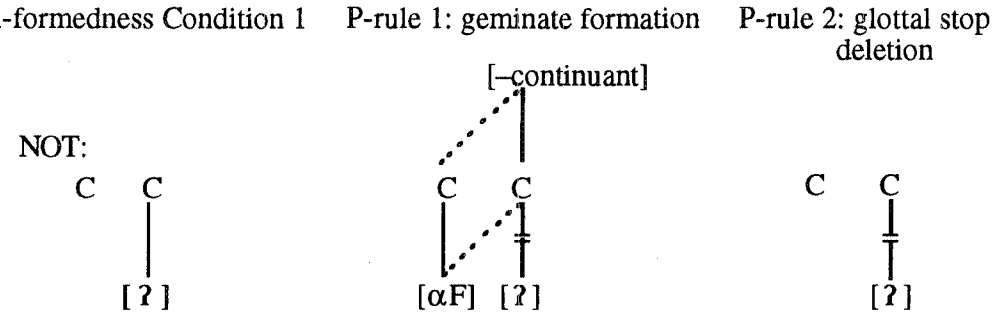
The voiceless continuants [**f**], [**s**], and [**h**] do not occur as long consonants. The phonetic realization of the geminate [**rr**] is a repeated articulation of the trill over a longer period of time, a realization that is slightly different from the other geminates. The geminate [**rr**] has a limited distribution. In the Fulfulde dialect of Fuuta Tooro, the trill [**r**] cannot occur as a geminate consonant (Paradis 1986:218). In the dialects of Liptaako (Bidaud & Prost 1982:16), Kaceccereere (McIntosh 1984:12), and Gombe (Arnott 1970a:384) the long [**rr**] does occur but not very frequently.

A long consonant can be long in the underlying structure of the morpheme or it can be the result of a phonological derivation whereby the feature bundle of a certain consonant is linked to an adjacent time slot that has been delinked from its underlying content. The following example shows a geminate consonant that is present in the underlying structure of the morpheme ***hɔkk-*** 'give' in the infinitive **hokkudɛ** 'to give'.



Often long consonants are the result of merger with the glottal stop [**ʔ**] which cannot occur adjacent to other consonants. This is described in Well-formedness Condition 1 and P-rule

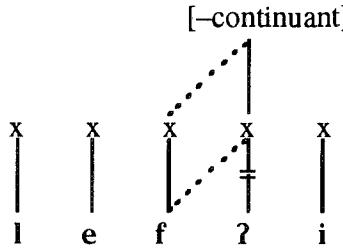
1. The ill-formed sequence of a consonant followed by a glottal stop can also be repaired by deletion of the glottal stop as described in P-rule 2.



The fact that there are two competitive repair rules that avoid a consonant preceding a glottal stop can be demonstrated in the alternative plural formations of the following words.

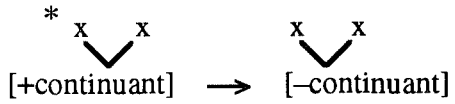
		P-rule 1	P-rule 2		singular
naw+ʔɛ	->	**nabbɛ,**	**nawɛ**	'ponds'	**naw-rɛ**
nɛw+ʔɛ	->	**nɛbbɛ,**	**nɛwɛ**	'hand palms'	**nɛw-rɛ**
laaw+ʔi	->	**laabi,**	**laawi**	'ways'	**laaw-ol**

In P-rule 1 the features of the glottal stop except for the feature [–continuant] are delinked when the glottal stop occurs in the underlying structure adjacent to another consonant. Its time slot is occupied by the features of the adjacent consonant. The merger of any consonant with a glottal stop results in a [–continuant] long consonant. The following example shows the phonological derivation of the long consonant [**pp**] from a merger of [**f**] and [**ʔ**] in the underlying structure of the word **leppi** 'strips' (< **lɛf+ʔi**).

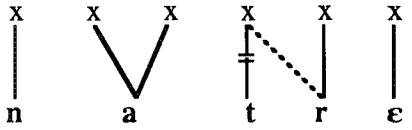


The features of the consonant [**f**] and the only remaining feature [–continuant] of the glottal stop merge into one [–continuant] consonant [**p**] that occupies both time slots of the underlying consonants [**f**] and [**ʔ**], thus forming the long consonant [**pp**].

Paradis presents a different analysis for this [**pp**] sequence. She describes how the [+continuant] fricative [**f**] occupying two time slots is strengthened because of the status of geminate consonants. Paradis (1986:284) has stated a rule that says that any consonant that is linked to two time slots is [–continuant]. Paradis (1986:284) represents the rule describing the strengthening of geminates in the following way:



This rule states that a [+continuant] consonant becomes [–continuant] when it is lengthened. In this study I propose merger with an underlying glottal stop as an explanation for the feature [-continuant] of derived geminates because [+continuant] geminates [**ww**], [**yy**], and [**rr**] do occur in Maasina and because other geminates are often the result of merger of two underlying consonants (see section 4.5.4). The following example shows the occurrence of the geminate consonant [**rr**] as a result of assimilation in the word **naarrɛ** < ***naat+rɛ** 'flood, entrance of water'.



The geminate [**rr**] occurs because the consonant [**t**] cannot occur in syllable final position preceding a more sonorant consonant [**r**] in the Fulfulde of Maasina. The consonant [**t**] is delinked and its time slot is associated with the features of the adjacent consonant [**r**], thus becoming a long rolling trill [**rr**].

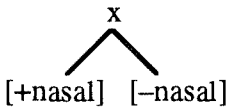
There is no reason why the [+continuant] consonants could not be long. And indeed some words with a [+continuant] long consonant are attested in Maasina.

ⁿdawwal	'ostrich'	also **ⁿdawuwal**
ʔɛyyɔ	'yes, indeed'	
'gɛrral'	'fowl'	

The fact that long consonants in Fulfulde are usually [–continuant] may have something to do with the historical developments of the language. The [-continuant] feature of most long consonants could have resulted from the fact that fricatives and approximants developed historically from intervocalic stops. The long obstruents remained [–continuant].

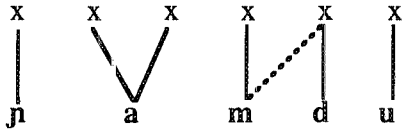
2.3.3 PRENASALIZATION

A prenasalized consonant is represented as a bundle of features linked to one time slot whereby two different values of the autosegmental feature nasal are linked in sequence to this single time slot.



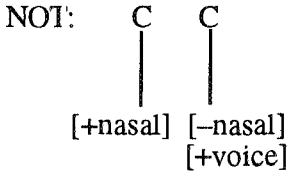
Prenasalized consonants are always voiced in Fulfulde. The following autosegmental representations describe the four prenasalized consonants {**ⁿd**, **ᵐb**, **ⁿj**, **ᵑg**} respectively.

A prenasalized consonant can be present in the underlying structure. A prenasalized consonant can also be derived from a sequence of a nasal consonant followed by a voiced plosive consonant. The following example shows the derivation of the prenasalized consonant [^{n}**d**] in the word **ɲaam^{n}du** < ***ɲaam-du** 'food; way of eating'.

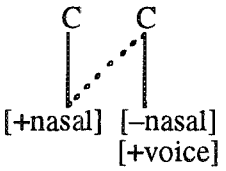


The feature [+nasal] spreads from the segment [**m**] to the segment [**d**]. The feature [–nasal] of the voiced stop is not de-linked. The result is a [+nasal][–nasal] sequence within the time slot of the voiced stop. This initial nasal part of the voiced stop [^{n}**d**] is linked to the place features on the time slot of the alveolar [**d**]. The prenasalization of voiced stops is described by the following Well-formedness Condition and A-rule.

Well-formedness Condition 2



A-rule 3: prenasalization



The ill-formed structure [nasal] [voiced stop] is prevented by prenasalization. A-rule 3 states that the feature nasal spreads to the following plosive consonant. The rule of nasal spreading to voiced stops is an automatic phonological rule to which there are no exceptions. The automatic nature of this phonological prenasalization rule has also been described by Gaden (1913:2-3) and Klingenheben (1963:12). This rule is important for the analysis of sequences of nasal and (voiced) plosive segments.

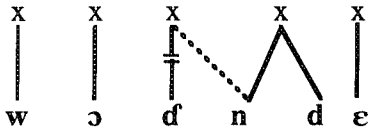
The analysis of different nasal-voiced plosive sequences

In a phonetic study on the length of sequences of nasals followed by a voiced plosive segment in the Fulfulde of 'Yola spoken in Nigeria (Breedveld 1988:59), I concluded that there was no phonetic difference between a NC sequence (a nasal followed by a voiced plosive), a ^{nn}C sequence (a long prenasalized consonant), and a N^{n}C sequence (a nasal followed by a prenasalized consonant) as distinguished by Arnott (1970a:385) for the Fulfulde of Gombe (Hausa states, Nigeria). I only found a phonetic difference between a sequence ^{n}C (a prenasalized consonant) on the one hand and the "long" sequences ^{nn}C, N^{n}C, and NC on the other hand. The controversy revolves around the question of whether it is possible to make a phonetic (!) distinction between the sequences **mb** vs. **m^{m}b**, **nd** vs. **n^{n}d**, **ŋg** vs. **ŋ^{ŋ}g** and **ɲj** vs. **ɲ^{ɲ}j** or not. Here it is claimed that such a phonetic distinction is not present in Fulfulde because an automatic phonetic rule makes a voiced consonant prenasalized when preceded by a nasal.

In Bamako I performed a small recognition test with the words **/wonde/** 'to be' and **/wonnde/** 'another' (orthography used in Mali). Two Fulfulde speakers were placed opposite each other. One of them got a piece of paper on which two sentences were written in which the two different words were given. The other one was not allowed to see the paper.

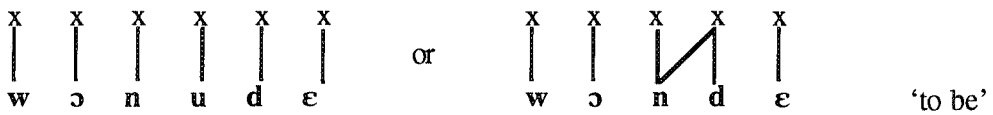
Mali orthography	translation	phonetic pronunciation
1. **huunde wonnde**	'another thing'	**[huu^{n}dɛ wɔn^{n}dɛ]**
2. **wonde ɗoo wɛlaa**	'to be here is not nice'	**[wɔn^{n}dɛ ɗɔɔ wɛlaa]**

The one with the paper had to pronounce only the underlined word without pronouncing the context of the sentence indicated. The listener could not see which sentence was indicated. The listener had to indicate which word he heard: **/wonnde/** 'another' or **/wonde/** 'to be'. Many times the listener could not identify the word when pronounced in isolation. The explanation for that is homonymy. It is impossible to identify the words in isolation because they are pronounced the same way, i.e. as **[wɔn^{n}dɛ]**. The words can only be differentiated using contextual semantic information. In free speech the verb **/wonde/** 'to be' is frequently pronounced as **wonudɛ**. Speakers use the insertion of the active voice marker in the infinitive as a strategy to avoid this homonymy which is a result of the phonological rules that apply to their underlying structures. The word **wɔn^{n}dɛ** 'another' is formed with the morphemes ***wɔɗ** and ***^{n}dɛ**, the prenasalized consonant is present in the underlying structure. The consonant [**ɗ**] is delinked because it cannot occur in syllable final position and its time slot is linked to the nasal segment of the prenasalized consonant [**^{n}d**].



'another'

The word **wɔn^{n}dɛ** 'to be' combines the verb stem ***wɔn** and the infinitive marker ***dɛ**. The active voice marker **-u-** preceding the infinitive maker is often omitted when the stem final consonant is allowed in syllable final position.



'to be'

The prenasalized consonant in **wɔn^{n}dɛ** 'to be' results from the application of the phonological rule that spreads the feature nasal to any following voiced consonant. The homonymy of these two words which differ in their morphological underlying structure has caused confusion between the analysis of the underlying and the surface forms. This confusion has penetrated the orthography of Fulfulde. In the orthography used in Mali the single prenasalized consonants are written as NC, the sequences of a nasal and a prenasalized consonants are written as NNC except when this long sequence occurs at the end of infinitives where it is written as NC again. In the literature different other orthographies are used (Breedveld 1988). For example in the Nigerian orthography all nasal plosive

sequences are written NC, whether it is a single prenasalized consonant or a sequence of two consonants (a nasal followed by a prenasalized). To a large extent the short and long nasal-plosive sequences are in complementary distribution. This could be the justification for the fact that in the Nigerian orthography all nasal-plosive sequences are written NC.

The distribution of different nasal-voiced plosive sequences
The distribution of the phonetically distinct long and short nasal-plosive sequences is almost complementary. The long sequences mostly occur intervocalically after short vowels; the prenasalized consonants mostly occur word initially or after long vowels. The alveolar segments [**n**] and [**d**] are taken as examples but the generalizations also apply to the labial, palatal, and velar nasal-plosive sequences. The general distribution of nasal-plosive sequences is the following:

ⁿd (short) :		**nⁿd** (long) :
VV__	#__	V__
waaⁿdu 'monkey'	**ⁿdaar** 'look!'	**ʔanⁿdal** 'knowledge'

There are however some exceptions to this general distribution.

EXCEPTION 1: The following words are found with a short vowel followed by a short nasal-plosive sequence (or prenasalized consonant).

maⁿdɛ	'when'
hɔⁿdɛ	'which' (NDE class)
hɔⁿgɛ	'which' (NGE class)

These question words are formed with two morphemes: a question marker **ma-** or **hɔ-** (as in **hɔ-tɔ** 'where' and **hɔ-nɔ** 'how') combines with the class concord **ⁿdɛ** (NDE class) or **ⁿgɛ** (NGE class). It is not uncommon for deictic forms to be phonologically aberrant.

EXCEPTION 2: There are a number of nouns where a short vowel is followed by a prenasalized consonant, such as the following words.

labaⁿgal	'bridle'
dawaⁿgel	'small dog'

The hypothesis is that these two words have a penultimate long vowel in their underlying structure which is shortened before a word final heavy syllable. This long vowel appears in the paradigms of the words for 'bridle' and 'dog' when they occur before a final light syllable, as shown in related forms of these nouns.

labaalɛ	'bridles'
rawaaⁿdu	'dog'
dawaadi	'dogs'

The long vowel [**aa**] in **labaalɛ** 'bridles' is evidence for vowel shortening in **laba^{n}gal** 'bridle'. The shortening of the penultimate vowel [**a**] in examples like **laba^{n}gal** 'bridle' and **dawa^{n}gel** 'small dog' is conditioned by the CVC shape of the suffixes -**^{n}gal** and -**^{n}gel**. Such shortening can also be seen in the formation of adjectives where a long penultimate vowel occurs before a CV shaped class suffix and a short(ened) penultimate vowel occurs before a CVC class suffix. The relation between vowel length in the penultimate syllable and the weight of the final syllable is shown in the paradigm of the adjectival stem 'white'.

^{n}daneewi	'white' (KI class)	long penultimate vowel + light final syllable
danɛɛjɔ	'white' ('O class)	long penultimate vowel + light final syllable
danɛwal	'white' (NGAL class)	short penultimate vowel + heavy final syllable
danewel	'white' (NGEL class)	short penultimate vowel + heavy final syllable

EXCEPTION 3: There are quite a number of words where the short vowel morpheme -**u**- is followed by a prenasalized consonant (short nasal-plosive sequence).

hakku^{n}dɛ	'in between, middle'
soɓɓu^{n}du	'corner'

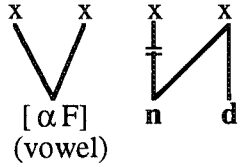
This morpheme -**u**- occurs in infinitives and participles formed with active verb stems. This vowel is often deleted unless its deletion would create ill-formed syllable structures.

EXCEPTION 4: Words in which a long vowel is followed by a long nasal-plosive sequence are also exceptions to the general distribution stated above.

^{n}juun^{n}di	<-	**juut + ^{n}di**	'long'
waan^{n}dɛ	<-	**waat + ndɛ**	'passed' (lit: that has died)

A long vowel followed by a long prenasalized consonant occurs only in productive word derivations in Maasina. The nasal phase in sequence VVN^{n}C is often shortened to VV^{n}C especially in non-productive derivations. The shortening of a long prenasalized consonant after a long vowel is an optional P-rule.

P-rule 4 (optional): prenasalized geminate shortening



This shortening of the **n^{n}d** sequence or any other nasal-voiced plosive sequence after long vowels is not obligatory in Maasina. In fast speech, however, the productive word derivations with a VVN^{n}C sequence often undergo the shortening rule. The prenasalized long consonant in the following words is sometimes (optionally, depending on speech rate) shortened.

wɔɔɗ	**+ⁿdɛ**	->	**wɔɔnⁿdɛ**	also	**wɔɔⁿdɛ**	'beautiful'
juut	**+ⁿdi**	->	**juunⁿdi**	also	**juuⁿdi**	'long'
jɔɔɗ	**+ⁿdɛ**	->	**jɔɔnⁿdɛ**	also	**jɔnⁿdɛ**	'seated position'

The tendency for long nasal-plosive sequences to occur after a short vowel and the tendency for short nasal-plosive sequences to occur after a long vowel suggests compensatory lengthening. Alternating length patterns of either a long vowel or a long nasal period are common especially for words with a nasal-plosive sequence. But there is no free variation between CVNⁿCV and CVVⁿCV. The alternating length patterns are only found when one compares cognate words in different dialects. The nasal period is shortened in a sequence of a long vowel followed by a long prenasalized consonant in Maasina. The vowel is shortened more often in Liptaako.

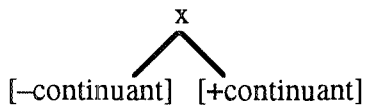
	Maasina	Liptaako	Gombe	Ringimaaji
'fish'	**liiⁿgu**	**liiⁿgu**	**liŋⁿgu**	**liɟiⁿgu**
'ashes'	**ⁿdooⁿdi**	**ⁿdonⁿdi**		
'thing'	**huuⁿdɛ**	**hunⁿdɛ**	**huuⁿdɛ**	**huʔuⁿdɛ, huuⁿdɛ**

The alternation of CVVC with CVCC is not an example of compensatory lengthening (contra Klingenheben 1963:20) but rather the result of a shortening of the CVVC syllable since a V:C: sequence is less preferred in some, and not allowed in other Fulfulde dialects by the well-formedness conditions for syllables. As a result of this, either the consonant or the vowel is shortened in some Nigerian and Cameroonian dialects (McIntosh 1984:15, 29). In Maasina, however, P-rule 4 only applies to non-productive forms. Sequences of a long vowel followed by a long consonant do occur in productive derivations.

Because of these four types of exceptions the distribution of long and short nasal-plosive sequences is not fully complementary. However, the general tendency of prenasalized consonants to occur after long vowels and the tendency of long nasal-plosive sequences to occur after short vowels makes their distribution highly redundant.

2.3.4 AFFRICATES

The affricates are represented as a bundle of features linked to one time slot whereby two feature values [–continuant] and [+continuant] are linked in sequence to this one time slot.



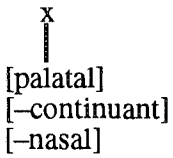
In Fulfulde there are three affricate consonants. These affricate stops all have palatal place features. The symbols [c], [ɟ], and [j̱] stand for the voiceless palatal affricate [cʃ], the voiced palatal affricate [ɟʒ], and the laryngealized palatal affricate [j̱ʒ̱] respectively. In fact, there are no plain palatal stops in Fulfulde. All palatal stops end in a [+continuant] fricative off-glide.

The affricates can occur as a geminate consonant which is linked to two time slots. A long consonant is phonetically realized by maintaining the closure (of the oral cavity) for a longer period of time. The following figures represent the geminates {**cc, jj, ɟɟ**} respectively.

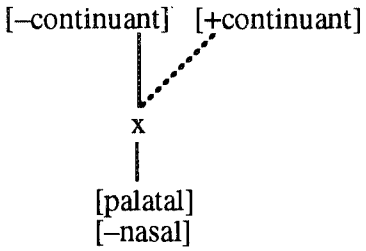
The [–continuant] initial segment of the speech sound is linked to the two time slots when the affricates are geminate. The [+continuant] fricative part occurs as an off-glide of the final time slot linked to the palatal stop. When geminate affricates result form a merger of palatal-alveolar fricative and a glottal stop, the general rule (P-1) produces a palatal stop, which then has to be modified into an affricate (A-5). A-rule 5 describes the insertion of a fricative off-glide because plain palatal oral stops are ill-formed in Fulfulde.

Well-formedness Condition 3

NOT:



A-rule 5: off-glide insertion



The occurrence of such a segment is prevented by the automatic insertion of a [+continuant] segment to the right of this underlying structure as described in A-rule 5. This rule describes the insertion of a fricative off-glide at the end of palatal stops, which is possibly also the historical explication for the affricates. The rule also makes sense because affricates behave phonologically like stops. The affricates [**jj**] and [**c**] in the following words are derived.

wuy	+	ʔɔ	->	**gujjɔ**	'thief'
hɔls	+	ʔɛ	->	**kɔlcɛ**	'hooves'

The segment [**ɟ**] is very rare in the language, no example is found where this segment is clearly derived. The merger of a [**y**] and [**ʔ**], which are adjacent in the underlying structure, results in the geminate consonant [**jj**]. Phonetically this long consonant is realized as [**jjʒ**]. The fricative off-glide is inserted at the end of the geminate palatal stop.

The merger of the segments [**s**] and [**ʔ**], which are adjacent in the underlying structure, follows the same linking and delinking as the derivation of the voiced palatal geminate [**ɟɟ**] from [**y+ʔ**]. In addition, a rule describing the change in place features is needed because

without it the merger of [s] and [ʔ] would incorrectly result in a geminate [tt] instead of the correct outcome [cc]. The assumption is that the consonant [s] is *ʃ in the underlying structure. The underlying consonant *ʃ includes palatal place features. The merger of [ʃ] and [ʔ] results in a long palatal affricate [cc] which is pronounced [ccʃ] with a palatal off-glide. The assumption that the fricative [s] underlyingly has palatal features is also useful in the description of the regular consonant alternation **s/c** and in the description of the syllable final alternation where [s] becomes the palatal approximant [y].

The assumption that the consonant [s] is the palatal fricative *ʃ in the underlying structure makes it necessary to formulate a rule resulting in the correct surface form of [s] when it occurs as a single consonant. This is described in the following structure condition and the related automatic phonological rule.

Well-formedness Condition 4

NOT: x
|
[+continuant]
[-voice]
[palatal]

A-rule 6: **s** -replacement

*ʃ → **s**

A phonetic rule changes the underlying palatal feature bundle of *ʃ when it occurs as a single consonant (linked to only one time slot) on the surface. The phonological rule preventing the occurrence of this ill-formed segment inserts the feature bundle alveolar in this context, thus changing *ʃ to [s].

In principle, affricates should be described and derived as stated in this section. These complex autosegmental representations give insight into the exact structure and are consistent with the historical origin of the affricates. Palatal affricates are claimed to originate from a palatal stop to which a fricative off-glide was attached, possibly triggered by the transition to a following (high) vowel. This explains why affricates behave like stops even though their last part is [+continuant]. For reasons of convenience, the orthographic symbols [c], [j], and [j] are used in the phonological representations of the affricate stops.

2.4 THE CONSONANTAL OR VOCALIC STATUS OF TIME SLOTS

The skeletal tier serves as a temporal sequence of anchor points for elements on the autosegmental tiers (Goldsmith 1990:48). For some authors, the skeletal tier has the form of an x-tier which represents a sequence of time slots which are equal in status (Hyman 1985:15). For others, the skeletal tier has the form of a CV-tier in which the consonantal and vocalic status of a time slot is given (Clements and Keyser 1983:62-84). Goldsmith (1990:50) specifies the slots on the skeletal tier as C when it is [–syllabic], as V when it is [+syllabic], and as X when it is not specified. The present study suggests a compromise between the two competing models. The marks C and V are labels for the time slots which are derived from the combination of autosegments that are linked to a particular time slot.

Traditional generative phonology distinguishes consonants from vowels by ascribing the feature [–consonantal] or [+vocalic] or [+syllabic] to vowels. The opposite values of [+consonantal] or [–vocalic] or [–syllabic] are then used to describe a consonant. In addition, consonants and vowels are often distinguished by using different names for their place features, e.g. [palatal] for consonants and [high] for vowels. The place of articulation

is mostly used to describe consonants and the approaching articulator is often used as the name of the feature used for vowels. But this distinction seems somewhat artificial. It obscures the fact that the labial-velar [**w**] and high-back [**u**] have the same place features, the only difference is that [**u**] is higher on the scale of sonority than [**w**]. Many generalizations will be missed in a phonological description using different feature names to distinguish between vowels and consonants. And the use of different features for the description of vowels and consonants makes it impossible to describe phonological assimilation rules like e.g. palatalization as a rule spreading the same feature [+high] from a vowel to an adjacent consonant. In this study there are five segmental tiers (back, round, front, high, low) with place features that are specified for both vowels and consonants. The feature ATR which is only linked to vowels can spread to an adjacent vocalic time-slot without affecting an intervening adjacent consonantal time slot. Glides differ from vowels in their degree of sonority and in ATR harmony. The vowels [**u**] and [**i**] cause the spreading of the feature [+ATR], whereas the glides [**w**] and [**y**] do not. In principle, the features [coronal] and [anterior] could also spread without affecting intervening vowels because these autosegmental features are linked to consonantal time slots only.

The main distinction between consonants and vowels lies in their sequential distribution which is related to their relative sonority: a vowel has to be adjacent to a consonant and a consonant has to be adjacent to a vowel (at least on one side, i.e. either preceding or following). In Fulfulde an utterance is, in principle, an endless repetition of the following obligatory order of consonants and vowels.

Well-formedness Condition 5: [CV(V)(C)]*

This obligatory pattern indicates that the maximal number of vocalic time slots in sequence is two and the maximal number of consonantal time slots in sequence is two. All words, and indeed all utterances, start with one single consonantal time slot. Words can end in any sequence (long vowel, short vowel, single consonant) but not in two consonants.

The structure [CV(V)(C)]* indicates at the same time the possible syllable structure in Fulfulde. The distribution of C and V is linked to the place of speech sounds in the syllable and the possible syllabic structures. This is also the reason why the feature [±syllabic] is often used to distinguish vowels from consonants. In this study, however, the features [syllabic], [vocalic] or [consonantal] are not included as autosegments on either the skeletal or the feature tiers. One reason for not including these features on the segmental tiers is the fact that they differ in nature from the other features: the terms [syllabic], [vocalic] or [consonantal] do not refer to one primary physiological or acoustic feature. And they do not behave like the other features: they do not spreading, i.e. assimilation does not involve the changing of the consonantal or vocalic status of a segment. On the contrary, vowels and consonants have to alternate. Each consonant requires the presence of at least one adjacent vowel and each vowel requires the presence of at least one adjacent consonant.

In this study a cumulative feature of sonority is used instead of the binary features [±syllabic], [±vocalic] or [±sonorant]. The sonority hierarchy is discussed in more detail in section 4.4. The theoretical consequences of the integration of a multi-valued feature describing the sonority of speech sounds into the system of predominantly binary features are not further explored in this study.

The consonantal or vocalic status of a time slot is determined by the autosegments which are linked to that time slot as described by the following two interpretation rules.

x = V
|
[+continuant]
[–nasal]
[+voice]
[–spread]
[–constricted]
[–lateral]
[–vibrant]
[–strident]
(highest degree of sonority)

There is a set of specific feature values that define a vowel. Any difference in the phonological set-up implies that the time slot is identified as a consonant. This also includes any difference in value on the scale of sonority where vowels are defined by the highest degree of sonority. Vowels and consonants also differ in place features.

V	C
|	|
[±front]	[±front]
[±back]	[±back]
[±front]	[±front]
[±high]	[±high]
[±low]	[±low]
[±ATR]	[±coronal]
	[±anterior]

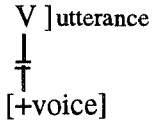
Nasalized, voiceless (or rather whispered), and laryngealized vowels do occur at the phonetic surface level in Fulfulde. The derivation of the consonantal or vocalic status should take place in the underlying structure in order to prevent the interpretation of the time slots linked to (phonetically predictable) voiceless, nasalized or laryngealized vowels as consonants. Some observations on the phonetic realization of the voiceless, laryngealized, nasal, and nasalized segments are presented in the following sections.

2.5 VOICELESS VOWELS AND [h]

Voiceless vowels are pronounced with whispered voice. Vowels can become voiceless or partly voiceless when they occur at the end of an utterance before a pause. Voiceless vowels and final glottality are not distinguished in the orthography. Vowels are pronounced voiceless at the end of sentences that do not end in final glottality. The vowels at the end of the following sentences (ending in adverbs or particular conjugational suffixes) are pronounced voiceless (whispered) before a pause.

ɓɛ ⁿgariḭ	'They have come.'
ɓɛ ⁿjeewti sannɛ̥	'They have enjoyed themselves very much.'
dɛbbɔ ʔɔ lootiimą̥	'The woman has washed herself.'
mi ʔanⁿdaa mą̥	'I don't know you.'
naggɛ ʔanniḭ	'Here is a cow.'
hɔnɔ mɔ wiyɛtɛɛ̥	'How is he called?'

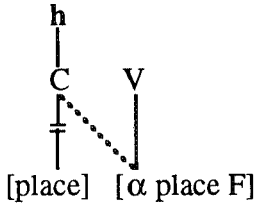
A-rule 7: pre-pausal vowel devoicing



The devoicing of final vowels is a late phonetic rule. The vocalic slot that occurs before a pause will be linked to a [–voice] segment and the [+voice] segment will be delinked. A vowel is [+spread] when it is [–voice].

The consonant [**h**] is also pronounced with whispered voice. It can only occur in syllable initial position. The position of the tongue during the pronunciation of [**h**] is identical to that of the following vowel.

A-rule 8: place assimilation of [**h**] to the following vowel



The consonant [**h**] is represented by different feature bundles depending on its context. The place feature specification of [**h**] is identical to that of the adjacent vowel.

	[h]	hi	he	hɛ	ha	hɔ	ho	hu
continuant	+	++	++	++	++	++	++	++
nasal	–	––	––	––	––	––	––	––
voice	–	–+	–+	–+	–+	–+	–+	–+
spread	+	+–	+–	+–	+–	+–	+–	+–
constricted	–	––	––	––	––	––	––	––
lateral	–	––	––	––	––	––	––	––
vibrant	–	––	––	––	––	––	––	––
strident	–	––	––	––	––	––	––	––
high	–	++	––	––	––	––	––	++
back	–	––	––	––	––	++	++	++
front	–	++	++	++	––	––	––	––
round	–	––	––	––	––	++	++	++
low	+	––	––	––	++	––	––	––
(ATR		+	+	–	–	–	+	–)
(coronal	–	–	–	–	–	–	–	–)
(anterior	–	–	–	–	–	–	–	–)

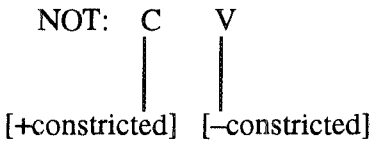
When the sound of the segment [**h**] is isolated on a tape (with a gate) the acoustic effect is identical with that of a voiceless vowel. The quality of the following vowel is heard as whispered during the pronunciation of the [**h**].

2.6 LARYNGEALIZATION OR CREAKY VOICE

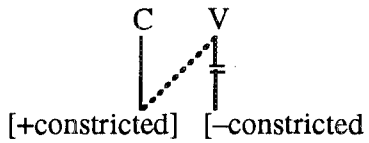
2.6.1 LARYNGEALIZED VOWELS AND [ʔ]

Vowels are automatically laryngealized when they occur adjacent to the segments [**ɓ**], [**ɗ**], [**j̈**], and [**ʔ**]. These consonants are all linked to the feature [+constricted]. At the phonetic surface level, laryngealized vowels do occur in Fulfulde. Laryngealization of vowels is not indicated in the orthography. In this section laryngealization is marked with a tilde [̰] under the laryngealized vowels to show that their distribution follows the rule given. Laryngealization spreads form a [+constricted] consonant to preceding and following vowels.

Well-formedness Condition 6a

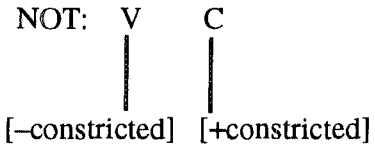


A-rule 9a: vowel laryngealization

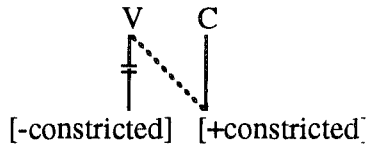


Well-formedness Condition 6a and A-rule 9a are the mirror image of 6b and 9b.

Well-formedness Condition 6b



A-rule 9b: vowel laryngealizatior



The following examples are given in a narrow phonetic transcription.

ɓɔ̰cɔ̰ɔ̰ɗɛ̰	'eggs'
ɔ̰mɔ fuṵj̈i	'he is lazy'
joomira̰a̰ɗɔ̰	'master'
ka̰a̰jɛ̰	'stones, rocks'
a̰a̰ra̰a̰ɓɛ̰	'Arabs'

The feature [+constricted] describes the state where the vocal cords are tightened and only the ligamental part of the vocal cords is vibrating during the pronunciation of the consonants [**ɓ**], [**ɗ**], and [**j̈**], this is also called creaky voice. The vocal cords are fully tightened for the pronunciation of the glottal stop [**ʔ**]. The release of the tightened vocal cords produces the sound that is characteristic for the glottal stop. The release is accompanied by creaky voice in Fulfulde. The tightening of the vocal cords during the pronunciation of the [+constricted] consonants spreads to the adjacent vowels resulting in laryngealized vowels, i.e. vowels pronounced with a creaky voice.

A glottal stop can occur word initially, intervocalically, and utterance finally. Glottal stops are pronounced when a word initial glottal stop follows another vowel final word in an utterance. An intervocalic glottal stop often shows (free?) variation with [**h**]. The glottal stop alternates with [**y**] in the environment of the vowel [**i**].

beʔi, behi, bey	'goats'
gaʔi, gahi, gay	'bulls'
wiʔi, wihi, wii	'has said'
waʔi, wayi	'resembles'

The glottal stop is not always realized utterance initially, its underlying presence can be noted by the creaky voice appearing on the vowel that precedes the glottal stop:

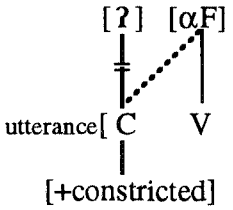
sawrụ	'staff, stick'
jawɔ̰ʔ also **jawɔ̰**	'bracelet'
ʔana weli̱	'it is nice'
yɔ ʔalla wuurnu mɔ̰	'may God make him/her live'

In utterance initial position, a glottal stop is generally realized only by the creaky voice onset of the initial vowel:

a̰a̰ra̰a̰bɛ̰	'Arabs'
ɔ̰mɔ waawi	'can he?'

The feature bundles of the glottal stop in utterance initial position are identical to the features of a laryngealized vowel. Isolated (on tape with a gate) the initial part of that word sounds exactly like a vowel with creaky voice, i.e. a laryngealized vowel. The position of the tongue during the pronunciation of [ʔ] is identical with that of the following vowel. Only the feature [+constricted] remains as a trace of the underlying glottal stop, sometimes realized only as the initial part of the utterance initial vowel.

P-rule 10: utterance initial glottal stop deletion



If a word beginning with a glottal stop is put in a position where it follows a vowel final word, then the initial consonant is pronounced as a [–continuant] glottal stop again.

2.6.2 FINAL GLOTTALITY

Arnott (1970a:65) describes final glottality as a glottal feature which is only realized at the end of sentences before a pause when the pre-pausal syllable is not marked by rising intonation. The glottal feature follows certain word categories and certain verbal

complexes. The word categories marked by final glottality are nominals, i.e. words ending in a noun class suffix and the independent pronouns (Arnott 1970a:388). The verbal complexes marked by final glottality are the subjunctive (also used in the progressive) and the relative verb forms (also used to form the stative) (Arnott 1970a:231). The distribution of the final glottality in the Fulfulde dialect of Gombe as described by Arnott is almost identical to its distribution in the Fulfulde of Maasina. One of the differences is that the demonstratives in Gombe do not have final glottality because their final morpheme is not the class suffix. Forms of the demonstratives ending in the class suffix do occur in Maasinankoore where they are characterized by final glottality. Furthermore, there are a number of adverbials like **ʔannii**ʔ 'here is' that are marked by final glottality in Maasina which do not occur in the Gombe dialect. Finally, the imperative is marked by final glottality in Maasina but not in Gombe (Arnott 1970a:252).

The hypothesis is that the final glottality is a morpheme [ʔ] that carries meaning. Its meaning is similar to the meaning of contexts in which an exclamation mark is used in the punctuation of a text. The final glottality thus indicates that something in the sentence is expressive. The following sentences with final glottality can be pronounced expressively, or they contain a focused constituent. The last column lists the category of the sentence final word that requires the occurrence of final glottality.

sanaa mɔ waraʔ	'He has to come!'	Subjunctive
nay ʔanniiʔ	'Here are cows!'	Adverbial predicate **ʔannii**ʔ
yɔ mɔ duwɛnɛʔ	'May he bless you!'	Exhortative
lɛɛtɛrɛ mɔ winⁿdannɔɔʔ	'It's a letter that he wrote!'	Relative
yinaʔ	'Swim!'	Imperative

The relative verb forms indicate that the initial noun phrase in the sentence is in focus. The meaning which is related to the use of the exclamation mark, which indicates attention or affirms that something is in focus, can be found in the context of the relative verb from where final glottality occurs. By syntactic extension, the stative and progressive forms which combine the durative with the subjunctive or with the relative verb forms are also marked by final glottality even though they are not explicitly expressive predicates.

ʔɔmɔ gɔllaʔ	'He works.'	Subjunctive
ʔɔmɔ nii gɔllaʔ	'He is just (busy) working.'	Subjunctive
ʔana heewiʔ	'There are many, it's much.'	Relative
ʔɔmɔ waawiʔ	'He can.'	Relative

The deictic function of the class marker in demonstratives has a meaning that is similar to that expressed by an exclamation mark. It draws attention. However, the near demonstrative (concord + **ga**) is not characterized by final glottality.

	huuⁿdɛ ⁿdɛɛʔ	'That thing!'	Class suffix
	huuⁿdɛ ⁿdeetoʔ	'That thing over there!'	Adverb **to**ʔ
but:	**huuⁿdɛ ⁿdɛɛga**	'That thing here.'	

The class marker in other nominal and pronominal forms has also a deictic function. By extension all nouns formed with the class marker, i.e. all nominals, are characterized by final glottality. This could also be an indication that the class suffixes are historically derived from forms with a deictic function.

ɲaam^{n}du^{ʔ}	'food'	Class suffix
miildɛ^{ʔ}	'to think'	Class suffix
sawru^{ʔ}	'stick, staff'	Class suffix
ɓeemri^{ʔ}	'drying up of flood'	Class suffix

Final glottality seems to interact with intonation patterns even though it has a segmental form [ʔ]. In Maasina, final glottality is deleted in all questions: both in yes-no questions with a rising intonation and in question-word-questions that do not have rising intonation. And questions are precisely the type of sentences in which an exclamation mark would not be expected. The absence of final glottality in the following questions overrules the fact that the relative verb form and the nominal infinitive require final glottality.

hɔnɔ foti ?	'How much?'	Relative
ʔɔmɔ waawi ?	'Can he?'	Relative
ŋarɗudɛ ?	'To be beautiful?'	Class suffix

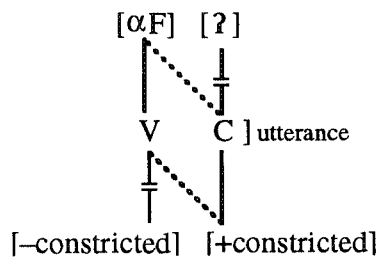
The last utterance was recorded on tape with a question intonation. I was asking for some words to be pronounced in isolation. I gave the French translation equivalent 'être beau' hoping to get the infinitive **wooɗudɛ** 'to be beautiful, to be good'. The consultant remembered that we discussed the word but was always very strict in giving correct translations. The hesitation about whether this was the word I wanted to ask explains the question intonation. This question intonation explains the absence of final glottality in this utterance.

In the above examples the final glottality is represented by a glottal stop. This is actually not always the phonetic realization of the final glottality in the Fulfulde of Maasina. Final glottality is often phonetically realized as the laryngealization of the final vowel.

lɛɛtɛrɛ mɔ win^{n}dannɔɔ(ʔ)	'It's a letter that he wrote!'	Relative
ʔɔmɔ gɔlla(ʔ)	'He's working.'	Subjunctive
ɲaam^{n}du(ʔ)	'Food.'	Class suffix

A separate rule should describe the optional omission of the glottal stop in this context.

P-rule 11 (optional): utterance final glottal stop deletion



This rule says that sometimes the glottal stop is not pronounced utterance finally. The underlying glottal stop can be deleted but it causes the laryngealization of the preceding vowel. The laryngealization of the vowel preceding the glottal stop can be described by the same rule as the rule which states that all vowels that are adjacent to [+constricted] consonants are laryngealized.

The effect of final glottality on a preceding consonant is difficult to perceive. When the word **laba^{n}gal** 'bridle' is pronounced sentence finally, the two final segments **-al** were both perceived with creaky voice. More often, the final glottality seemed to leave no trace when an utterance was consonant final. The phonetic effect of final glottality on consonant final utterances needs to be investigated to confirm the impression that final sonorant consonants are laryngealized when followed by final glottality.

2.6.3 LARYNGEALIZED CONSONANTS

In this study the consonants [**ɓ**], [**ɗ**], and [**j̰**] are described as laryngealized, sharing the feature [+constricted] with the glottal stop [ʔ]. This statement differs from the description of these consonants by many authors. There does not appear to be any consensus on the phonetic nature of these consonants. A summary of the opinions in the literature about the consonants {**ɓ**, **ɗ**, **j̰**} and the confusing terminology is given below.

glottalized:	Arnott (1970a:41): {**ɓ**, **ɗ**, and **j̰**}
implosive:	Mukarovsky (1963:47) Arnott (1970a:385): {only [**ɓ**] and [**ɗ**]} Labatut (1973:50) Sylla (1982:25) Paradis (1986:171)
voiceless implosive:	Labouret (1952:8) Lex (1987)
ejective:	Arnott (1970a:385): {only [**j̰**] }
preglottalized:	Klingenheben (1963:1-2) Ladefoged (1964:17) (with doubt) Swift, Tambadu, Imhoff (1965:17) Noye (1974:8) Bidaud & Prost (1982:12)
laryngealized:	Ladefoged (1964:17) Noye (1989:vii)

The many different terms indicate that the issue is a problematic one. Most authors consider the use of these terms to be sufficient explication for the phonetic nature of the sounds and do not go into the matter explicitly. Only Ladefoged and Lex accompany their statements with more elaborate explanations of the sounds. After a summary of the opinions of the

other authors, I will concentrate on the views of Ladefoged and Lex. The discussion will add some arguments in favour of Lagefoged's description of the consonants {**ɓ, ɗ, ʄ**} as laryngealized consonants.

Arnott (1970a:41) arranges [**ɓ**], [**ɗ**], and [**ʄ**] as glottalized segments in his phoneme chart. In his appendix (Arnott 1970a:385) he adds further details about some consonants, stating that [**ɓ**] and [**ɗ**] are implosive and [**ʄ**] is ejective. Arnott mentions creaky voice (=laryngealized) as an effect of a glottal stop on adjacent vowels. He does not elaborate on the phonetic description of these terms.

Labouret (1952:8) is more explicit. He describes {**ɓ, ɗ, ʄ**} as voiceless implosives ("occlusives sourdes avec implosion"). This in contrast to other authors who usually see these consonants as voiced.

Klingenheben's term "stimmhaften Verschlusslaute mit Kehlverschluss" is interpreted by Mukarovsky (1963:47) as implosive. I cannot conclude this from Klingenheben's own description. Klingenheben (1927:86) says that these sounds ("Kehlverschlusslaute") are explosive or at least start as an "explosive" like the affricate [**ɗy**] (= [**ʄ**]). Whatever Klingenheben's thoughts are about {**ɓ, ɗ, ʄ**}, he definitely does not describe them as implosive. Klingenheben (1963:1-2) gives the term laryngeal consonants as an equivalent of "Kehlverschluss" in his later work. Klingenheben describes {**ɓ, ɗ, ʄ**} as the oral consonants {**b, d, y**} pronounced as a glide or transition to the next vowel between a glottal stop and a vowel where [**ʔ**] fuses with the oral plosive. This description seems to indicate that Klingenheben perhaps thought that {**ɓ, ɗ, ʄ**} are preglottalized. He uses the term laryngeal as a place feature.

Noye (1974:8) writes in his course book that {**ɓ, ɗ, ʄ**} are called implosives but "you have to hear them to make them correctly". He states that they resemble a glottal stop preceding the consonants {**b, d, y**} respectively. In his dictionary (1989:viii) {**ɓ, ɗ, ʄ**} are listed without comment as laryngealized. Perhaps he changed his opinion from preglottalized to laryngealized.

Lex and Ladefoged provide more extensive studies on the "glottal" consonants. Ladefoged (1964:16-17) uses the symbols [**ʔb**], [**ʔd**], and [**ʔj**] for the consonants {**ɓ, ɗ, ʄ**} in Fulfulde. Ladefoged says he has not been able to distinguish between voiced consonants with accompanying glottal stop and similar consonants marked by laryngealization, therefore he marks both by a prefixed glottal stop [**ʔ**].

Laryngealized voicing is described as a state of the glottis with a great deal of tension in the intrinsic laryngeal musculature, so that the vocal cords no longer vibrate as a whole. The ligamental and arytenoid parts of the vocal cords vibrate separately, sometimes almost 180° out of phase with one another, one end opening as the other end is closing. This produces an apparent increase, often an approximate doubling, of the rate of occurrence of glottal pulses.

Ladefoged has doubts about the categorization of all the "laryngealized" consonants in Seereer, Wolof, and four Fulfulde dialects. In these languages laryngealization typically consists of the quickest possible change from normal voicing to a glottal stop, followed by a rapid change back to normal voicing again; the glottal stop usually occurred a few milliseconds before the consonant closure was made.

Ladefoged mentions that the features implosive and laryngealized are often linked. Laryngealized voicing often occurs during an implosive consonant. And the laryngealized

sounds may be incidentally implosive on some occasions, but they are always distinguished from their voiced counterparts by being laryngealized.

Lex (1987) concluded that {ɓ, ɗ, ɟ} are phonetically injective on the basis of a phonetic study of these consonants in the Fulfulde of Fulaadu (Senegal). Injective consonants are consonants characterized by an ingressive air stream caused by a closure in the oral cavity and lowering of the larynx resulting in a lower pressure in the mouth that causes air to stream into the mouth when the oral closure is released. This is usually described with the term "implosive"; a term she wants to avoid because apparently in French the term "implosée" has the meaning "unreleased".

Measuring the direction of the air stream coming in or going out of the mouth with a kymograph ("phneumotachographe"), she clearly shows that word initially the glottal consonants are accompanied by an ingressive air stream that occurs shortly after the plosive release. This ingressive air stream is however absent or very small when the glottal consonants occur intervocalically or word finally. In Fulaadu glottal consonants can also occur word finally, this is not possible in Maasina.

Lex uses pictures made with an oscillogram, showing the fundamental frequency of the utterances, to indicate where the ingressive air stream and the activity of the vocal cords synchronize with the pronunciation of the glottal consonants.

Measuring the activity of the vocal cords via two electrodes that are attached to the outside of the throat near the larynx with a laryngograph, she tries to show that glottal consonants show a particular pattern of voicing (Lex 1987:52). The following figure shows the voicing of glottal consonants according to Lex, using her terminology.

	initial single C	intervocalic single C	intervocalic geminate CC
voicing	no	yes	no
voiced onset time	positive	large/negative	small/negative
ingressive air stream	yes	no/little	no/little

A positive voiced onset time means that the type of voicing of a particular consonant is expanded to the initial part of the following segment, in this case a vowel. In the case of a voiceless glottal consonant this is realized as a kind of aspiration following the glottal consonant's release. A negative voiced onset time means that the voicing of the following vowel expands to the final part of the glottal consonant. A small last part of geminate glottal consonants is voiced and this geminate is adjacent to a vowel. The intervocalic glottal consonants are voiced entirely. This is due to the large expansion of the voicing of the adjacent vowels (Lex 1987:39). The conclusion of Lex is that the consonants [ɓ], [ɗ], [ɟ], and [g'] are voiceless injectives which she symbolizes as [p<], [t<], [c<], [k<] respectively. (The consonant [g'] is rare in Fulaadu, it only occurs in some Arabic loan-words, it is not attested in Maasina)

The demonstration that word initial glottal consonants are accompanied by ingressive air stream after the release of the closure is convincing and very interesting. But it seems that Lex (1987:54) rejects the possibility that the glottal consonants are laryngealized too quickly. In fact her examples of intervocalic geminate consonants (Lex 1987:48) that are accompanied by vocal cords placed against each other ("cordes vocales accollées") point in the direction of laryngealization.

The state of the glottis for the production of voiceless sounds is a state of the glottis where the vocal cords are separated from each other so that air can pass freely. For voiced sounds the glottis is in a state where the vocal cords are placed relaxed next to each other so that the passing air causes a vibration with regular intervals. During the production of laryngealized sounds, i.e. sounds produced with a creaky voice, the vocal cords are tightened and placed close next to each other so that the passing air will cause only a very irregular vibration on a small part of the vocal cords. The frequency of laryngealized sounds is very irregular and the sound will look more like a voiceless sound than like a voiced sound on an oscillogram. This could explain why Lex interpreted the glottal consonants as basically voiceless.

She interprets the pictures given by the laryngograph only as voiced or voiceless. She fails to describe what the picture of the laryngograph would look like if a sound would be laryngealized. The frequency pattern that she presents as typical for laryngealized consonants (Lex 1987:54) is much too simple and probably wrong. This is why I doubt her hypothesis concerning the voicing of the consonants {**ɓ, ɗ, ʄ**}. She does demonstrate clearly an ingressive air-stream when {**ɓ, ɗ, ʄ**} occur word initially (actually utterance initially because the words are pronounced in isolation). My conclusion from her phonetic study is that laryngealized consonants can be pronounced with implosion utterance initially.

My hypothesis that the consonants {**ɓ, ɗ, ʄ**} are laryngealized is largely based on acoustic observations. The sounds were studied in isolation with a gate and in context while the frequency was shown on an oscilloscope. Vowels adjacent to the consonants [**ɓ**], [**ɗ**], [**ʄ**], and also [**ʔ**] are clearly laryngealized in voicing. The spreading of a feature laryngealized from the laryngealized consonants to the adjacent vowels is then a plausible explanation.

The phonetic study of Lex (1987) shows a clear ingressive air stream near the mouth in word initial position. Laryngealized consonants can also be realized accompanied by a lowering of the larynx and implosion (Ladefoged 1964). A decisive phonetic experiment would be the measuring of the air pressure above and below the glottis and the recording of images of the vocal cords during the pronunciation of the sounds {**ɓ, ɗ, ʄ**} compared with {**b, d, j**}. None of the consultants were willing to undergo such a test. Until such an experiment is carried out, the assumption is that the consonants {**ɓ, ɗ, ʄ**} are laryngealized consonants that can become implosive in initial position. This conclusion is based on acoustic observations and on the behaviour of laryngeal consonants: they cause laryngeal voicing of adjacent vowels.

2.7 NASALIZED VOWELS

Nasalized vowels are the result of the occurrence of an underlying sequence of a short vowel followed by a nasal preceding a word boundary or preceding [**s**]. The nasalization of vowels is an optional (phonological) P-rule. The word final nasal consonant which conditions the nasalization is lost on the surface in most cases. A nasal consonant assimilates in place to the initial consonant of the next word when the nasal in word final position is realized. Utterance finally the nasal can become velar [**ŋ**]. Many words are consistently pronounced without the final nasal and with a nasal vowel.

		orthography
ʔabbã	'my father'	**abbam**
hɔkkã	'give me'	**hokkam**
kɛɛŋɛ̃	'yesterday'	**keenyen**
kɔɔtɛ̃	'let's go home'	**kooten**
sɛwrɛ wɔnã burgu	'the herd will be in the inner Niger Delta'	**sewre wonan burgu**

The next words contain a nasalized vowel on the phonetic surface where a VN sequence occurs before [s] in the underlying structure.

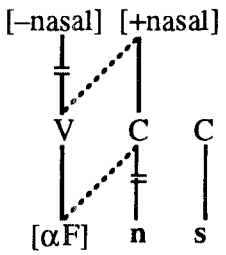
		orthography
dɔ̃sɔŋkɛ	'hunter'	**donsonke**
yãsaadɛ	'to talk, to discuss'	**yansaade**

In some environments the word final nasal appears on the surface, especially when the next word starts with a nasal. This is shown in the following two examples.

ɛɓɛ ʔɛ jã	'They are with peace.'
ɛɓɛ ʔɛ jam nii	'They are with peace only.'

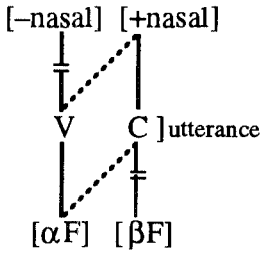
The assumption is that a nasal is present in the underlying structure wherever a nasalized vowel occurs. Two segment structure conditions describe the nasalization of the vowel and the deletion of the nasal stop, one in word final position where this process is frequent but optional. The nasalization of the vowel and the deletion of the alveolar nasal is obligatory before [s].

P-rule 12: vowel nasalization of VN before **s**



P-rule 12 states that an alveolar nasal stop is not allowed before [s]. The underlying vowel nasal sequences becomes a nasalized vowel.

P-rule 13 (optional): word final vowel nasalization of VN



P-rule 13 states that sometimes a word final vowel nasal sequence becomes a nasalized vowel. There are certain contexts in which a VN sequence is allowed word finally. Consider the following sentences in the orthography of Mali.

So on ngon ton golle, neldaa kam.
if you pl. have there work, send-CIR-SUB-you me.'
'If you have the work there, you should send it to me.'

Hebbin loonde ndee.
fill-IMP water pot that
'Fill that water pot!'

The above sentences were taken down in phonetic script. They were pronounced several times. The difference could perhaps be explained by the speed: more nasalization and more dropping of word final nasals in faster speech. The following strings show the phonetic transcriptions of the above sentences.

sɔ ʔɔŋ ⁿgɔ̃n tɔ̃ŋ ⁿgɔllɛ, nɛldaa kãʔ
sɔ ʔɔŋ ⁿgɔ̃ tɔ̃ gɔllɛ, nɛldaa kãʔ

hebbin lɔɔⁿdɛ ⁿdɛ̨ɛ̨
hebb̃ĩ lɔɔⁿdɛ ⁿdɛ̨ɛ̨

The occurrence of a word final nasal seems restricted to slow and careful speech. Words pronounced in isolation are often pronounced with the final nasal. The word final nasal is also pronounced when a word is stressed, e.g. when it is important in a story. A number of words with final nasals were pronounced within a one page story that was once read very slowly and once in normal speed. The following two phonetic transcriptions of these words gives a comparison of nasalization of word final VN sequences in slow and fast speech.

underlying form		slow speech	fast speech
yaran	'usually drinks'	**yarã**	**yarã**
kɔsam	'milk'	**kɔsam**	**kɔsã**
tan	'only'	**tã**	**tã**
nay mum	'his cows'	**mum**	**mũ**
ɲanⁿdɛ ⁿdɛn	'one day'	**ⁿdɛn**	**ⁿdɛ̃**
nɔn ⁿdɛ	'that is how'	**nɔn**	**nɔn**
seeɗa tan	'only a little'	**tã**	**tã**
ⁿdiyam	'water'	**ⁿdiyam**	**ⁿdiyã**
sabi hoɗum	'why'	**hoɗũ**	**hoɗũ**
huurtanaadɛ kam	'to marry me'	**kam**	**kam**
mutan	'will go down'	**mutã**	**mutã**
hakkilɛ mum	'her mind'	**mũ**	**mũ**
ɗum waawaa	'it's not possible'	**ɗũ**	**ɗũ**
tan	'just'	**ta**	**tã**

underlying form		slow speech	fast speech
lanⁿdii ɗum	'asked him'	**ɗũ**	**ɗũ**
huurtanaadɛ ɗum	'to marry him'	**ɗũ**	**ɗũ**
ɓiyum	'his child'	**ɓiyũ**	**ɓiyũ**
lanⁿdii ɗum	'asked her'	**ɗũ**	**ɗũ**
mɔɔmɔɔ ɗum	'touch him'	**ɗũ**	**ɗũ**
ⁿdɛɛn	'then'	**ⁿdɛɛn**	**ⁿdɛɛn**

The final nasal is dropped more often in fast speech than in slow speech, leaving a nasalized vowel. Maybe the word **nɔn** 'how' does not drop its final nasal because it is followed by the word **ⁿdɛ** 'it' starting with a nasal segment. Maybe the word **kam** 'me' does not drop the final nasal because it receives stress. Also the bilabial [**m**] seems more resistant to deletion than the alveolar nasal [**n**]. In slow speech the distribution is less clear, of course there is more opportunity to stress words in slow speech. The final vowel-nasal sequence in the word **ⁿdɛɛn** 'then' does not become a nasalized vowel because nasalization of long vowels does not occur.

The impression is that the final time slot is not deleted and that the syllable containing a nasal vowel behaves like a heavy syllable. There are only a few instances where the weight of the last syllable can be shown. One of these is in the context of deriving the correct length of the vowel in the penultimate syllable of adjectives. In the following examples the length of the vowel in the penultimate syllable depends on the weight of the last syllable which contains the class suffix. A long vowel is shortened in the penultimate syllable of nouns before a heavy syllable. The following paradigm of the adjective 'white' shows that the syllable weight of the class suffixes **-wal** and **-jã** have the same effect on the length of the penultimate vowel [**ɛ**].

danɛjã	**danɛɛjã**	'white ('DAM class)'
danɛwal	**danɛɛwal**	'white (NGAL class)'

The rule shortening the penultimate vowel before a heavy syllable is optional, but the variation in final vowel length of the word ending in the class suffix **-jam** or **-jã** is identical to the variation found in the word ending in the class suffix **-wal**. This adjective does not show any kind of variation. If the last syllable contains the class marker **-jɔ**, then the form is always **danɛɛjɔ** 'white (person)'. The penultimate vowel in the word **danɛɛjɔ** 'white (person)' is not shortened because the last syllable has the form CV and is therefore a light syllable. The weight of the syllables is also an argument to assume that a nasal consonant is present in the underlying structure of nasalized vowels.

A remark has to be made about the co-occurrence of final glottality and nasalized vowels. The impression is that nasal vowels that occur before a pause where final glottality can be expected are both nasalized and laryngealized. This assumption is based on acoustic impressions while listening to those sounds in isolation and in context and while watching their frequency on the oscilloscope.

The precise phonetic nature of laryngeal voicing and its co-occurrence with nasalization in Fulfulde needs to be confirmed by more detailed phonetic experiments which are outside

the scope of the present study. Similarly the assumption that all voiced consonants followed by final glottality are realized with laryngeal voicing will need further verification.

2.8 LABIAL APPROXIMANTS [ɥ], [β], AND [w]

Studies by Labatut (1973) and by Mohamadou (1985) revealed the existence of a second labial approximant [β] next to [w] in some varieties of Fulfulde. Labatut describes the Fulfulde of the Dageeja spoken in Northern Cameroon. Mohamadou's description is based on the Fulfulde spoken in the eastern parts of Aadamaawa, called Fommbinaare or Fuunaangeere, of which southern Aadamaawa is a subgroup. Field work on Ringimaaji (Mbororo) in North West Cameroon showed the existence of an element that will be described as [β]. Paradis (1986) describes a segment [ɥ] in the Fulfulde of Mauritania. Field work in Maasina (Mali) showed the existence of a segment that will be described as [ɥ]. In this section the phonetic realization of these segments is described together with a sketch of their distribution in the different dialects. The genesis of the different distributional patterns of [β], [ɥ], and [w] is discussed in more detail in the section on the initial consonant alternation (3.1.6).

The exact pronunciation of both [ɥ] and [β] differs slightly from the standard interpretation of these symbols. Labatut (1973:49) describes the segment as a bilabial fricative [β] in the Fulfulde of the Dageeja. Later he stated that the friction during the pronunciation of [β] is very weak. In the orthography of the Fulfulde of the Dageeja he uses the letter "v". Mohamadou (1985:40) also uses the letter "v" which is pronounced as a sonorant labiodental fricative with a very loose or lax articulation. Paradis (1986:178) is not explicit about the phonetic realization, both [ɥ] and [w] are called rounded glides. The glide [ɥ] is said to be the consonantal equivalent of [ü]. Ladefoged (1964:25) states that Seereer, Dyola, and the Fula of Mopti have neither [v] nor [w] but a bilabial or labiodental approximant that he symbolizes with [ʋ]. This sound differs from [v] mainly by the lack of friction, and from [w] by the absence of the raising of the back of the tongue. Ladefoged states in his appendix B (1964:45) that the Fulfulde spoken in Mopti has [ʋ] for [w] in some contexts.

This study uses the symbol [ɥ] for the unrounded bilabial/palatal approximant attested in Maasina. The [ɥ] is taken to symbolize a [–round] [+front] [+anterior] labial approximant. There is no rounding, the lips form the sound [ɥ] while being spread with a tongue position that is equal to that of front vowels. There seems to be no available symbol for an unrounded labial approximant that has the tongue in a palatal position (which also should explain why [ɥ] sometimes becomes [j] when it becomes [–continuant]). The rounding of [ɥ] described by Paradis (1986:180) is rejected. The hypothesis is that the segment [ɥ] in Pulaar has a realization not with rounding but with a spread articulation of the lips like in Maasina. The segment [ɥ] in Maasina and Pulaar differs form the segment [β] in Ringimaaji and Aadamaawa in their phonetic nature and in their phonological distribution.

The segment [β] attested in Ringimaaji is not pronounced as [ɥ] or [w]. There is some consensus on the pronunciation of [β] and "v". There is very little friction in the pronunciation of [β] and "v", this is also stated by both Labatut and Mohamadou. The description of the exact place features of "v" or [β] also varies. Mohamadou says the segment "v" is labiodental, Labatut calls [β] bilabial. There is only agreement on the fact that "v" or [β] is not labiovelar. The confusion between bilabial and labiodental might be caused by the

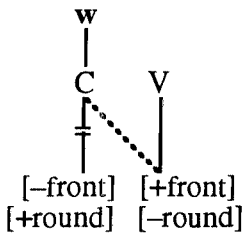
typical pronunciation of this segment which I witnessed in Ringimaaji. The lower lip is moved inwards into the mouth in the direction of the teeth. This gives the optional impression of a labiodental. But the lower lip never reaches the teeth. The air passing through the opening between the two lips causes a very light friction. In this study the symbol [β] is used for the segment attested in Ringimaaji. [β] is taken to symbolize a [-round] labial approximant with a very light friction. The hypothesis about the exact place of articulation of the segment [β] needs further study. Perhaps the filming of the pronunciation can provide slow-motion pictures that will show this more clearly. The hypothesis is that the phonetic nature of Mohamadou's [v] and Labatut's [β] are more similar than the terms labiodental and bilabial suggest. From now on [β] will refer to both [v] and [β].

The question is whether the segments [ɥ] and [β] are simply different pronunciations of the same underlying segment in the different dialects or not. The distribution of these segments differs. In Maasina the segment [ɥ] is in complementary distribution with [w]. The segment [ɥ] occurs only syllable initially before front vowels. The following examples show the distribution of [ɥ] and [w] in Maasina.

u:	**wurɔ / gurɛ**		'village'
ɔ:	**wɔjɛrɛ / bɔjɛ**		'hare'
a:	**waaⁿdu / baaɗi**		'monkey'
ɛ:		**ɥɛlaa**	'isn't nice'
e:		**ɥeeⁿdu / beeli**	'pond, lake'
i:		**ɥirɔ / birɛ**	'rib'

This complementary distribution can be explained by a phonological rule describing the assimilation of labial glides to front vowels.

A-rule 14: place assimilation of [w] to [ɥ]



A labiovelar [w] that becomes [+front, -round] before front vowels will become a [ɥ]. The same distribution of [ɥ] and [w] occurs also stem finally in Maasina.

Maasina			
yɛɛɥ-ɛɛdɛ	'to miss'	**yɛɛw-aama**	'has missed'
deɥ-el	'little girl'	**ⁿdew-oy**	'little girls'
jaɥ-el	'little bracelet'	**jaw-ɔ**	'bracelet'
mi taɥ-ii	'I have found'	**taw-dɛ**	'to find'
laaɥ-i	'roads'	**laaw-ol**	'road'

In Maasina [w] and [ɥ] are in complementary distribution: [w] occurs before [–front] vowels and [ɥ] occurs before [+front] vowels. Paradis (1986:178) observed the same complementary distribution of [ɥ] and [w] in Pulaar (Mauritania). Paradis postulates the glide [ɥ] in the underlying structure but it can only be realized as [ɥ] before front vowels. The following examples show the distribution of [ɥ] and [w] in Pulaar.

Pulaar			
u:	**wuurdɛ**		'to live'
o:	**wowru**		'mortar'
ɔ:	**wɔjɛrɛ**		'hare'
a:	**waa^{n}du**		'monkey'
ɛ:		**ɥɛccɔ**	'side'
e:		**ɥee^{n}du**	'pond, lake'
i:		**ɥin^{n}dudɛ**	'to write'

The consonant [ɥ] can occur before the vowels {**ɛ, e, i**} and the consonant [w] occurs before the vowels {**a, ɔ, o, u**}. Paradis states that the consonant [ɥ] that marks the inchoative (called the "associative extension" in this study) becomes [j] when it is strengthened, i.e. when it becomes [–continuant].

The distribution of [β] and [w] in Dageeja, Aadamaawa, and Ringimaaji is different from the distribution of [ɥ] and [w] in Pulaar and Maasina. In Ringimaaji the segment [β] can be found to distinguish meaning in minimal pairs. There is however a restriction on the segment [w] which can only occur before [–front] vowels. In other words the segment [w] cannot occur before [+front] vowels. This is similar to the behaviour of the segment [w] in Maasina. The following words show distribution of [β] and [w] in Dageeja*.

Dageeja				
u:	**wurɔ**	'camp, village'	**βurti**	'turned up'
o:	**woni**	'is'	**βolβi**	'has said'
ɔ:	**wodaaɓe**	'nomadic Fulbe'	**βojere**	'hare'
a:	**waalde**	'age group'	**βaare**	'beard'
ɛ:			**asaβeere**	'Saturday'
e:			**βeeti**	'in the morning'
i:			**βicco**	'tale'

In the Fulfulde of the Dageeja [β] can occur before all vowels, [w] only occurs before the vowels {**a, ɔ, o, u**}. The distribution of [β] and [w] in (southern) Aadamaawa shows the same pattern as in Dageeja.

* The orthography used in the examples does not distinguish the vowel [ɛ] and [ɔ]. The vowel quality is predictable here from adjacent vowels.

Aadamaawa				
u:	**wula**	'be hot'	**βula**	'abjure'
ɔ:	**wooda**	'have'	**βooda**	'moo, low'
a:	**wama**	'dance'	**βama**	'plait (mat or rope)'
ɛ:			**βela**	'be nice'
i:			**βila**	'destroy'

The consonant [β] can occur before all vowels, the consonant [w] only occurs before the vowels {**a, o, u**}. And again, the same distribution of [β] and [w] is attested in Ringimaaji. In Ringimaaji [β] can occur in both syllable initial and syllable final position and [β] can occur before all vowels. The distribution of [w] is restricted, [w] does not occur before front vowels. The distribution of [β] and [w] in Ringimaaji is similar to the one in the Aadamaawa dialects.

Ringimaaji				
u:	**wuuwugɔ**	'to bend'	**βuuβugɔ**	'to sweep'
o:	**won^{n}dugɔ**	'to live together'	**βoβru / bobi**	'mortar'
ɔ:	**wɔllɔ / gɔllɛ**	'cheek'	**βɔldɛ / bɔllɛ**	'word'
a:	**waa^{n}du / baadi**	'monkey'	**βaatugɔ**	'to die (animals)'
ɛ:			**βɛɛlɔ**	'hunger'
e:			**βelugɔ**	'to be sweet, good'
i:			**βiigɔ**	'to say'

The distribution of [w] and [β] in Ringimaaji could suggest, however, that [w] is historically derived from [β] occurring before the vowels {**a, ɔ, o, u**}. However, the spreading of a feature [–front] is unlikely. Spreading of the feature [+back] would explain the occurrence of [w] before {**ɔ, o, u**} but not for [**a**] which is [–back]. And the rule should be optional because [β] also occurs before these vowels. Synchronically [β] is phonologically distinct.

The approximant [ɥ] can be described as an allophone of [w] in Maasina and Mauritania. The approximant [β] can be described as a separate phoneme in Cameroon. These statements are true but [w], [β], and [ɥ] are treated as segments with a restricted distribution in this study because there is a great similarity between the distribution of the labial glides in the dialects. The complementary distribution of [w] and [ɥ] in Pulaar and Maasina should be noted, more interesting is the development of [β] in Ringimaaji and Aadamaawa where this consonant has been reanalyzed as the phonological counterpart of [**b**] in the consonant alternation system in order to disambiguate the two alternation sets **w : b : ^{m}b** and **w : g : ^{n}g** (see section 3.1.6).

The hypothesis is that the Fulfulde dialects of the Ringimaaji, the Dageeja, and Aadamaawa share an innovation of the distribution of [β]. The fact that [w] does not occur in these dialects before front vowels is described by the same word structure condition (14) as in Maasina. But the segment [β] is introduced in environments where ambiguity related to the consonant alternation of [w] occurs replacing the **w : b : ^{m}b** set with **β : b : ^{m}b** so that the alternation pattern is again predictable from the (basic) continuant consonant (see Anderson 1976:131-2). The hypothesis is that the consonant [β] developed from the

consonant [ɥ] and was given some distinct phonetic features like more friction to allow its presence before [–front] vowels.

The hypothesis of Mohamadou (1985:43) that [β] is a retention of the [+continuant] consonant alternating with [**b**] is rejected because there are still too many examples where [**w**] alternates with [**b**]. The ambiguity of [**w**] alternating with both [**b**] and [**g**] results from the loss of the [+continuant] consonant *ɣ alternating with the [–continuant] consonant [**g**]. And because a (historical) phonological rule changing [β] to [**w**] before [**a**] is not phonetically plausible: what element or place feature could be spreading from [**a**] to [β] causing [β] to become labiovelar? In Chapter three on initial consonant alternation some of the last statements will be further explained and illustrated.

2.9 VOWEL ASSIMILATION

In this section some assimilation rules for vowels are discussed. All vowel assimilation rules in Maasina are anticipatory, i.e. a vowel assimilates to the following vowel. The rules of frontness assimilation and the fusion of **aw** > **ɔɔ** apply only in a few frequently used words, whereas the ATR-harmony applies without exception in all words.

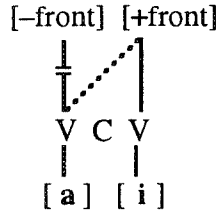
2.9.1 FRONTNESS ASSIMILATION

The phonological rule of frontness assimilation describes the change of the vowel [**a**] to [ɛ] before a vowel [**i**] in the following syllable (of the same word). This rule must apply after the ATR-harmony because the vowel [ɛ] resulting from an underlying [**a**] does not obey the vowel harmony rule. The sequence **ɛ-i** usually undergoes ATR-harmony resulting in the sequence **e-i** but not in the words that undergo frontness assimilation of [**a**]. There is one word where the rule of frontness assimilation applies in all Fulfulde dialects.

***yah+i** > **yɛhi** 'went'

Frontness assimilation is an optional rule which only applies to a few high frequency words.

P-rule 15 (optionally): frontness assimilation of [**a**] to [ɛ]



The number of words where the frontness assimilation occurs is a little larger in Maasinankoore. In some instances two forms of a word exist: with and without the frontness assimilation. The frontness assimilation seems to occur more often in the centre of Maasina than in its periphery, i.e. Kunaari, Gimballa or the Haayre.

sadʃii	or	**sɛdʃii**	'hello' [lit: (it) has been difficult?]
ⁿjanⁿdi	or	**ⁿjɛnⁿdi**	'iron'
laɓi	or	**lɛɓi**	'knife'

The words given here are the only examples of frontness assimilation found in the Maasina data. The fact that examples of frontness assimilation are very few and are very frequently used words suggests that this rule is a recent innovation.

2.9.2 TOTAL VOWEL ASSIMILATION

Short unstressed vowels can assimilate completely to the vowel in the following syllable.

fill-an-tɔ	or	**fill-ɔn-tɔ**	'will tell for'	tell-DAT-M.INCOMPL
haɓɓ-anɔɔka	or	**haɓɓ-ɔnɔɔka**	'has not been tied'	tie-N.P.COMPL-PAST

This rule is optional in the above examples. Total vowel assimilation has occurred in a number of fused morphemes. It can explain the first vowel in the class suffixes **-ɛrɛ**, **-iri**, **-uru** and in conjugational suffixes such as **-ata**, **-ɛtɛ**, and **-ɔtɔ**.

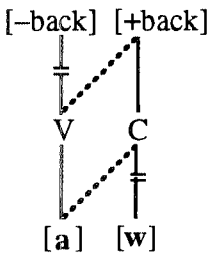
2.9.3 MERGER OF [a] WITH [w]

The vowel [**a**] can merge with a following labiovelar [**w**] to form a long vowel [**ɔɔ**] . Only two examples are available in the data.

***jawm**	>	**jɔɔm**	'possessor of'
mawdʃɔ	>	**mɔɔdʃɔ**	'old, great'

Different phonological changes occur when ***aw** > **ɔɔ**, i.e. spreading of the feature [+back] and the deletion of the labiovelar [**w**] resulting in compensatory lengthening of the vowel [ɔ]. These changes are represented in P-rule 16.

P-rule 16 (optional): merger of [**a**] and [**w**] resulting in [**ɔɔ**]



The optionality and the very restricted number of words in which the merger of [**a**] and [**w**] occurs make it that this rule is labelled as a P-rule. The application of P-rules can depend on the frequency of a word and on the rapidity of speech. There are no rigid boundaries for the application of optional P-rules. Often variant forms can be used alternatively by the same speaker, e.g. **mawdʃɔ** and **mɔɔdʃɔ** 'old person' with and without the rule applying. The phonological rules with limited application possibly indicate stylistic speech differences. The fact that no rigid boundaries for the domain of optional phonological rules can be given is in conflict with the assumption of lexical strata: the division of the lexicon into clearly

defined domains to which the application of a certain phonological rule is limited (see Paradis 1992 and Mohanan 1982).

2.9.4 ATR VOWEL HARMONY

Fulfulde is analyzed in this study as having seven phonemic vowels. This analysis is based on the data of the Maasina dialect and the Ringimaaji dialect. The vowels [**e**] and [**o**] are phonologically predictable variants of [**ɛ**] and [**ɔ**] in many environments but not everywhere. The instances where [**e**] and [**o**] cannot be predicted phonologically gives these two vowels phonemic status. All vowels can occur either as long or short vowels. The following figure shows the vowel inventory of Fulfulde.

i u
e o
ɛ ɔ
a

The present analysis deviates from the majority of the literature which describes Fulfulde as having five vowel phonemes (Mukarovsky 1963:25, Zoubko 1980:14, Sylla 1982:22, Bidaud & Prost 1982:9). The following figure shows the traditional five vowel inventory used by most authors.

i u
e o
a

These five vowels are also used in the official orthography of Fulfulde which has been recommended by the UNESCO meeting held in Bamako in 1966. Some authors state that phonetically there are more than five vowels. There are different proposals for the number of vocalic allophones and the rules predicting the occurrence of the additional vowels.

Stennes (1967:1) postulates five phonemic and nine phonetic vowels for the Aadamaawa dialect. He says that the allophony is conditioned by length. Short vowels are more central than long vowels. Only the quality of the vowel [**a**] doesn't seem to change with the change of length. The following figure shows Stennes' phonetic vowel system.

ii uu
i ʊ
e o
ɛɛ ɔɔ
a / aa

Arnott (1970a:386-7), who described the Fulfulde of Gombe in Nigeria, McIntosh (1984:10), who described Kaceccereere in Nigeria, and Mohamadou (1985:43), who described South Aadamaawa in Cameroon, also claim that there are five contrastive vowel phonemes of whose allophones are conditioned by vowel length. They differ from Stennes

in that they state that the pronunciation of a short [**a**] is different from that of a long [**aa**] in quality. So they distinguish ten phonetic vowels.

The occurrence of ten different vowel qualities of which five are phonemic with vowel length as the conditioning factor for allophony is rejected here. The analysis followed here shows more similarity with Klingenheben's views. Klingenheben (1963:2, 8) proposes five vowels for Fulfulde with the following qualities.

i **u**
ɛ **ɔ**
a

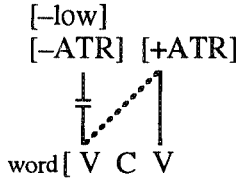
He also states that the vowels [**e**] and [**o**] do occur as a result of partial assimilation to a following vowel [**u**]. He does not distinguish these last two vowels because they do not indicate a difference in meaning.

Field work on the Fulfulde of Maasina in Mali and on the Ringimaaji dialect in Cameroon does not show a difference in vowel height between long and short vowels. The only difference in vowel quality that is predictable in certain environment is caused by assimilation to other [+ATR] vowels. This vowel harmony occurs independently of vowel length. The verb stems ***fɔɔɗ-*** 'pull' and ***rɛm-*** 'cultivate' undergo [+ATR] assimilation when they are followed by the [+ATR] vowel [**i**].

Maasina	Ringimaaji	
mi fooɗ-ii mɔ	**mi fooɗ-i mɔ**	'I dragged (pulled) him.'
ʔɔmɔ fɔɔɗ-a taaba	**ʔɛmɔ fɔɔɗ-a taaba**	'He smokes (pulls) tobacco.'
ʔɔmɔ rɛm-a	**ʔɛmɔ rɛm-a**	'He is cultivating.'
mɔ rem-ii	**ʔɔ rem-i**	'He has cultivated.'

The vowels [**e**] and [**o**] in the examples above are derived. They are conditioned by assimilation to a following [+ATR] vowel according to the rule of ATR-harmony.

A-rule 17: ATR assimilation



A-rule 17 states prevents that a [+ATR] time slot precedes a time slot that is [–ATR] and [-low] in the same word. The feature [–low] is included in this word structure condition to describe the fact that the vowel [**a**] blocks ATR-harmony. The word boundary is essential in the structure condition and the related repair rule because [+ATR] harmony does not cross word boundaries. The fact that intervening consonants are not linked to the ATR tier makes it possible for the feature [+ATR] to spread to a vowel in a preceding syllable skipping the intervening consonants without causing the crossing of association lines. On the ATR tier vowels are adjacent. The tier containing the autosegmental feature ATR is

only linked to vowels and not to consonantal time slots. An argument for this can be found in the fact that the approximants [**w**] and [**y**] do not cause ATR-harmony even though they do not differ much in their feature specification from the vocalic approximants [**u**] and [**i**]. The following examples show that the feature [+ATR] linked to the high vowels [**i**] and [**u**] is spread to preceding vowels in the same word but [+ATR] spreading does not take place before the glides [**y**] and [**w**].

kɔyⁿgal	'foot'
jɔyrɛ	'cleverness'
jɔwrɔ	'owner' (short for **jɔm-wurɔ**)
ɲɔɔwdɛ	'to sow'
rɛwɓɛ	'women'
nɛwrɛ	'hand palm'
ɓɛyɗɔ	'woman who bore a child'
ɓɛydaari	'increase'

The [–ATR] vowels [ɛ] and [ɔ] in the stem become [+ATR] vowels [**e**] and [**o**] only when followed by a [+ATR] vowel in the following syllable. The occurrence of the approximants [**w**] and [**y**] does not have any influence on the vocalic quality of the [–ATR] vowels [ɛ] and [ɔ]. This is also evidence for the fact that the change from [ɛ] to [**e**] and from [ɔ] to [**o**] is caused by ATR-harmony, not by assimilation in tongue height .

Paradis (1986, 1992) and Dunn (1987, 1989) describe the Pulaar dialect spoken in Mauritania. Both Paradis (1986:138) and Dunn (1987:20) give five phonemic vowels [**a**, ɛ, ɔ, **i**, **u**]. They are the first to mention the ATR vocalic harmony and its phonological role in the occurrence of the allophony between the vowels **e** / ɛ and the vowels **o** / ɔ. They state that the vowels [**e**, **o**] are derived from the underlying vowels [ɛ, ɔ] respectively. A rule spreading the feature [+ATR] changes the [–ATR] vowels [ɛ, ɔ] to [+ATR] when followed by the [+ATR] vowels. In their framework an element which is the equivalent of the feature [+ATR] spreads from the [+ATR] vowels [**i**, **u**] on to the vowels [ɛ, ɔ].

Like in Pulaar (Paradis 1986:142), the feature [+ATR] only spreads to preceding vowels in the Maasina dialect and in the Ringimaaji dialect. The harmony span, that is the phonological domain in which the harmony rule is operating in both dialects, is the word. The feature [+ATR] spreads leftwards until the boundary of the phonological word. The harmony therefore is not necessarily displayed on the whole phonological word since [+ATR] spreading does not go rightward. The ATR-harmony (as both Paradis and Dunn also state) is blocked by the vowel [**a**]. The following words are given to show that ATR-harmony is blocked by the vowel [**a**].

jɛɛ-tati	'eight' (5+3)
jee-ɗiɗi	'seven' (5+2)
dɛf-aali	'has not cooked'
def-ii	'has cooked'

The final [+ATR] vowel [**i**] in the morpheme **-tati** does not have an effect on the vowel [ɛɛ] in the form **jɛɛ-** (a contraction of ***jɔy** 'five' + ʔɛ 'and'). An intervening vowel [**a**] in

the verbal conjugational suffix **-aali** also blocks ATR-harmony of the vowel [ɛ] in the morpheme **dɛf-** 'cook'. But the vowel [ɛ] becomes the [+ATR] vowel [e] when it precedes a [+ATR] vowel directly as in **defii** 'has cooked' and **jeeɗiɗi** 'seven'.

Both Dunn and Paradis present the vowels in the suffixes of the classes **ⁿgel** and **ⁿgol** underlyingly always as identical to the [+ATR] vowels [e, o]. There is no adjacent [i] or [u] present that could have caused the spreading of an [+ATR] feature (or element). Yet they do not include the vowels [e] and [o] in the phonological vowel inventory. Paradis does not include them for economic reasons: she claims that the number of morphemes is too small to call the vowel phonemic. Only the following morphemes in Pulaar occur with a [+ATR] vowel [e, o] without a conditioning adjacent [+ATR] vowel present.

gel	class suffix
gol	class suffix
fof	'all'
gorgol	'aunt' (perhaps suffix **gol**)

Paradis (1986:147) presumes a floating vowel in the underlying representation of these morphemes. This [+ATR, +high] floating vowel is deleted after predicting the [+ATR] vowel quality of the vowels. The deletion is explained by its occurrence in closed syllables where long vowels have a tendency to be shortened.

In the Maasina data there are several other morphemes which have the vowels [e] and [o] occurring as the underlying segments in the lexical form. There is no evidence for an underlying [+ATR] vowel [i] or [u] in these morphemes. The [+ATR] vowels [e] and [o] occur without any other [+ATR] vowel following. These underlying [+ATR] vowels trigger ATR-harmony in the preceding syllables of the same word. The following list are words which contain underlying vowels [e] or [o].

ⁿgel	NGEL class concord
ⁿgol	NGOL class concord
koy	KOY class concord
kol	KOL class concord
to	'there, yonder'
ley	'under, on, in'
dow	'above, on, in'
dee	'subsequently'
bey	'goats' (short for **behi** or **beʔi**)

The vowels in the preceding morphemes become [+ATR] when these morphemes with underlying vowels [e] or [o] are combined with other morphemes in a word. Many examples of ATR-harmony caused by [e] or [o] can be found since the suffixes **-ⁿgel** (also **-el**, **-wel**, **-gel**) and **-koy** (also **-oy**, **-woy**) form the singular and plural of the diminutive (which are productive word formations).

gɔr-kɔ	'man'
wɔr-ɓɛ	'men'
gor-el	'small man'
ⁿgor-oy	'small men'

The number of morphemes in which the [+ATR] vowels [**e**] and [**o**] occur underlyingly is perhaps marginal, but the number of words in which these affixes trigger [+ATR] harmony is considerable. The [+ATR] vowels have to be postulated underlyingly in order to correctly derive the vowel harmony with preceding vowels in the same word. Paradis' proposal of "floating" vowels that are [+ATR] reflects a possible historical development of the vowels [**e**] and [**o**]. It is also possible that historically [+high, +ATR] vowels have lowered their vowel height in a closed syllable. The cognate morpheme of the class suffix **ⁿgel** in other Fulfulde dialects are **ⁿgil** (speaker from the south of Mali) and **ⁿgii** (Fuuta Jallon) which indicates the possible occurrence of the [+high, +ATR] vowel [**i**] in the proto-Fulfulde form of this suffix. An example like **bey** 'goats' shows that an underlying vowel [**e**] has been followed by a [+ATR] vowel [**i**] historically. The plural forms **behi** or **beʔi** 'goats' which occur in other dialects confirm this. The list of morphemes with an underlying [**e**] or [**o**] is not impressive. For practical reasons a five vowel orthography is still the best recommendation. Nevertheless, the set of words where the occurrence of [**e**] or [**o**] is not phonologically conditioned points to the development of the phonemic status of these vowels, even if these vowels have a limited distribution. In this study, Fulfulde is analyzed with seven vowels whereby the occurrence of the vowels [**e**] and [**o**] can often be predicted by the application of ATR vowel harmony.