

CALCULATING DIFFERENCES IN PHONOLOGICAL FEATURES OF CONSONANTS  
IN A SAMPLE OF 25 BANTU LANGUAGES

A course paper in Statistics

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## **1. Introduction\***

### **1.1 The main objective**

The main objective of the present study is two-fold: (1) an investigation of the possibility of employing a numerical calculation in order to determine the relationships between a sample of sub-Saharan Bantu languages; and (2) basing this on the differences in phonological features of selected morphological elements.

Whether or not we can draw diachronic conclusions from the material is a question the present essay intends to answer.

Numerical calculations of relationships between languages have, admittedly, already been done by several people, in particular the so-called glottochronologists (cf. Hymes 1960ab, Embleton 1986; see also Maho 1992). The present study also has clear connections to the relatively recent method of dialectometrics which intends at providing a synchronic status quo description of phonological, morphological and possibly also syntactical characteristics of a sample of languages (cf. Goebel 1982, Guarisma & Möhlig 1988; see also Vossen 1984 who uses both glottochronology and dialectometrics).

### **1.2 What follows below**

What follows below, then, is firstly a description of the languages and linguistic elements chosen. Then follows a detailed run-through, in part 3, of the procedure employed. In parts 4 and 5, the results are presented and discussed. Part 6, finally, aims at summing up the essay.

## **2. Some choices and the problems connected with them**

### **2.1 The languages chosen**

A sample of 25 Bantu languages have been chosen (see table 1 and figure 1). The Bantu languages cover more or less entire sub-Saharan Africa (save western Africa). The letter-codes used to identify languages in table 1, and elsewhere, are from Guthrie (1967-1971).

All Bantu languages are supposedly descendants of a common parent language, called proto-Bantu, which customarily is placed somewhere in the southern parts of present Cameroon.

Various authorities differ in their datings of this proto-language, but a rough estimate would be somewhere around 3 to 5 thousands years ago. Thus we can assume the chosen morphological elements (see below) to be directly, or rather etymologically, comparable.

The choice of languages have mainly been based on the (un)availability of literature. From a methodological point of view, this is certainly not a basis for choice that is recommendable in order to get a representative sample but, nonetheless, the most practical.

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\* Acknowledgements are rightfully due to Roeland van Hout for valuable hints and comments and Johan Hagman for letting me use his incredible program (although I didn't actually USE it, he did it for me).

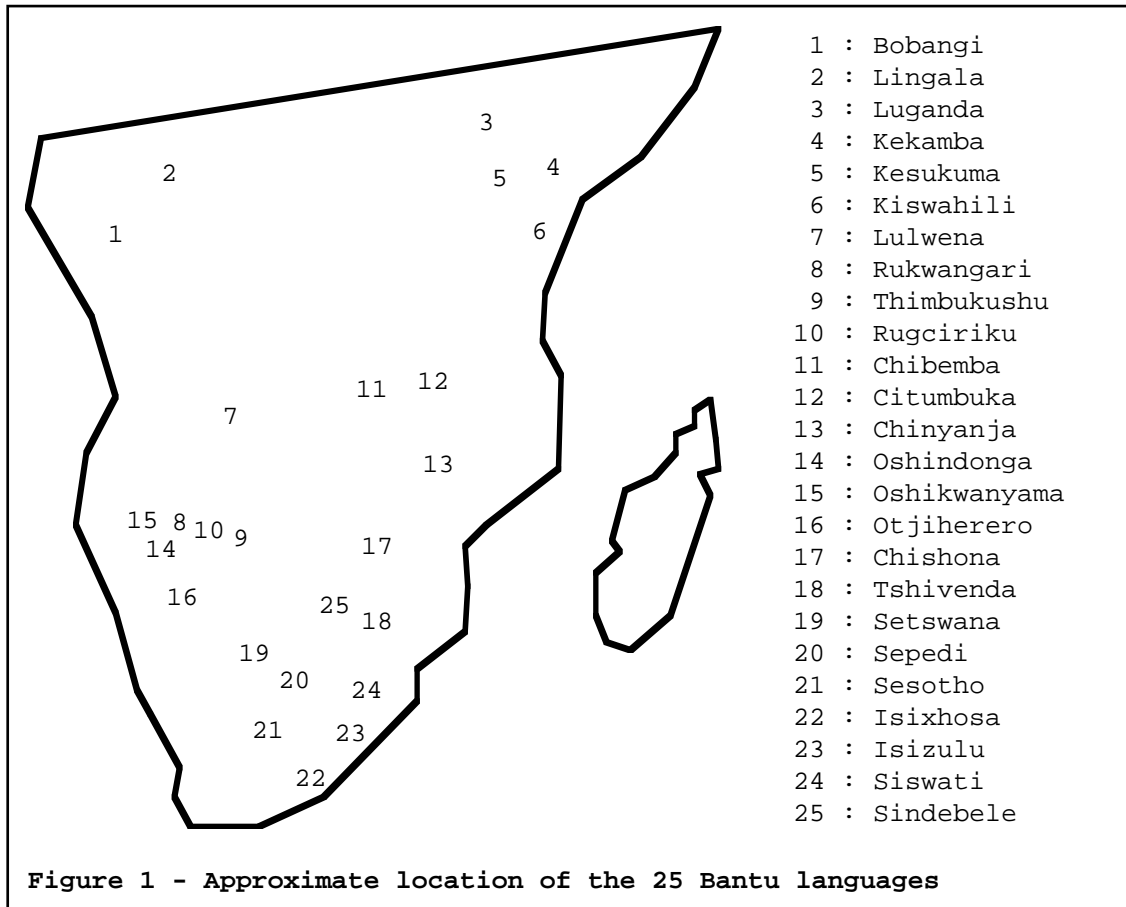
<b>TABLE 1 - LIST OF LANGUAGES</b>			
<b>Language</b>	<b>Number</b>	<b>Spoken in (approximately)</b>	<b>Main reference</b>
Bobangi	C32 (1)	Zaire	Whitehead 1899
Lingala	C36d (2)	Zaire	Guthrie 1988
Luganda	E15 (3)	Uganda	Cole 1965
Kekamba	E55 (4)	Kenya	Whiteley & Muli 1962
Kesukuma	F21 (5)	Tanzania	Batibo 1985
Kiswahili	G42 (6)	Kenya, Tanzania	Perrott 1957
Lulwena	K14 (7)	Angola, Zambia	White 1949
Rukwangari	K33 (8)	Angola, Namibia	Dammann 1957
Thimbukushu	K43 (9)	Angola, Namibia	Fisch 1977
Rugciriku	K62 (10)	Angola, Namibia	Möhlig 1967
Chibemba	M42 (11)	Tanzania, Zambia	van Sambeek 1955
Citumbuka	N21 (12)	Malawi	Vail 1971
Chinyanja	N31a (13)	Malawi, Zambia	Price 1946
Oshikwanyama	R21 (14)	Angola, Namibia	Turvey et al. 1977
Oshindonga	R22 (15)	Angola, Namibia	Fivaz 1986
Otjiherero	R31 (16)	Namibia	Booyesen 1982
Chishona	S12 (17)	Zimbabwe	Fortune 1957
Tshivenda	S21 (18)	South Africa	Ziervogel et al. 1981
Setswana	S31 (19)	Botswana, South Africa	Cole 1955
Sepedi	S32 (20)	South Africa	Lombard et al. 1985
Sesotho	S33 (21)	Lesotho, South Africa	Guma 1971
Isixhosa	S41 (22)	South Africa	Louw 1978
Isizulu	S42 (23)	South Africa	Doke 1961
Siswati	S43 (24)	South Africa, Swaziland	Ziervogel & Mabuza 1976
Sindebele	S44 (25)	South Africa, Zimbabwe	O'Neil 1912

The restricted availability of literature is mainly due to the fact that there are few good and modern grammar descriptions of Bantu languages published and also that those that indeed are published are not always readily accessible from cold and far away Scandinavia. Still, disregarding the languages that could have been chosen and only considering those that actually were chosen, there are a few points that need to be stressed.

Firstly, the grammar descriptions used to extract the linguistic data have been publicized during a time span of almost one hundred years (or to be more exact, from 1899 to 1988). This naturally reflects the way in which the languages are described. Thus the morphological data used may present differences due to factors other than actual ``structural`` ones.

One could of course question if it is appropriate to compare languages from such diverse temporal settings and still claim the study to be synchronic. However, the need to expand the sample of languages together with the restricted (un)availability of literature more or less forced the present choice. Still, if the method itself proves useful, any future calculations will unquestionably have to be based on a sample selected on other (and better) criteria.

Secondly, various authors stress different things in their descriptions which means that the relevant information needed for the present study has not been easily accessible from all grammar descriptions. This is especially true with regard to the so-called locative classes/genders (16, 17 and 18; see more below on these) which in some languages employ agreement morphemes while not doing so in others. Unfortunately, not all authors make it explicitly clear whatever case is the case, which is the main reason they have been ignored in the present study (see more below).



Thirdly, partly due to the time span of publication dates and also due to the fact that various authors employ different theoretical frameworks when describing a language, it is not always clear if a certain morpheme in a certain language is comparable to another morpheme in another language. In particular, this concerns the etymological status of gender 8, 10 and 10-9 (see more below). Thus, for example, what I have considered to be gender 10 is in languages 19 through 25 traditionally described as being gender 8. However, as Doke (1967) argues, these should in fact be considered to be gender 10 and not 8.

## 2.2 The genders chosen

The Bantu languages display a rich set of genders (usually between ten and fifteen) and thus they also have a rich set of gender agreement morphemes.

The proto-Bantu language is customarily said to have exhibited either 19 or 23 genders, depending on authority believed. The former number stems from Guthrie (1967-1971) and the latter from Meinhof (1899).

Table 2 below, which is based on Welmers (1973), displays some general characteristics of the Bantu genders or, as they are normally called, nominal classes. The genders are, in order to facilitate inter-linguistic comparisons, by tradition numbered 1 through 19 (or 23). This system was initially created by Bleek (1862) and later supplemented by Meinhof (1899) and others, thus it is usually called the Bleek-Meinhof-system.

Class	Prefix	Semantic domain
1	*mu-	humans
1a	-	kins, proper names, personifications, animals
2	*ʃa-/*ba-	plural to class 1
2a	-	plural to class 1a
2b	-	plural to class 1a
3	*mu-/*mu-	trees, plants, inanimates
4	*mi-/*mĩ-	plural to class 3
5	*dĩ-/*lĩ-	miscellaneous, augmentatives (rarely, infinitives)
6	*ma-	plural to classes 5, 11, 14 and-or 15
6a	*ma-	liquids
7	*kĩ-	miscellaneous, diminutives, augmentatives, manner/style
8	*ʃĩ-/*bĩ-	plural to class 7
9	*nĩ-	animals, inanimates
10	*dĩ-/*lĩ-	plural to class 9 (sometimes 7)
10-9	*dĩ-nĩ-/*lĩ-nĩ-	plural to class 9 and-or class 11
11	*du-/*lu-	long thin things, abstracts
12	*ka-	diminutives
13	*tu-	plural to class 12 and-or class 11
14	*ʃu-/*bu-	abstracts, pluralia tantum, plural to class 12
15	*ku-	infinitives
16	*pa-	locatives; near or explicit
17	*ku-	locatives; remote or general
18	*mu-	locatives; inside
19	*pĩ-	diminutives
20	*Yu-	augmentatives, diminutives
21	*Yĩ-	augmentatives, pejoratives
22	*Ya-	plural to class 20
23	*Yĩ-	locative (unspecified)

**Table 2 - General (semantic) characteristics of the Bantu nominal genders.**

Note that one of the genders is numbered 10-9, due to the fact that this gender was originally a composite gender of genders 10 and 9 but had already in proto-Bantu, it is assumed, become a gender of its own (see also Cole 1967).

Only genders 1 through 18 are generally spread across the Bantu area. Three of these (16-18) usually have locative significance and seldom function as ``appropriate`` genders and we will disregard from these in the present study. These genders very often seem to lack proper series of agreement morphemes, since they are mostly used comparable to European prepositional phrases, i.e. indicating spatiality with regard to the noun concerned, and not as genders categorizing nouns.

Genders 19 through 23 have likewise been ignored since these are not very well described in the literature and, as is the case with genders 16 through 18, they do not function as ``proper`` genders, especially in the South African languages.

Note also that, for matters of simplicity, we will ignore genders 1a, 2a, 2b, and 6a, the last of which is morphologically and phonologically identical to gender 6. Genders 1a, 2a and 2b are usually variants of classes 1 and 2 (hence the subordinate numbering) though they do display structural differences with regard to the nominal gender markers. These have nevertheless been ignored.

Thus only genders 1 through 15 have been chosen for this study. Ideally, of course, all possible genders should have been taken into account. However, not all grammar descriptions are equally good in describing particularly the agreement morphemes, especially with regard to classes 16 through 23. Also, it is not always clear what exactly are the classes present in each language.

TABLE 3 - GENDERS IN THE CHOSEN LANGUAGES																								
Lg	Genders																							
	1	2	3	4	5	6	7	8	9	10	-9	11	12	13	14	15	16	17	18	19	20	21	22	23
1	+	+	+	+	+	+	+	+	+	-	+	+	-	-	+	+	?	?	?	?	?	?	?	?
2	+	+	+	+	+	+	+	+	+	-	+	+	-	-	+	+	?	?	?	?	?	?	?	?
3	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	+	-	+	+
4	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-
5	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-
6	+	+	+	+	+	+	+	+	+	-	+	-	-	-	+	+	+	+	+	-	-	-	-	-
7	+	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	-	-	-	-	-
8	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-
9	+	+	+	?	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-
10	+	+	+	-	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-
11	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-
12	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-
13	+	+	+	+	+	+	+	+	-	+	+	-	+	+	+	+	+	+	+	-	-	-	-	-
14	+	+	+	+	+	+	+	+	+	-	+	+	+	-	+	+	+	+	+	-	-	-	-	-
15	+	+	+	+	+	+	+	+	+	-	+	+	+	-	+	+	+	+	+	-	-	-	-	-
16	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	-	-	-	-
17	+	+	+	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+	+	-	-	+	-
18	+	+	+	+	+	+	+	+	+	-	+	+	-	-	+	+	+	+	+	-	+	+	-	-
19	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	+	+	+	-	-	-	-	-
20	+	+	+	+	+	+	+	-	+	+	+	-	-	-	+	+	+	+	+	-	-	-	-	-
21	+	+	+	+	+	+	+	-	+	+	+	-	-	-	+	+	+	+	-	-	-	-	-	-
22	+	+	+	+	+	+	+	-	+	+	+	+	-	-	+	+	+	+	-	-	-	-	-	?
23	+	+	+	+	+	+	+	-	+	+	+	+	-	-	+	+	+	+	-	-	-	-	-	?
24	+	+	+	+	+	+	+	-	+	+	+	+	-	-	+	+	+	+	+	-	-	-	-	?
25	+	+	+	+	+	+	+	-	+	+	+	+	-	-	+	+	+	+	-	-	-	-	-	?

Table 3 below displays the full set of genders present (or rather, traditionally considered to be present) in the sample of selected Bantu languages.

There is, however, another kind of problem that has been over-looked in the present study. For instance, in Thimbukushu (language no. 9) we find a remnant of gender 4 in the form of a nominal gender marker, but we find no agreement morphemes of this gender. Those nouns that take the gender 4 prefix employ the agreement morphemes of gender 10. Unfortunately, these kinds of changes (though being few) are not reflected in the calculations made below.

Yet another problem is that the genders are paired in certain ways, e.g. nouns in gender 1 are all singular. The plural forms of these are found in gender 2. Likewise, singular nouns in gender 7 have their plural correspondences in gender 8. However, in languages 19 through 25, we find that the plural of gender 7 is actually gender 10. If there are no phonological or morphological differences between the gender morphemes in two certain languages then the below described method will not be able to detect differences solely in differing systems of singular/plural-pairings. In future calculations however, this will have to be retriplied somehow.

We will, nonetheless, return to these and other matters (e.g. the classification of animate nouns) in the final discussion (see parts 4 and 5 below).

### 2.3 The morphemes chosen

Four types of agreement morphemes have been picked out for the present study: the gender marker on nouns (or the so-called class prefix), the gender agreement marker on adjectives plus the subjective and objective markers on finite verbs.

Table 4 below displays the full set of chosen morphemes, arranged according to language. Note that absent genders have been marked with a dash (-) in the below table.

<b>TABLE 4 - AGREEMENT MORPHEMES (ARRANGED BY LANGUAGE)</b>					
<b>Language</b>	<b>Gender</b>	<b>Nominal marker</b>	<b>Subjectival marker</b>	<b>Objectival marker</b>	<b>Adjectival marker</b>
C.32	1	mò	á	mò	mò
C.32	2	bà	bá	bà	bà
C.32	3	mò	mó	mó	mò
C.32	4	mì	mí	mí	mì
C.32	5	lì	lí	lí	lì
C.32	6	mà	má	má	mà
C.32	7	è	è	è	è
C.32	8	bì	bí	bí	bì
C.32	9	N	è	è	è
C.32	10	-	-	-	-
C.32	10.9	N	lí	lí	lì
C.32	11	lò	ló	ló	lò
C.32	12	-	-	-	-
C.32	13	-	-	-	-
C.32	14	bò	bó	bó	bò
C.32	15	kò	kó	kó	kò
C.36d	1	mò	a	ø	mæ
C.36d	2	bà	ba	ø	ba
C.36d	3	mò	e	ø	mo
C.36d	4	mì	i	ø	mì
C.36d	5	lì	e	ø	li
C.36d	6	mà	i	ø	ma
C.36d	7	è	e	ø	e
C.36d	8	bì	i	ø	bi
C.36d	9	N	e	ø	N
C.36d	10	-	-	-	-
C.36d	10.9	N	i	ø	N
C.36d	11	lò	i	ø	lo
C.36d	12	-	-	-	-
C.36d	13	-	-	-	-
C.36d	14	bò	i	ø	bo
C.36d	15	kò	i	ø	ko
E.15	1	omu	a	mu	omu
E.15	2	aʃa	ʃa	ʃa	aʃa
E.15	3	omu	gu	gu	omu
E.15	4	emi	gi	gi	emi
E.15	5	e	li	li	li
E.15	6	ama	ga	ga	ama
E.15	7	eki	ki	ki	eki
E.15	8	eʃi	ʃi	ʃi	eʃi
E.15	9	eN	e	gi	eN
E.15	10	-	-	-	-
E.15	10.9	eN	zi	zi	eN
E.15	11	olu	lu	lu	olu
E.15	12	aka	ka	ka	aka
E.15	13	otu	tu	tu	otu
E.15	14	oʃu	bu	bu	oʃu
E.15	15	oku	ku	ku	oku
E.55	1	mo	mo	mo	mo
E.55	2	a	me	ma	a

E.55	3	mo	o	wo	mo
E.55	4	me	e	me	me
E.55	5	e	ye	ye	e
E.55	6	ma	ma	ma	ma
E.55	7	ke	ke	ke	ke
E.55	8	i	si	i	N
E.55	9	N	e	me	N
E.55	10	-	-	-	-
E.55	10.9	N	si	i	N
E.55	11	o	w	wo	mo
E.55	12	ka	ka	ka	ka
E.55	13	to	to	tw	to
E.55	14	o	o	wo	mo
E.55	15	ko	ko	ko	ko
F.21	1	mu	o	mu	mu
F.21	2	ba	ba	ba	ba
F.21	3	mu	go	go	mu
F.21	4	mi	e	ye	mi
F.21	5	li	le	le	li
F.21	6	maa	ga	ga	ma
F.21	7	ke	Si	ke	ke
F.21	8	Si	Si	Si	Si
F.21	9	Ni	e	ye	Ni
F.21	10	-	-	-	-
F.21	10.9	Ni	ji	ji	Ni
F.21	11	lo	lo	lo	lo
F.21	12	kaa	ka	ka	ka
F.21	13	too	to	to	to
F.21	14	bo	bo	bo	bo
F.21	15	ko	ko	ko	ko
G.42	1	m	a	a	m
G.42	2	wa	wa	wa	wa
G.42	3	m	u	u	m
G.42	4	mi	i	i	mi
G.42	5	yi	li	li	yi
G.42	6	ma	ya	ya	ma
G.42	7	ki	ki	ki	ki
G.42	8	vi	vi	vi	vi
G.42	9	N	i	i	N
G.42	10	-	-	-	-
G.42	10.9	N	zi	zi	N
G.42	11	-	-	-	-
G.42	12	-	-	-	-
G.42	13	-	-	-	-
G.42	14	u	u	u	m
G.42	15	ku	ku	ku	ku
K.14	1	mu	a	mu	mu
K.14	2	ʃa	ʃa	ʃa	ʃa
K.14	3	mu	u	u	u
K.14	4	mi	yi	yi	yi
K.14	5	li	li	li	li
K.14	6	ma	a	a	ma
K.14	7	tɕi	tɕi	tɕi	tɕi
K.14	8	ʃi	ʃi	ʃi	ʃi
K.14	9	N	yi	yi	yi
K.14	10	ji	ji	ji	ji
K.14	10.9	-	-	-	-
K.14	11	lu	lu	lu	lu
K.14	12	ka	ka	ka	ka

K.14	13	tu	tu	tu	tu
K.14	14	u	u	u	u
K.14	15	ku	tçi	tçi	tçi
K.33	1	mu	a	mu	mu
K.33	2	va	va	va	va
K.33	3	mu	gu	gu	mu
K.33	4	-	-	-	-
K.33	5	e	li	li	e
K.33	6	ma	ga	ga	ma
K.33	7	si	si	si	si
K.33	8	i	yi	yi	i
K.33	9	N	zi	zi	N
K.33	10	-	-	-	-
K.33	10.9	noN	di	di	noN
K.33	11	ru	ru	ru	ru
K.33	12	ka	ka	ka	ka
K.33	13	tu	tu	tu	tu
K.33	14	u	u	u	u
K.33	15	ku	ku	ku	ku
K.43	1	mu	ɣa	mu	mu
K.43	2	ha	ha	wa	ha
K.43	3	mu	ɣu	ɣu	ɣu
K.43	4	mi	ði	ði	ði
K.43	5	di	di	di	di
K.43	6	ma	ɣa	ɣa	ma
K.43	7	Øi	Øi	Øi	Øi
K.43	8	yi	yi	yi	yi
K.43	9	N	ɣa	mu	mu
K.43	10	-	-	-	-
K.43	10.9	N	ði	ði	ði
K.43	11	ru	ru	ru	ru
K.43	12	ka	ka	ka	ka
K.43	13	tu	tu	tu	tu
K.43	14	ɣu	ɣu	ɣu	ɣu
K.43	15	ku	ku	ku	ku
K.62	1	mu	w	mu	mu
K.62	2	βa	βa	βa	βa
K.62	3	mu	u	u	mu
K.62	4	-	-	-	-
K.62	5	li	li	li	li
K.62	6	ma	ɣa	ɣa	ma
K.62	7	Si	Si	Si	Si
K.62	8	βi	βi	βi	βi
K.62	9	N	yi	yi	N
K.62	10	-	-	-	-
K.62	10.9	di	di	di	di
K.62	11	ru	ru	ru	ru
K.62	12	ka	ka	ka	ka
K.62	13	tu	tu	tu	tu
K.62	14	u	ɣu	ɣu	ɣu
K.62	15	ku	ku	ku	ku
M.42	1	umu	a	mu	mu
M.42	2	aβa	βa	βa	βa
M.42	3	umu	u	u	u
M.42	4	imi	i	i	i
M.42	5	ili	li	li	li
M.42	6	ama	ya	ya	ya
M.42	7	itçi	tçi	tçi	tçi
M.42	8	ifi	fi	fi	fi

M.42	9	iN	i	i	i
M.42	10	-	-	-	-
M.42	10.9	iN	Si	Si	Si
M.42	11	ulu	lu	lu	lu
M.42	12	aka	ka	ka	ka
M.42	13	utu	tu	tu	tu
M.42	14	uʃu	ʃu	ʃu	ʃu
M.42	15	uku	ku	ku	ku
N.21	1	mu	wa	mu	mu
N.21	2	ʃa	ʃa	ʃa	ʃa
N.21	3	mu	wu	wu	wu
N.21	4	mi	yi	yi	yi
N.21	5	li	li	li	li
N.21	6	ma	ʒa	ʒa	ʒa
N.21	7	ci	ci	ci	ci
N.21	8	vi	vi	vi	vi
N.21	9	N	yi	yi	yi
N.21	10	-	-	-	-
N.21	10.9	ziN	zi	zi	zi
N.21	11	lu	lu	lu	lu
N.21	12	ka	ka	ka	ka
N.21	13	tu	tu	tu	tu
N.21	14	u	wu	wu	wu
N.21	15	ku	ku	ku	ku
N.31a	1	mu	a	mu	wa
N.31a	2	a	a	wa	a
N.31a	3	mu	u	u	wa
N.31a	4	mi	i	i	ya
N.31a	5	li	li	li	la
N.31a	6	ma	a	wa	a
N.31a	7	tçi	tçi	tçi	tça
N.31a	8	-	-	-	-
N.31a	9	N	i	i	ya
N.31a	10	ti	ti	ti	ta
N.31a	10.9	zi	zi	zi	za
N.31a	11	-	-	-	-
N.31a	12	ka	ka	ka	ka
N.31a	13	ti	ti	ti	ta
N.31a	14	u	u	u	wa
N.31a	15	ku	ku	ku	kwa
R.21	1	omu	mu	mu	mu
R.21	2	ova	va	va	va
R.21	3	omu	u	u	mu
R.21	4	omi	di	di	di
R.21	5	e	li	li	li
R.21	6	oma	ma	a	ma
R.21	7	oSi	Si	Si	Si
R.21	8	oi	i	i	i
R.21	9	oN	i	i	i
R.21	10	-	-	-	-
R.21	10.9	eeN	di	di	di
R.21	11	olu	lu	lu	lu
R.21	12	oka	ka	ka	ka
R.21	13	-	-	-	-
R.21	14	ou	u	u	u
R.21	15	oku	ku	ku	ku
R.22	1	omu	a	mu	omu
R.22	2	aa	ya	ya	aa
R.22	3	omu	ʒu	ʒu	omu

R.22	4	omi	ði	ði	ooN
R.22	5	e	li	li	e
R.22	6	oma	ʎa	ʎa	oma
R.22	7	oSi	Si	Si	oSi
R.22	8	ii	yi	yi	ii
R.22	9	oN	yi	yi	oN
R.22	10	-	-	-	-
R.22	10.9	ooN	ði	ði	ooN
R.22	11	olu	lu	lu	olu
R.22	12	oka	ka	ka	oka
R.22	13	-	-	-	-
R.22	14	uu	wu	wu	uu
R.22	15	oku	ku	ku	oku
R.31	1	omu	ø	mu	omu
R.31	2	ova	ve	ve	ova
R.31	3	omu	u	u	omu
R.31	4	omi	vi	vi	omi
R.31	5	e	ri	ri	e
R.31	6	oma	ye	ye	oma
R.31	7	otçi	tçi	tçi	otçi
R.31	8	ovi	vi	vi	ovi
R.31	9	o	i	i	o
R.31	10	-	-	-	-
R.31	10.9	odo	ðe	ðe	odo
R.31	11	oru	ru	ru	oru
R.31	12	oka	ke	ke	oka
R.31	13	otu	tu	tu	otu
R.31	14	ou	u	u	ou
R.31	15	oku	ku	ku	oku
S.12	1	mú	a	mu	mu
S.12	2	ʃá	ʃa	ʃa	ʃa
S.12	3	mú	u	u	mu
S.12	4	mí	i	i	mí
S.12	5	rí	ri	ri	ri
S.12	6	áa	a	a	ma
S.12	7	tçi	tçi	tçi	tçi
S.12	8	zwí	zwi	zwi	zwi
S.12	9	N	i	i	N
S.12	10	-	-	-	-
S.12	10.9	øN	dzi	dzi	N
S.12	11	rú	ru	ru	ru
S.12	12	ká	ka	ka	ka
S.12	13	tú	tu	tu	tu
S.12	14	ʃú	hu	hu	hu
S.12	15	kú	ku	ku	ku
S.21	1	mu	u	mu	mu
S.21	2	ʃa	ʃa	ʃa	ʃa
S.21	3	mu	u	u	mu
S.21	4	mí	i	i	mí
S.21	5	li	li	li	li
S.21	6	ma	a	a	ma
S.21	7	tSi	tSi	tSi	tSi
S.21	8	zwi	zwi	zwi	zwi
S.21	9	N	i	i	N
S.21	10	-	-	-	-
S.21	10.9	dziN	dzi	dzi	dziN
S.21	11	lu	lu	lu	lu
S.21	12	-	-	-	-
S.21	13	-	-	-	-

S.21	14	ɸu	ɸu	ɸu	ɸu
S.21	15	u	hu	hu	hu
S.31	1	mo	o	mo	mo
S.31	2	ba	ba	ba	ba
S.31	3	mo	o	o	mo
S.31	4	me	e	e	me
S.31	5	le	le	le	le
S.31	6	ma	a	a	ma
S.31	7	se	se	se	se
S.31	8	-	-	-	-
S.31	9	N	e	e	N
S.31	10	di	di	di	tsediN
S.31	10.9	diN	di	di	diN
S.31	11	lo	lo	lo	lo
S.31	12	-	-	-	-
S.31	13	-	-	-	-
S.31	14	bo	bo	bo	bo
S.31	15	xo	xo	xo	xo
S.32	1	mo	o	mo	yø
S.32	2	ba	ba	ba	ba
S.32	3	mo	o	o	wø
S.32	4	me	e	e	yæ
S.32	5	le	le	le	læ
S.32	6	ma	a	a	a
S.32	7	se	se	se	sæ
S.32	8	-	-	-	-
S.32	9	N	N	e	yæ
S.32	10	di	di	di	tSædiN
S.32	10.9	diN	di	di	tSæN
S.32	11	-	-	-	-
S.32	12	-	-	-	-
S.32	13	-	-	-	-
S.32	14	bo	bo	bo	byø
S.32	15	xo	xo	xo	mø
S.33	1	mo	ó	mo	émò
S.33	2	ba	bá	ba	bábà
S.33	3	mo	ó	o	ómò
S.33	4	me	é	e	émè
S.33	5	le	lé	le	lélè
S.33	6	ma	á	a	ámà
S.33	7	se	sé	se	sésè
S.33	8	-	-	-	-
S.33	9	N	é	e	éN
S.33	10	li	lí	li	tséN
S.33	10.9	liN	lí	li	tséN
S.33	11	-	-	-	-
S.33	12	-	-	-	-
S.33	13	-	-	-	-
S.33	14	bo	bó	bo	bóbò
S.33	15	ho	hó	ho	hóhò
S.41	1	umu	u	m	mu
S.41	2	a6a	ba	6a	6a
S.41	3	umu	u	wu	m
S.41	4	imi	i	yi	mi
S.41	5	ili	li	li	li
S.41	6	ama	a	wa	ama
S.41	7	isi	si	si	si
S.41	8	-	-	-	-
S.41	9	iN	i	yi	iN

S.41	10	izi	zi	zi	zi
S.41	10.9	iziN	zi	zi	zi
S.41	11	ulu	lu	lu	lu
S.41	12	-	-	-	-
S.41	13	-	-	-	-
S.41	14	u6u	6u	6u	6u
S.41	15	uku	ku	ku	oku
S.42	1	umu	u	m	om
S.42	2	a6a	6a	6a	a6a
S.42	3	umu	u	wu	om
S.42	4	imi	i	yi	emi
S.42	5	ili	li	li	eli
S.42	6	ama	a	wa	ama
S.42	7	isi	si	si	esi
S.42	8	-	-	-	-
S.42	9	iN	i	yi	eN
S.42	10	izi	zi	zi	eziN
S.42	10.9	iziN	zi	zi	eziN
S.42	11	ulu	lu	lu	olu
S.42	12	-	-	-	-
S.42	13	-	-	-	-
S.42	14	u6u	6u	6u	o6u
S.42	15	uku	ku	ku	oku
S.43	1	umu	u	mu	amu
S.43	2	ba	ba	ba	ba
S.43	3	umu	u	wu	mu
S.43	4	imi	i	yi	mi
S.43	5	li	li	li	li
S.43	6	ema	a	wa	ma
S.43	7	si	si	si	si
S.43	8	-	-	-	-
S.43	9	iN	i	yi	iN
S.43	10	ti	ti	ti	ti
S.43	10.9	tiN	ti	ti	tiN
S.43	11	lu	lu	lu	lu
S.43	12	-	-	-	-
S.43	13	-	-	-	-
S.43	14	bu	bu	bu	bu
S.43	15	ku	ku	ku	ku
S.44	1	umu	u	m	mu
S.44	2	aba	ba	ba	ba
S.44	3	umu	u	wu	mu
S.44	4	imi	i	yi	mi
S.44	5	ili	li	li	li
S.44	6	ama	a	wa	ma
S.44	7	isi	si	si	si
S.44	8	-	-	-	-
S.44	9	iN	i	yi	i
S.44	10	izi	zi	zi	zi
S.44	10.9	iziN	zi	zi	zi
S.44	11	ulu	lu	lu	lu
S.44	12	-	-	-	-
S.44	13	-	-	-	-
S.44	14	ubu	bu	bu	bu
S.44	15	uku	ku	ku	ku

## 2.4 The consonant phonemes

Since the respective vowel phonemes in the gender morphemes are subject to various assimilation rules to an extent that the consonants are not, the vowels have been ignored in the present study.

Thus, as generally is the case in comparative phonology, the consonants are believed to be more powerful in order to determine phonological relationships, especially when diachronic conclusions are desired. Hence the present study has focused on the phonology of the consonants.

After the above displayed morphemes have been ``stripped off`` the non-consonants, we arrive at table 5 below which is a simplified version of table 4. (See also table 8 further below for an explanation of the phonological symbols, or characters, employed.)

TABLE 5 - CONSONANTS IN GENDER AGREEMENT MARKERS (ARRANGED BY LANGUAGE)					
Language	Gender	Nominal marker	Subjectival marker	Objectival marker	Adjectival marker
C.32	1	m	V	m	m
C.32	2	b	b	b	b
C.32	3	m	m	m	m
C.32	4	m	m	m	m
C.32	5	l	l	l	l
C.32	6	m	m	m	m
C.32	7	V	V	V	V
C.32	8	b	b	b	b
C.32	9	N	V	V	V
C.32	10	-	-	-	-
C.32	10.9	N	l	l	l
C.32	11	l	l	l	l
C.32	12	-	-	-	-
C.32	13	-	-	-	-
C.32	14	b	b	b	b
C.32	15	k	k	k	k
C.36d	1	m	V	ø	m
C.36d	2	b	b	ø	b
C.36d	3	m	V	ø	m
C.36d	4	m	V	ø	m
C.36d	5	l	V	ø	l
C.36d	6	m	V	ø	m
C.36d	7	V	V	ø	V
C.36d	8	b	V	ø	b
C.36d	9	N	V	ø	N
C.36d	10	-	-	-	-
C.36d	10.9	N	V	ø	N
C.36d	11	l	V	ø	l
C.36d	12	-	-	-	-
C.36d	13	-	-	-	-
C.36d	14	b	V	ø	b
C.36d	15	k	V	ø	k
E.15	1	m	V	m	m
E.15	2	ß	ß	ß	ß
E.15	3	m	g	g	m
E.15	4	m	g	g	m
E.15	5	V	l	l	l

E.15	6	m	g	g	m
E.15	7	k	k	k	k
E.15	8	ß	ß	ß	ß
E.15	9	N	V	g	N
E.15	10	-	-	-	-
E.15	10.9	N	z	z	N
E.15	11	l	l	l	l
E.15	12	k	k	k	k
E.15	13	t	t	t	t
E.15	14	ß	b	b	ß
E.15	15	k	k	k	k
E.55	1	m	m	m	m
E.55	2	V	m	m	V
E.55	3	m	V	w	m
E.55	4	m	V	m	m
E.55	5	V	y	y	V
E.55	6	m	m	m	m
E.55	7	k	k	k	k
E.55	8	V	s	V	N
E.55	9	N	V	m	N
E.55	10	-	-	-	-
E.55	10.9	N	s	V	N
E.55	11	V	w	w	m
E.55	12	k	k	k	k
E.55	13	t	t	tw	t
E.55	14	V	V	w	m
E.55	15	k	k	k	k
F.21	1	m	V	m	m
F.21	2	b	b	b	b
F.21	3	m	g	g	m
F.21	4	m	V	y	m
F.21	5	l	l	l	l
F.21	6	m	g	g	m
F.21	7	k	S	k	k
F.21	8	S	S	S	S
F.21	9	N	V	y	N
F.21	10	-	-	-	-
F.21	10.9	N	j	j	N
F.21	11	l	l	l	l
F.21	12	k	k	k	k
F.21	13	t	t	t	t
F.21	14	b	b	b	b
F.21	15	k	k	k	k
G.42	1	m	V	V	m
G.42	2	w	w	w	w
G.42	3	m	V	V	m
G.42	4	m	V	V	m
G.42	5	y	l	l	y
G.42	6	m	y	y	m
G.42	7	k	k	k	k
G.42	8	v	v	v	v
G.42	9	N	V	V	N
G.42	10	-	-	-	-
G.42	10.9	N	z	z	N
G.42	11	-	-	-	-
G.42	12	-	-	-	-
G.42	13	-	-	-	-
G.42	14	V	V	V	m
G.42	15	k	k	k	k

K.14	1	m	V	m	m
K.14	2	ß	ß	ß	ß
K.14	3	m	V	V	V
K.14	4	m	Y	Y	Y
K.14	5	l	l	l	l
K.14	6	m	V	V	m
K.14	7	tç	tç	tç	tç
K.14	8	ß	ß	ß	ß
K.14	9	N	y	y	y
K.14	10	j	j	j	j
K.14	10.9	-	-	-	-
K.14	11	l	l	l	l
K.14	12	k	k	k	k
K.14	13	t	t	t	t
K.14	14	V	V	V	V
K.14	15	k	tç	tç	tç
K.33	1	m	V	m	m
K.33	2	v	v	v	v
K.33	3	m	g	g	m
K.33	4	-	-	-	-
K.33	5	V	l	l	V
K.33	6	m	g	g	m
K.33	7	s	s	s	s
K.33	8	V	Y	Y	V
K.33	9	N	z	z	N
K.33	10	-	-	-	-
K.33	10.9	n	d	d	n
K.33	11	r	r	r	r
K.33	12	k	k	k	k
K.33	13	t	t	t	t
K.33	14	V	V	V	V
K.33	15	k	k	k	k
K.43	1	m	¥	m	m
K.43	2	h	h	w	h
K.43	3	m	¥	¥	¥
K.43	4	m	ð	ð	ð
K.43	5	d	d	d	d
K.43	6	m	¥	¥	m
K.43	7	Ø	Ø	Ø	Ø
K.43	8	Y	Y	Y	Y
K.43	9	N	¥	m	m
K.43	10	-	-	-	-
K.43	10.9	N	ð	ð	ð
K.43	11	r	r	r	r
K.43	12	k	k	k	k
K.43	13	t	t	t	t
K.43	14	¥	¥	¥	¥
K.43	15	k	k	k	k
K.62	1	m	w	m	m
K.62	2	ß	ß	ß	ß
K.62	3	m	V	V	m
K.62	4	-	-	-	-
K.62	5	l	l	l	l
K.62	6	m	¥	¥	m
K.62	7	S	S	S	S
K.62	8	ß	ß	ß	ß
K.62	9	N	y	y	N
K.62	10	-	-	-	-
K.62	10.9	d	d	d	d

K.62	11	r	r	r	r
K.62	12	k	k	k	k
K.62	13	t	t	t	t
K.62	14	V	Ƴ	Ƴ	Ƴ
K.62	15	k	k	k	k
M.42	1	m	V	m	m
M.42	2	β	β	β	β
M.42	3	m	V	V	V
M.42	4	m	V	V	V
M.42	5	l	l	l	l
M.42	6	m	Y	Y	Y
M.42	7	tç	tç	tç	tç
M.42	8	f	f	f	f
M.42	9	N	V	V	V
M.42	10	-	-	-	-
M.42	10.9	N	S	S	S
M.42	11	l	l	l	l
M.42	12	k	k	k	k
M.42	13	t	t	t	t
M.42	14	β	β	β	β
M.42	15	k	k	k	k
N.21	1	m	w	m	m
N.21	2	β	β	β	β
N.21	3	m	w	w	w
N.21	4	m	Y	Y	Y
N.21	5	l	l	l	l
N.21	6	m	Ƴ	Ƴ	Ƴ
N.21	7	c	c	c	c
N.21	8	v	v	v	v
N.21	9	N	Y	Y	Y
N.21	10	-	-	-	-
N.21	10.9	N	z	z	z
N.21	11	l	l	l	l
N.21	12	k	k	k	k
N.21	13	t	t	t	t
N.21	14	V	w	w	w
N.21	15	k	k	k	k
N.31	1	m	V	m	w
N.31	2	V	V	w	V
N.31	3	m	V	V	w
N.31	4	m	V	V	y
N.31	5	l	l	l	l
N.31	6	m	V	w	V
N.31	7	tç	tç	tç	tç
N.31	8	-	-	-	-
N.31	9	N	V	V	Y
N.31	10	t	t	t	t
N.31	10.9	z	z	z	z
N.31	11	-	-	-	-
N.31	12	k	k	k	k
N.31	13	t	t	t	t
N.31	14	V	V	V	w
N.31	15	k	k	k	kw
R.21	1	m	m	m	m
R.21	2	v	v	v	v
R.21	3	m	V	V	m
R.21	4	m	d	d	d
R.21	5	V	l	l	l
R.21	6	m	m	V	m

R.21	7	S	S	S	S
R.21	8	V	V	V	V
R.21	9	N	V	V	V
R.21	10	-	-	-	-
R.21	10.9	N	d	d	d
R.21	11	l	l	l	l
R.21	12	k	k	k	k
R.21	13	-	-	-	-
R.21	14	V	V	V	V
R.21	15	k	k	k	k
R.22	1	m	V	m	m
R.22	2	V	y	y	V
R.22	3	m	ɸ	ɸ	m
R.22	4	m	ð	ð	N
R.22	5	V	l	l	V
R.22	6	m	ɸ	ɸ	m
R.22	7	S	S	S	S
R.22	8	V	y	y	V
R.22	9	N	y	y	N
R.22	10	-	-	-	-
R.22	10.9	N	ð	ð	N
R.22	11	l	l	l	l
R.22	12	k	k	k	k
R.22	13	-	-	-	-
R.22	14	V	w	w	V
R.22	15	k	k	k	k
R.31	1	m	ø	m	m
R.31	2	v	v	v	v
R.31	3	m	V	V	m
R.31	4	m	v	v	m
R.31	5	V	r	r	V
R.31	6	m	y	y	m
R.31	7	tç	tç	tç	tç
R.31	8	v	v	v	v
R.31	9	V	V	V	V
R.31	10	-	-	-	-
R.31	10.9	ð	ð	ð	ð
R.31	11	r	r	r	r
R.31	12	k	k	k	k
R.31	13	t	t	t	t
R.31	14	V	V	V	V
R.31	15	k	k	k	k
S.12	1	m	V	m	m
S.12	2	ß	ß	ß	ß
S.12	3	m	V	V	m
S.12	4	m	V	V	m
S.12	5	r	r	r	r
S.12	6	V	V	V	m
S.12	7	tç	tç	tç	tç
S.12	8	zw	zw	zw	zw
S.12	9	N	V	V	N
S.12	10	-	-	-	-
S.12	10.9	N	dz	dz	N
S.12	11	r	r	r	r
S.12	12	k	k	k	k
S.12	13	t	t	t	t
S.12	14	ß	h	h	h
S.12	15	k	k	k	k
S.21	1	m	V	m	m

S.21	2	ß	ß	ß	ß
S.21	3	m	V	V	m
S.21	4	m	V	V	m
S.21	5	l	l	l	l
S.21	6	m	V	V	m
S.21	7	tS	tS	tS	tS
S.21	8	zw	zw	zw	zw
S.21	9	N	V	V	N
S.21	10	-	-	-	-
S.21	10.9	N	dz	dz	N
S.21	11	l	l	l	l
S.21	12	-	-	-	-
S.21	13	-	-	-	-
S.21	14	ß	ß	ß	ß
S.21	15	V	h	h	h
S.31	1	m	V	m	m
S.31	2	b	b	b	b
S.31	3	m	V	V	m
S.31	4	m	V	V	m
S.31	5	l	l	l	l
S.31	6	m	V	V	m
S.31	7	s	s	s	s
S.31	8	-	-	-	-
S.31	9	N	V	V	N
S.31	10	d	d	d	N
S.31	10.9	N	d	d	N
S.31	11	l	l	l	l
S.31	12	-	-	-	-
S.31	13	-	-	-	-
S.31	14	b	b	b	b
S.31	15	x	x	x	x
S.32	1	m	V	m	y
S.32	2	b	b	b	b
S.32	3	m	V	V	w
S.32	4	m	V	V	y
S.32	5	l	l	l	l
S.32	6	m	V	V	V
S.32	7	s	s	s	s
S.32	8	-	-	-	-
S.32	9	N	N	V	y
S.32	10	d	d	d	N
S.32	10.9	N	d	d	N
S.32	11	-	-	-	-
S.32	12	-	-	-	-
S.32	13	-	-	-	-
S.32	14	b	b	b	by
S.32	15	x	x	x	m
S.33	1	m	V	m	m
S.33	2	b	b	b	b
S.33	3	m	V	V	m
S.33	4	m	V	V	m
S.33	5	l	l	l	l
S.33	6	m	V	V	m
S.33	7	s	s	s	s
S.33	8	-	-	-	-
S.33	9	N	V	V	N
S.33	10	l	l	l	N
S.33	10.9	N	l	l	N
S.33	11	-	-	-	-

S.33	12	-	-	-	-
S.33	13	-	-	-	-
S.33	14	b	b	b	b
S.33	15	h	h	h	h
S.41	1	m	V	m	m
S.41	2	6	b	6	6
S.41	3	m	V	w	m
S.41	4	m	V	y	m
S.41	5	l	l	l	l
S.41	6	m	V	w	m
S.41	7	s	s	s	s
S.41	8	-	-	-	-
S.41	9	N	V	y	N
S.41	10	z	z	z	z
S.41	10.9	N	z	z	z
S.41	11	l	l	l	l
S.41	12	-	-	-	-
S.41	13	-	-	-	-
S.41	14	6	6	6	6
S.41	15	k	k	k	k
S.42	1	m	V	m	m
S.42	2	6	6	6	6
S.42	3	m	V	w	m
S.42	4	m	V	y	m
S.42	5	l	l	l	l
S.42	6	m	V	w	m
S.42	7	s	s	s	s
S.42	8	-	-	-	-
S.42	9	N	V	y	N
S.42	10	z	z	z	N
S.42	10.9	N	z	z	N
S.42	11	l	l	l	l
S.42	12	-	-	-	-
S.42	13	-	-	-	-
S.42	14	6	6	6	6
S.42	15	k	k	k	k
S.43	1	m	V	m	m
S.43	2	b	b	b	b
S.43	3	m	V	w	m
S.43	4	m	V	y	m
S.43	5	l	l	l	l
S.43	6	m	V	w	m
S.43	7	s	s	s	s
S.43	8	-	-	-	-
S.43	9	N	V	y	N
S.43	10	t	t	t	t
S.43	10.9	N	t	t	N
S.43	11	l	l	l	l
S.43	12	-	-	-	-
S.43	13	-	-	-	-
S.43	14	b	b	b	b
S.43	15	k	k	k	k
S.44	1	m	V	m	m
S.44	2	b	b	b	b
S.44	3	m	V	w	m
S.44	4	m	V	y	m
S.44	5	l	l	l	l
S.44	6	m	V	w	m
S.44	7	s	s	s	s

S.44	8	-	-	-	-
S.44	9	N	V	y	V
S.44	10	z	z	z	z
S.44	10.9	N	z	z	z
S.44	11	l	l	l	l
S.44	12	-	-	-	-
S.44	13	-	-	-	-
S.44	14	b	b	b	b
S.44	15	k	k	k	k

### 3. The numerical procedure

#### 3.1 The numerical values

Each consonant is assigned a numerical value based on five pre-established phonological features, which are shown in table 6 below. (The absence of values 1 through 3 is explained further below.)

Feature	Value	Definition
u : labialization	4	non-labialized
	5	labialized
v : affrication	4	non-affricated
	5	alveolar s/z-affrication
	6	prepalatal S/j-affrication
	7	palatal ç-affrication
x : degree of oral closure	4	nasal (complete continuous closure)
	5	plosive (complete discontinuous cl.)
	6	liquid (partly complete continuous cl.)
	7	fricative (incomplete continuous cl.)
	8	continuant/semi-vowel (no closure)
y : place of articulation	4	bilabial (BL)
	5	labiodental (LB)
	6	dental (D)
	7	alveolar (A)
	8	prepalatal (PP)
	9	palatal (P)
	10	velar (V)
	11	glottal (G)
z : voicing/aspiration	4	voiced
	5	voiceless
	6	voiceless-aspirated

Thus, for instance, the phoneme /m/ has been assigned the following values: 4 with regard to feature u (being labialized); 4 with regard to feature v (no affrication); 4 with regard to feature x (complete and continuous oral closure); 4 with regard to feature y (bilabial); and 4 with regard to feature z (voiced). This we write as {4;4,4;4;4}, i.e. {u;v;x;y;z}.

As for the chosen phonological features, the only one in need of some explaining is feature x, i.e. degree of oral closure. This has been decided upon based mainly on articulatory (and to some degree also acoustic) properties. If we assume the oral characteristics of a phoneme (as opposed to its nasal characteristics) to be primary and, also, if we consistently distinguish oral and nasal air flow, then the above displayed ``scale'' (i.e. nasal, plosive, liquid, fricative, continuant) becomes more apparent.

Nasals display a complete oral closure which in addition is continuous through-out the entire phoneme production. Plosives are also characterized by a complete oral closure though a discontinuous one. Fricatives are characterized by a continuous but incomplete oral closure, while continuants have no oral closure at all.

The problematic category of phonemes is undoubtedly liquids, i.e. /l/ and /r/ (and also flaps). The /l/ phoneme is partly complete and continuous, thus close to plosives, while the /r/ phoneme is more difficult to characterize. While being close to fricatives (articulatorily, acoustically and perceptually), they are characterized by several discontinuous and complete closures. But, this is a matter of pronunciation. Phonetically, /r/ does not necessarily have to be completely closed at all, thus being closer to fricatives. This is also the reason why liquids have been judged as being between plosives and fricatives. Note also that flaps, according to the above description actually becomes defined as a plosive.

TABLE 7 - ASSIGNED VALUES TO DIFFERENT TYPES OF PHONEMES					
Phoneme	u Labialization	v Affrication	x Oral closure	y Oral location	z Voicing
m	4	4	4	4	4
n	4	4	4	6	4
ñ	4	4	4	10	4
l	4	4	6	6	4
r	4	4	6	7	4
b	4	4	5	4	4
p	4	4	5	4	5
d	4	4	5	7	4
t	4	4	5	7	5
c	4	4	5	9	5
g	4	4	5	10	4
k	4	4	5	10	5
ß	4	4	7	4	4
f	4	4	7	4	5
v	4	4	7	5	4
f	4	4	7	5	5
ð	4	4	7	6	4
ø	4	4	7	6	5
z	4	4	7	7	4
s	4	4	7	7	5
j	4	4	7	8	4
š	4	4	7	8	5
ç	4	4	7	9	5
ʝ	4	4	7	10	4
x	4	4	7	10	5
h	4	4	7	11	4
w	5	4	8	4	4
y	4	4	8	8	4
dz	4	5	5	6	4
ts	4	5	5	6	5
dj	4	6	5	6	4
tš	4	6	5	6	5
tç	4	7	5	6	5

Table 7 above, then, displays the values assigned to each type of phoneme. (See also table 8 below for an explanation of the phonological symbols used.)

Manner of articulation	Place of articulation								
	BL	LD	D	A	PP	P	V	G	
Nasals	m		n				ɱ		
Plosives									
• Voiced	b		d				g		
• Voiceless	p		t			c	k		
• Aspirated (+ h)									
Affricates									
• Voiced			dz	dj					
• Voiceless			ts	tʃ	tɕ				
• Aspirated (+ h)									
Liquids			l	r					
Fricatives									
• Voiced	β	v	ð	z	j		ʝ	h	
• Voiceless	f	f	θ	s	ʃ	ç	x		
• Aspirated (+ h)									
Glides	w				y				

TABLE 8 - CONSONANT CHART

Note the following deviations from the IPA Alphabet:

f = IPA /ɸ/      Ø = IPA /θ/      j = IPA /ʒ/      S = IPA /ʃ/  
 ʝ = IPA /ɣ/      ɱ = IPA /ŋ/      y = IPA /j/

Problems have arisen in the process of assigning values to phonemes and certain simplifications have been made.

- (1) Palatalized sounds are equalled with palatal ç-affrication since these are phonetically very similar and no language employs both as phonologically distinctive.
- (2) The bilabial implosive /ɓ/ is valued as the explosive /b/, since in those languages where it occurs, it occurs in complementary distribution with the latter.
- (3) Homorganic nasals /N/ are valued as the dental nasal /n/.
- (4) Polysyllabic morphemes with more than one consonant have been given as distinct values as possible, i.e. the ``most extreme`` consonant has been allowed to determine the values.
- (5) Morphemes without a consonant, i.e. single-vowel morphemes /V/, acquire the values {3;3;3;3;3;3}.
- (6) Zero-morphemes /ø/ acquire the values {2;2;2;2;2;2}.
- (7) Of the original set of 19 or 23 genders in proto-Bantu, some modern Bantu languages have lost some genders. Most languages have lost genders 19 through 23. Other genders are also occasionally lacking, as, for instance, gender 12 in Tshivenda, Setswana, Isizulu and others. Such absent genders have been given the values {1;1;1;1;1;1}, i.e. except in genders 16-23 which have been ignored completely (as explained in part 2 above).

### 3.2 The statistical status of the assigned values

It is important to note that the assigned values are ordinal, not intervall, since we would not want to imply that the difference between, say, a nasal and a plosive is the same as that between a fricative and a continuant.

However, they are ordered in relation to one another, thus they can not be nominal.

### 3.3 The assigning of values

Each consonant in table 5, then, is assigned a numerical value according to table 7, which is based on the five phonological features described in table 6. Thus we get table 9 below which simply is a ``numerical`` version of table 5.

TABLE 9 - ASSIGNED NUMERICAL VALUES (ARRANGED BY GENDER)																					
lg	g	Nominal					Subjectival					Objectival					Adjectival				
		u	v	x	y	z	u	v	x	y	z	u	v	x	y	z	u	v	x	y	z
1	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
2	1	4	4	4	4	4	3	3	3	3	3	2	2	2	2	2	4	4	4	4	4
3	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
4	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
6	1	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4
7	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
8	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
9	1	4	4	4	4	4	4	4	7	10	4	4	4	4	4	4	4	4	4	4	4
10	1	4	4	4	4	4	5	4	8	4	4	4	4	4	4	4	4	4	4	4	4
11	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
12	1	4	4	4	4	4	5	4	8	4	4	4	4	4	4	4	4	4	4	4	4
13	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	5	4	8	4	4
14	1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
15	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
16	1	4	4	4	4	4	2	2	2	2	2	4	4	4	4	4	4	4	4	4	4
17	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
18	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
19	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
20	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	8	8	4
21	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
22	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
23	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
24	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
25	1	4	4	4	4	4	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4
1	2	4	4	5	4	4	4	4	5	4	4	4	4	5	4	4	4	4	5	4	4
2	2	4	4	5	4	4	4	4	5	4	4	2	2	2	2	2	4	4	5	4	4
3	2	4	4	7	4	4	4	4	7	4	4	4	4	7	4	4	4	4	7	4	4
4	2	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3
5	2	4	4	5	4	4	4	4	5	4	4	4	4	5	4	4	4	4	5	4	4
6	2	5	4	8	4	4	5	4	8	4	4	5	4	8	4	4	5	4	8	4	4
7	2	4	4	7	4	4	4	4	7	4	4	4	4	7	4	4	4	4	7	4	4
8	2	4	4	7	5	4	4	4	7	5	4	4	4	7	5	4	4	4	7	5	4
9	2	4	4	7	11	4	4	4	7	11	4	5	4	8	4	4	4	4	7	11	4

10	2	4	4	7	4	4	4	4	7	4	4	4	4	4	4	4	4	4	7	4	4
11	2	4	4	7	4	4	4	4	7	4	4	4	4	4	4	4	4	4	7	4	4
12	2	4	4	7	4	4	4	4	7	4	4	4	4	4	4	4	4	4	7	4	4
13	2	3	3	3	3	3	3	3	3	3	3	3	3	5	4	8	4	4	3	3	3
14	2	4	4	7	5	4	4	4	7	5	4	4	4	4	4	7	5	4	4	4	4
15	2	3	3	3	3	3	4	4	8	8	4	4	4	4	4	8	8	4	3	3	3
16	2	4	4	7	5	4	4	4	7	5	4	4	4	4	4	7	5	4	4	4	4
17	2	4	4	7	4	4	4	4	7	4	4	4	4	4	4	7	4	4	4	4	4
18	2	4	4	7	4	4	4	4	7	4	4	4	4	4	4	7	4	4	4	4	4
19	2	4	4	5	4	4	4	4	5	4	4	4	4	4	4	5	4	4	4	4	4
20	2	4	4	5	4	4	4	4	5	4	4	4	4	4	4	5	4	4	4	4	4
21	2	4	4	5	4	4	4	4	5	4	4	4	4	4	4	5	4	4	4	4	4
22	2	4	4	5	4	4	4	4	5	4	4	4	4	4	4	5	4	4	4	4	4
23	2	4	4	5	4	4	4	4	5	4	4	4	4	4	4	5	4	4	4	4	4
24	2	4	4	5	4	4	4	4	5	4	4	4	4	4	4	5	4	4	4	4	4
25	2	4	4	5	4	4	4	4	5	4	4	4	4	4	4	5	4	4	4	4	4
1	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2	3	4	4	4	4	4	3	3	3	3	3	3	3	2	2	2	2	2	4	4	4
3	3	4	4	4	4	4	4	4	5	10	4	4	4	4	4	5	10	4	4	4	4
4	3	4	4	4	4	4	3	3	3	3	3	3	5	4	8	4	4	4	4	4	4
5	3	4	4	4	4	4	4	4	5	10	4	4	4	4	5	10	4	4	4	4	4
6	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4
7	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
8	3	4	4	4	4	4	4	4	5	10	4	4	4	4	5	10	4	4	4	4	4
9	3	4	4	4	4	4	4	4	7	10	4	4	4	4	7	10	4	4	4	7	10
10	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4
11	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
12	3	4	4	4	4	4	5	4	8	4	4	4	5	4	8	4	4	5	4	8	4
13	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	5	4	8	4
14	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4
15	3	4	4	4	4	4	4	4	7	10	4	4	4	4	7	10	4	4	4	4	4
16	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4
17	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4
18	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4
19	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4
20	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	5	4	8	4
21	3	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4
22	3	4	4	4	4	4	3	3	3	3	3	3	5	4	8	4	4	4	4	4	4
23	3	4	4	4	4	4	3	3	3	3	3	3	5	4	8	4	4	4	4	4	4
24	3	4	4	4	4	4	3	3	3	3	3	3	5	4	8	4	4	4	4	4	4
25	3	4	4	4	4	4	3	3	3	3	3	3	5	4	8	4	4	4	4	4	4
1	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2	4	4	4	4	4	4	3	3	3	3	3	3	2	2	2	2	2	4	4	4	4
3	4	4	4	4	4	4	4	4	5	10	4	4	4	4	5	10	4	4	4	4	4
4	4	4	4	4	4	4	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4
5	4	4	4	4	4	4	3	3	3	3	3	3	4	4	8	8	4	4	4	4	4
6	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4
7	4	4	4	4	4	4	4	4	8	8	4	4	4	4	8	8	4	4	4	8	8
8	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	4	4	4	4	4	4	4	4	7	6	4	4	4	4	7	6	4	4	4	7	6
10	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
12	4	4	4	4	4	4	4	4	8	8	4	4	4	4	8	8	4	4	4	8	8
13	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	3	4	4	8	8
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25	109	4	4	4	6	4	4	4	7	7	4	4	4	7	7	4	4	4	7	7
1	11	4	4	6	6	4	4	4	6	6	4	4	4	6	6	4	4	4	6	4
2	11	4	4	6	6	4	3	3	3	3	3	2	2	2	2	2	4	4	6	4
3	11	4	4	6	6	4	4	4	6	6	4	4	4	6	6	4	4	4	6	4



15	13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
16	13	4	4	5	6	5	4	4	5	6	5	4	4	5	6	5	4	4	5	6	5
17	13	4	4	5	6	5	4	4	5	6	5	4	4	5	6	5	4	4	5	6	5
18	13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
19	13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
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11	14	4	4	7	4	4	4	4	7	4	4	4	4	7	4	4	4	4	7	4	4
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25	14	4	4	5	4	4	4	4	5	4	4	4	4	5	4	4	4	4	5	4	4
1	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5
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3	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5
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11	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5
12	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5
13	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	5	4	5	10	5
14	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5
15	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5
16	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5
17	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5
18	15	3	3	3	3	3	4	4	7	11	4	4	4	7	11	4	4	4	7	11	4
19	15	4	4	7	10	5	4	4	7	10	5	4	4	7	10	5	4	4	7	10	5
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22	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5
23	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5
24	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5
25	15	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5	4	4	5	10	5

### 3.4 The calculations

Two ``kinds`` of calculations will be made, which will form the bases for our subsequent discussions in parts 4 and 5 below. Firstly, we will employ the actual numerical method (as described below) and, secondly, we will supplement these with a set of StatView tables.

Thus, firstly each row of consonants (or rather, set of four times five features) is compared relative to each other. In order to exemplify: let us take the values for the four various gender morphemes, for gender 15, for languages 21 (Sesotho) and 22 (Isixhosa), from the above table. The calculated difference between these two languages (with regard to gender 15) is then as follows:

(1) Language	Values
Sesotho	{4;4;7;11;4} {4;4;7;11;4} {4;4;7;11;4} {4;4;7;11;4}
Isixhosa	{4;4;5;10;5} {4;4;5;10;5} {4;4;5;10;5} {4;4;5;10;5}
-----	
Difference	{0;0;2;01;1} {0;0;2;01;1} {0;0;2;01;1} {0;0;2;01;1}

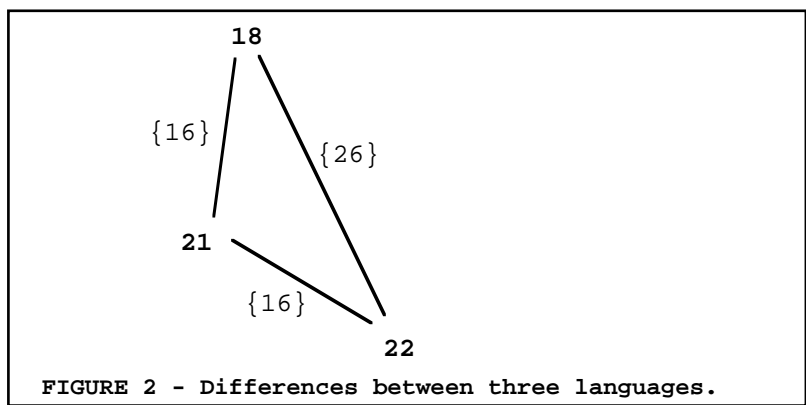
This gives a total difference value of {16} between languages 21 and 22. Adding a third language to the comparison, e.g. 18 (Tshivenda), would yield the following calculations:

(2) Language	Values
Sesotho	{4;4;7;11;4} {4;4;7;11;4} {4;4;7;11;4} {4;4;7;11;4}
Tshivenda	{3;3;3;03;3} {4;4;7;11;4} {4;4;7;11;4} {4;4;7;11;4}
-----	
Difference	{1;1;4;08;1} {0;0;0;00;0} {0;0;0;00;0} {0;0;0;00;0}

(3) Language	Values
Isixhosa	{4;4;5;10;5} {4;4;5;10;5} {4;4;5;10;5} {4;4;5;10;5}
Tshivenda	{3;3;3;03;3} {4;4;7;11;4} {4;4;7;11;4} {4;4;7;11;4}
-----	
Difference	{1;1;2;08;2} {0;0;2;01;1} {0;0;2;01;1} {0;0;2;01;1}

Thus the relative differences between these three languages (with regard to gender 15) are as follows: 21 vs. 22 => {16}; 18 vs. 21 => {16}; and 18 vs. 22 => {26}.

Based on these values of difference we could construe a kind of language web, or cluster analysis, as in figure 2 below (cf. also, for instance, Swadesh 1972).



With the aid of Johan Hagman's computer programme we can then make large scale calculations between all possible pairs of languages and thus create three kinds of results: cluster analyses (appendixes 1-6); dendrograms (appendixes 7-12); and a numerical table of differences between each pair of language (appendix 13). The results from these calculations will be discussed in part 4 below.

The second ``kind`` of calculation is really nothing but a set of StatView tables (appendixes 14ff.) based on, firstly, each gender separately and, secondly, on the phonological features x (degree of oral closure) and y (place of articulation). These aspects will be more fully explained and discussed in part 5 below.

### **3.5 A few words on variables**

The independent variable in the study at hand is the closeness of the 25 Bantu languages. However, ``closeness`` is a two-fold concept. We may discuss closeness in terms of genetic distance (diachronic closeness) but we may also discuss it in terms of typological distance (synchronic closeness). What we can say for sure, with the above described procedure, is something about the typological closeness of the languages chosen (again, based on the selected phonological features). Saying something about the genetic closeness is much a matter of interpretation and tradition.

Had we known nothing beforehand on the history of these languages, we would have been able to make stronger genetic claims with the above procedure (not due to statistical accurateness but factual ignorance). However, we do know something about the history of these languages. Thus what we can do is to compare the results we receive with the already known (or rather, supposed) data and see how well they correlate with each other (in parts 4 and 5 below).

The dependent variables are the values assigned to the consonants, which are supposed to say something about the phonological similarities and/or differences between the various selected nominal gender morphemes. Thus we might also specify a kind of intervening variable, i.e. the choice of morphosyntactic (or possibly syntactomorphological?) category. Had we added morphemes from other parts of the inflectional/derivational morphology, we could of course have ended up with a completely different result. However, the intervening variable of morphosyntactic category is presently ignored.

### **3.6 The internal validity**

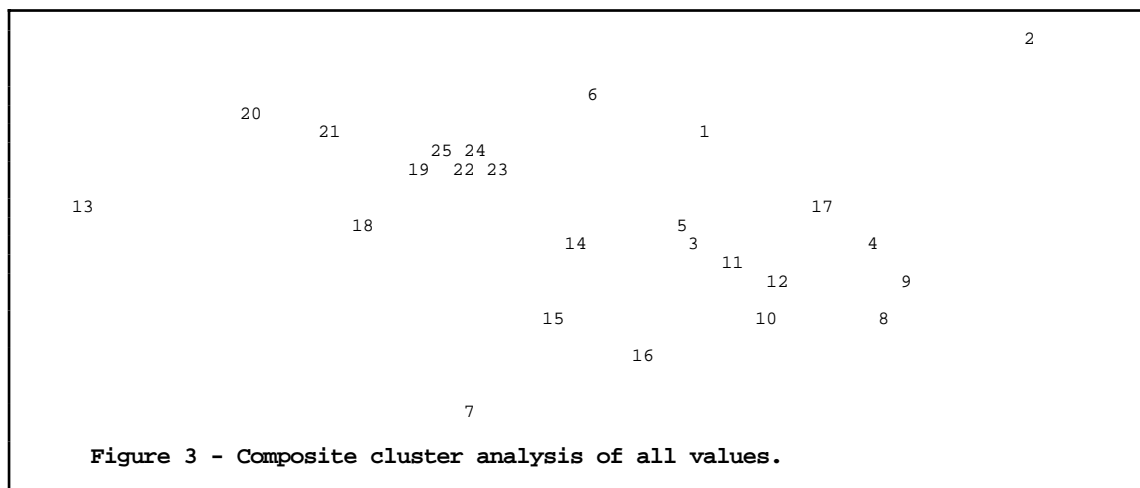
The internal validity of the present study is of course debatable. If we restrict the present study to (synchronic) typology alone, we can undoubtedly claim to have full interval validity; in principle at least since we are assuming that we may ignore the time span of almost one hundred years that the publication dates cover (see above).

We would, however, like to say something about diachronic relationships which makes matters more complicated. In order to sort this out we need to look at the results in light of what we ``already`` knew about the genetic situation.

#### 4. Clustering the languages

##### 4.1 Dendrograms and cluster analyses

With the above described calculations made, Johan Hagman has kindly produced dendrograms and cluster analyses with the aid of his computer programme for each phonological feature separately (i.e. displaying distances based on labialization, affrication, oral closure, oral location and voicing-aspiration; see appendixes 2-6) plus a composite comparison of all features taken together (see appendix 1).



The composite cluster analysis is roughly reproduced in figure 3 above (see also appendix 1) since much of the subsequent discussions will be based on this. All other hagmanian graphics have been appendixed.

##### 4.2 Comparing the results with known (or supposed) data

The letter-codes established by Guhrie (1967-1971) and which are customarily used to identify Bantu languages (cf. table 1), reflect geographical relationships more accurately than genetic ones. However, in the sample of languages used, we can actually use the letter-codes as rough indicators of genetic relationships. Thus, languages 17 through 25 (i.e. the ones with codes beginning with g) are more closely related to each other than any of those are towards, for instance, languages 14 through 16. These latter are, in turn, more closely related towards each than towards any of the other languages in the sample. This is due to the fact that geographical relatedness, partly at least, often goes ``hand in hand`` with genetic relatedness (this, of course, is a truth with some modification). However, the choice of languages, which initially was based on the availability of literature, did accidentally group most of the languages (though cf. below) into correlated geographical and genetic groups.

One language, no. 2 Lingala has constantly placed itself in the periphery (cf., especially, the dendrogram in appendix 7). This is highly positive since this is the only language in the sample with a relatively high degree of creolized characteristics, e.g. a simplified syntax. Lingala also has a reduced gender marking system which is reflected in the phonological forms of the agreement markers, especially with regard to subjectival and objectival markers (cf. tables 4 and 5).

That languages nos. 18 through 25 tend to cluster together is highly positive since these languages are fairly close genetically (though not necessarily mutually intelligible). Language no. 17 Chishona also belongs to this group but has ended up far from the others. This, however, is not necessarily a problem. While languages 18 through 24 are found in South Africa, Chishona is the national language of Zimbabwe which has a somewhat ``cut off`` history from its sister languages further south. Language 25 Sindebele is, however, found in Zimbabwe as well as South Africa but is often described as an Isizulu dialect.

Three northern Namibian languages, no. 14 Oshindonga, no. 15 Oshikwanyama and no. 16 Otjiherero, have also grouped themselves together, which (from a diachronical point of view) they should, as have no. 8 Rukwangari, no. 9 Thimbukushu and no. 10 Rugciriku (also in northern Namibia).

Now, the problematic cases are languages 7, 17, 12 and 13. As for Lulwena (no. 7), it ``should`` have placed itself in connection to nos. 8 through 10. However, it is not too far away to cause serious considerations. Also, both the language and its speakers have been more influenced from central African people and languages than have nos. 8 through 10. As is the case with language no. 17 Chishona (cf. above), also Lulwena has somewhat of a ``cut off`` history towards the ``supposed`` related group.

Languages 12 and 13 have ended up fairly far apart. Actually this is the first serious ``flaw`` in the results. There is no intuitive reason to expect them so far from each other. It can only be explained with various reasons, e.g. extensive influencing on either language from surrounding languages (possibly no. 12, since 13 is in the periphery); that their supposed genetic closeness might not be so close after all (perhaps no. 13 has ``moved in`` lately); or simply that either the literature is imprecise in the morphological/phonological description or the calculation employed is not a sufficient method to capture the ``real`` .

#### **4.3 Comparing the known (or supposed) data with the results**

Going the other way around, i.e. looking at which languages cluster together and explain why they do so, yields some interesting observations.

Languages 19 and 22 through 25 cluster very close in the cluster analysis as well as in the dendrogram (appendix 7), which they ``should``. Somewhat annoying though, is the fact that nos. 20 and 21 have splintered off from this group. According to known data, if nos. 20 and 21 have splintered off, so should no. 19, since they are all mutually intelligible and, some say, even dialects of the same language. However, this can partly be explained by the fact that all three languages have since long been standardized independently by various mission societies (and subsequently by ministries). Also, which certainly has influenced the material is the fact that languages 20 and 21 lack gender 11 while language 19 does not.

In the cluster analysis, languages 3, 4, 5, 8, 9, 10, 11, 12 and 17 form somewhat of a cluster. Nos. 3 and 5 are geographically very close, as are languages 11 and 12. Nos. 17 and 4 is also acceptable (see above on no. 17). It is annoying that languages 8 through 10 have ended up in this grouping. However, phonological closeness between otherwise not so close languages is more easily acceptable than phonological ``farness`` between otherwise close languages. Thus, the most annoying fact with this grouping is, as noted above, that language 13 has ended up in the periphery and not closer to language 12.

Languages 14 through 16 (and possibly also 7; though cf. the dendrogram in appendix 7) form a fairly nice group, as they should.

When looking at the composite dendrogram (see appendix 7) we can note that the aforementioned languages ``subgroup`` as follows: 3, 5, 12, 11, 9 and 17 (plus possibly 4) as opposed to 8, 10, 14, 15 and 16. The latter subgroup is the most pleasing one, being very close geographically and fairly close genetically. However, it is unpleasing that language no. 9 did not end up in this subgroup but instead the former. Nevertheless, disregarding language no. 9 (and also no. 17), we see that this subgrouping corresponds nicely to the traditional eastern and western Bantu divide.

Languages 1 and 6 have ended up fairly close (though not in the dendrogram, appendix 7). This can be explained by referring to the special social importance of no. 6 Kiswahili as a lingua franca in all of eastern and parts of central Africa. The influence of Kiswahili on Bobangi is not an undeniable fact. However, it would have been more reassuring if other languages as well would have shown tendencies towards Kiswahili, e.g. languages 3 through 5.

As for language no. 2, we have already mentioned its special status (see above).

## 5. Genders, morphological types and phonological variance

As mentioned above, this part of the discussion will be based on a set of diagrams produced with StatView (version 4.02). Mainly two kinds have been produced, namely box plots and univariate line charts. Also, tables 4 and 5 above are relevant for the below discussions.

The 16 box plots (one for each gender) are based on each feature type differentiated per morpheme type, hence producing 20 ``columns`` on the x-axis. The box plots, being based on percentiles, are good indicators of internal variance but, based on the present material, they do not perform all that well if there are genders lacking in some languages, i.e. with values {1;1;1;1;1}. Thus we have also produced univariate line charts to complement these.

The univariate line charts are based on features x (degree of oral closure) and y (place of articulation), thus producing 32 charts, i.e. two for each gender. The so-called observations on the x-axis are the 25 languages. Furthermore, each language has four values depicted in the charts, i.e. one for each morpheme type, termed nx, sx, ox and ax (for feature x) and ny, sy, oy and ay (for feature y). Hence we can relatively easy see whenever there is, not only interlanguage variance but also intralanguage variance. As mentioned, the line charts have mainly been produced so as to supplement the box plots.

Thus we will first look at how the individual genders themselves tends to vary (or not to vary) intralinguistically, i.e. how much the four chosen morphological types tend to be either similar or dissimilar (with regard to their consonantal phonemes). We will call this intra-gender-variance. In order to exemplify, gender 15 in Kiswahili (language no. 6) displays a low degree on intra-gender-variance since all four gender markers employ the same consonantal phoneme (which in this case is /k/). Conversely, gender 1 in Chinyanja (language no. 13) displays a high(er) degree of intra-gender-variance since we find two, or three, different consonantal phonemes when comparing the four gender marker (i.e. /m/, /w/ and /ø/).

Based on the conclusions drawn from intra-gender-variance we will also look at the four types of gender markers separately and try to see if there are any correlations between morphological type and variance, i.e. if change

tends to be a phenomena that happens to one type of gender marker more often than to another.

### 5.1 Three categories of genders

When reviewing the StatView diagrams (and also tables 4 and 5 above) we can actually make an interesting observation with regard to intra-gender-variance, especially when comparing it with how this correlates (or does not correlate) interlinguistically. Somewhat roughly (but not totally without reason), we can thus group the genders into three separate categories. However, there are some exceptional points (and possible exceptions) to this generalization.

Those genders that display a low degree of intra-gender-variance and also a low degree of interlinguistic variability are genders 12, 13 and 15. These genders are characterized by a plosive consonant in the nominal gender markers (thus they are hereafter termed plosive genders). For instance, the nominal gender marker of gender 12 always displays the velar plosive /k/ (unless the entire gender has been ``erased`` from the language). This /k/-phoneme is furthermore present in the other three gender markers. The same applies for gender 13 and also for gender 15 (with a slight reservation for the latter, cf. languages nos. 18-21).

Those genders that display a high degree of intra-gender-variance but a low degree of interlinguistic variance are notably genders 1, 3, 4, 6, 9 and possibly also 10-9. These genders are characterized by a nasal phoneme in the nominal gender marker (thus henceforth nasal genders) which is seldom retained in the other three gender markers. However, comparing interlinguistically we find the same nasal phoneme in all nominal gender markers across the language sample. For instance, gender 6 displays the bilabial nasal /m/ in the nominal gender marker of all languages (which is also true for genders 3 and 4) while the consonant phonemes in the subjectival and objectival gender markers vary considerably (/b/, /g/, /m/, /ʒ/ and /ø/).

The remaining genders (i.e. 2, 5, 7, 8, 10, possibly 10-9, 11 and 14) are all characterized by a low degree of intra-gender-variance but a high degree of interlinguistic variability (i.e. opposite to the nasal genders). This third category of genders are furthermore the ones for which we find somewhat conflicting reconstructions in the literature (save gender 7). For instance, the proto-Bantu forms of the nominal gender markers for genders 2, 8 and 14 are reconstructed with either /\*ʒ/ (Meinhof 1932) or /\*b/ (Guthrie 1967-1971), while genders 5, 10 and 11 are reconstructed with either /\*l/ (Meinhof 1932) or /\*d/ (Guthrie 1967-1971). The notable exception in this group is gender 7 which is invariably reconstructed with a /\*k/. This might be reason to place it among the ``plosive genders`` from a diachronical point of view. However, the (proto)presence of a high front vowel /\*î/ has caused the original /\*k/ to change into a fricative or affricate in some languages (a process which is customarily called spirantization). None of the above termed ``plosive genders`` (12, 13 and 15) are reconstructed with a high front vowel which might be the main reason why these display non-variance. Thus we might possibly term this third category as spirantised genders. However, this would not reflect the inclusion of genders 2, 11 and 14.

The possible fourth category of genders, i.e. such that display a high degree of intra-gender-variance as well as a high degree of interlinguistic variability, are completely absent, i.e. there seems to be no totally ``chaotic`` genders (which, of course, in a sense is fortunate).

## 5.2 Looking at the different types of gender markers

As seen in the box plot diagram of gender 1 (appendix 14-1), the subjectival gender marker on finite verbs (su;sv;sx;sy;sz) clearly displays the highest degree of diversity. The nominal gender marker (nu;nv;nx;ny;nz) on the other hand is completely stable through-out all languages, i.e. all languages display the phoneme /m/. A quick glance at the univariate line charts confirms that the phonological diversity is indeed displayed by the subjectival gender markers (marked with squares in the diagram in appendix 14-1).

This is more or less a consistent fact for all genders which leads us to the conclusion that, assuming that all the languages in the sample once had identical gender markers (i.e. at the proto-Bantu stage), diachronical change tends to affect agreement morphemes more often than the actual nominal gender markers, especially the subjectival/objectival gender markers on finite verbs.

Note however that genders 12 and 13, although they do not display any considerable degree of phonologically variance (being grouped in category two above), the box plot diagrams for these still indicate that they do. This is explained by the fact that many languages completely lack these genders and therefore the percentiles have been somewhat ``distorted`` which is partly rectified by the univariate line charts.

## 5.3 A short summary

Thus in summary of part 5, we can conclude mainly the following four points:

- (1) Nasal genders display intralinguistic variance but no interlinguistic such, while plosive genders display hardly any variance at all.
- (2) Both nasal and plosive genders tend to vary less interlinguistically than do the remaining genders.
- (3) There are no totally ``chaotic`` genders, i.e. all genders show some kind of phonological stability, either intralinguistically or interlinguistically.
- (4) The gender markers on finite verbs (i.e. subjectival and objectival gender markers) tend to be the ones that vary most while nominal gender markers tend to be more stable.

Points (1) through (3) above could further be elaborated into the conclusion that there are no ``fricative genders`` or indeed ``continuant genders``. Thus, nasals and plosives are given a special status in contrast to other phonemes, which of course is satisfying since they both appear at one extreme of feature x (degree of oral closure). In addition, nasals are also often classified as plosives by some phonologists/phoneticians.

## 6. Concluding remarks, problems and possible prospects

### 6.1 Some conclusions and problems

What can we now say, for instance, about the internal validity of the above described study. Well, the internal validity depends on whether or not we want to extend our conclusions from typology to diachrony. The results correlate fairly well with known diachronic data. Some inconsistencies were

found but many of these can be explained on account of factors outside the scope of study (i.e. such that have not been measured or analyzed, or so-called intervening variables).

In order to be able to draw sound genetic conclusions we might want to refine the bases for calculations, i.e. expanding the morphological inventory as well as improving the phonological feature-theory with which to yield numerical values. With more time at hand we should also make another choice of languages, in order to improve the geographical (and perhaps also the typological) representativity as well as adjusting, or rather decreasing, the temporal variability.

Actually, the comparisons above has provided us with a, possible, new independent variable since what we can do with the comparisons is to see how well the above described procedure performed, i.e. assuming, of course, that the known (or supposed) data is correct. Thus we would want to find out if the difference between the old and new results are significant or not. If they are we would either want to adjust the premises for the procedure (e.g. fixing up the phonological theory behind it) or simply reject the whole idea. If the differences are not significant, we can, at least, go on until we find other factors reducing its value (e.g. other, more reliable, methods that reveal different results based on a set of completely different criteria). However, we can always resort to the typological claims and leave the genetic ones behind, at least temporarily.

The problem in connection herewith is, without doubt, how to measure the old data. We have no real way of assigning comparable values to the old data since most, or even all, of it is based on intuitive estimations together with a variety of different structural criteria, e.g. phonological, lexical, morphological, syntactic, or what have you.

## **6.2 Problems with the sources and the material**

With regard to the literature sources, which has already been pointed out but needs to be stressed again, is that the sources are scattered over a time span of almost one hundred years. A larger study definitely needs to be based on a more synchronically even sample.

As for the morphological elements chosen, there are two kinds of restrictions in the present material. Firstly, we have only used four types of nominal gender morphemes. We could have added further morpheme types, e.g. gender markers on demonstratives, genitives and relative clauses. However, the problem with these is that they are very often identical with one of the already chosen four. Also, the literature is not consistently listing these types of gender morphemes consistently. Sometimes, they are described together with other morphological elements with which they have merged (as is the case with the genitive markers), i.e. the part which constitutes the actual gender marker is not distinguished from the other element.

The second kind of restriction concerns the fact that we have restricted the material to nominal morphology only. We could have expended the material with verbal morphology as well, and perhaps also lexical data.

## **6.3 Problems with the phonological analysis**

One major problem which we might want to do something about is that vowels have not been distinguished. This is particularly a problem when a labial consonant has disappeared but left a trace of ``labiality`` on the vowel, i.e. instead of an original unrounded vowel we might find a rounded vowel

in its place. However, I have no clear examples of this from the above utilized morpheme inventory. Also, Bantu languages do not make phonological distinctions between rounded and unrounded vowels, all front vowels are unrounded while all back vowels (save /a/) are rounded.

One possible way of adding vowel distinctions would simply be to add further values for feature x in order to distinguish the phonological features closeness/openness, i.e. instead of ending the scale at continuants we might add close vowels, mid vowels and open vowels. Rounded vowels could then be given value 5 with regard to labialization while front-central-back distinctions might be distinguished with feature y (place of articulation).

Another problem is that tones have been completely ignored. We would have to include these if we would take vowel distinctions into account since many Bantu languages (as well as many other languages) utilize tone distinctions. For this we would, again, be forced to add yet another feature, say, tonality (or similar).

Yet another problem that concerns phonology is that we have not distinguished orality and nasality in any greater detail. If we had used languages that distinguish oral and nasal (or rather oral-nasal) vowels, then we must add a sixth feature, say, nasal flow (or similar).

#### **6.4 Future prospects and hopes**

As a kind of summarizing point, one might want to say that the method itself has clearly proved interesting and promising for future studies. Unfortunately, the procedure relies on extensive coding which makes it a time consuming operation. Thus, whether or not it will be further elaborated in the future depends, not on the presence/absence of interest, but rather (as often seems to be the case) on temporal, technical and/or financial facilities at hand.

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## LIST OF APPENDIXES

### Hagmanian graphics

- 1 Composite cluster analysis of all features.
- 2 Cluster analysis of feature u (labialization).
- 3 Cluster analysis of feature v (affrication).
- 4 Cluster analysis of feature x (degree of oral closure).
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- 7 Composite dendrogram for all features.
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- 10 Dendrogram for feature x (degree of oral closure).
- 11 Dendrogram for feature y (place of articulation).
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- 13 Numerical relations between the languages based on all features.

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- 14-1 Box plot diagram and univariate line charts for gender 1.
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