ASPECTS OF THE MORPHOPHONOLOGY OF DAGAARE

by

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Aspects of the morphophonology of Dagaare

submitted by   Alexander Angsongna   in partial fulfilment of the requirements for

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Abstract

Dagaare is a Mabia/Gur language spoken in northwestern Ghana and parts of Burkina Faso. The aim of this dissertation is to contribute to the understanding of morphophonological patterns such as vowel harmony, tone alternation, as well as aspectual and nominal inflection using theoretic models such as Optimality Theory and Minimalist Syntax. It also contributes to the overall description and documentation of Dagaare.

In Dagaare, there are two main harmony systems – tongue root harmony involving all lexical categories and rounding harmony which generally involves only the imperfective form of the verb. Both harmony patterns are root-controlled with tongue root harmony being bidirectional while rounding harmony is only progressive, spreading rightward. I account for both harmony patterns based on the interaction of markedness and faithfulness constraints within Optimality Theory, arguing that harmony is driven by theoretic constraints such as [SPREAD].

Tone in Dagaare is analysed in simple nouns and verbs as well as in complex cases including compounds, and associative phrases. Default verb forms are shown to involve spreading while imperfective forms always have a suffix tone opposite to that of the root. Nouns are analysed as involving two mechanisms where one involves tone spreading from the suffix to the root and another involves the insertion of a polar tone on the suffix.

With inflectional morphology, I examined verbal and nominal inflection involving aspectual and number marking. I presented a discussion of the default vs. imperfective contrast in verb forms as well as number marking on nouns and nominal modifiers. For the verbs, evidence is shown that the contrast that has been described as perfective vs. imperfective actually involves default vs. imperfective. The final vowel of the default verb is analysed as inherently meaningless while the imperfective suffix always has a dedicated progressive meaning.

For nominal inflection, nouns are categorized into classes based on similarity of the singular suffix and that of the plural suffix. Nominal inflection is shown to result from phonological processes such as harmony, vowel length; morphosyntactic processes such as derivation and semantic factors like individuation while verbal inflection is a result of morphological, phonological and syntactic properties.

Lay Summary

This dissertation explores the word structure and sound system of Dagaare, a Mabia/Gur language spoken in northwestern Ghana and in some parts of Burkina Faso. The goal is to show how words are formed from different components and how words differ in the expression of grammatical meanings like aspect and number (INFLECTIONAL MORPHOLOGY). It also focuses on the system of sounds and establishes generalisations about which sound combinations are possible and impossible in processes such as VOWEL HARMONY and TONE. Based on a large database collected with speakers in Ghana, I discuss cases involving verbs, simple nouns, compounds and phrases, and propose a formal analysis showing how sounds agree in particular properties and in specific contexts.

Preface

This dissertation is the original, intellectual, and independent work of the author, Alexander Angsongna. Feedback and suggestions on the organization, description and analysis of the data presented here were provided by my supervisory committee. The majority of the data reported on in this dissertation was collected through fieldwork in Ghana. The research was approved by the Behavioural Research Ethics Board of the University of British Columbia [certificate #H16-01221].

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List of Abbreviations

1	First person
2	Second person
3	Third person
COP	Copula
CNJ	Conjunction
DEM	Demonstrative
DET	Determiner
DIST	Distal demonstrative
REM.PST	Remote past
FOC	Focus
FUT	Future
HAB	Habitual marker
HUM	Human
IDEO	Ideophone
IMV	Imperative
INF	Infinitive
IPFV	Imperfective
INTR	Intransitive
MOD	Modality marker
NEG	Negation
NMLZ	Nominaliser
NONHUM	Nonhuman
NUM	Number
PFV	Perfective
POL	Polarity marker
POSS	Possessive pronoun
PL	Plural

PST	Past
PXL	Proximal demonstrative
Q	Quantifier
RECIP	Reciprocal
REL	Relativizer
SG	Singular
V	verb

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This dissertation would never have reached this successful completion without the invaluable contributions, support, patience, and encouragement of a lot of people. I first express my heartfelt gratitude to my supervisory committee.

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Dedication

This dissertation is dedicated to:

My parents – ***Roger and Aloysia Angsongna*** and

all the language consultants in Sombo

Chapter 1: Introduction to Dagaare

1.1 Introduction

In this dissertation there are two main objectives: one is to make a contribution to the understanding of morphophonological patterns such as vowel harmony, tone alternation as well as aspectual and nominal inflection using theoretic approaches such as Optimality Theory (McCarthy, 2011; McCarthy & Prince, 1993a; Prince & Smolensky, 2004a) and Minimalist Syntax (Chomsky, 1993, 1995, 1998; Radford, 2004).

Although patterns such as vowel harmony and tone have been well investigated in a number of African languages, there are other languages which have been less researched in terms of these phenomena. Dagaare is an example of such language. For instance, in spite of works on vowel harmony in some African languages (like Yoruba, Dagbani or Akan), discussion on vowel harmony in Dagaare has been relatively scanty with only a brief description of the phenomenon in Bodomo (1997) and an acoustic discussion of tongue root harmony in Ozburn et al. (2018) and Akinbo et al. (in prep.). These studies however have not provided a detailed account of the various patterns of harmony in the language.

Similarly, tone is another pattern with relatively limited discussion in Dagaare even though it is well researched in other African languages (e.g., Margi, Bambara, Dagbani, Buli etc). Studies on Dagaare tone have focused generally on the nominal system with little or no attention to other categories such as verbs, nominalisations, compounds and more. In addition, discussions on inflectional morphology in Dagaare has always been on the morphophonological (e.g., Bodomo 1997; Bodomo & Marfo, 2006) and lexical (Grimm 2010, 2021) properties of number marking, less so for aspectual inflection on verbs.

This dissertation therefore intends to contribute by attempting to fill the knowledge gap in the literature through a detailed account of harmony patterns, tone alternations and aspectual and nominal inflections in Dagaare. While providing a detailed account for these phenomena, various important issues such as markedness and faithfulness constraints as well as harmonic and tonal domains will be integral in the analysis.

The second objective of this dissertation is to contribute to the description and documentation of Dagaare as well as contributing to theories of phonology/morphology and syntax. The remaining part of this chapter provides a short background on Dagaare, its speakers, varieties, status and closely related languages to Dagaare. A basic sketch of the syntax which may prove relevant to the understanding of the various patterns is also provided in this chapter.

1.2 The people and language

1.2.1 The Dagaaba people

The language under discussion is Dagaare. A person who speaks Dagaare as a native language is *Dagao* and the plural of which is *Dagaaba*. The term *Dagao* is also used to refer to the homeland of Dagaare-speaking people (Dagaaba). In Burkina Faso (Bodomo 1997), the corresponding terms are Dagara which refers to both the speakers and the language, and Dagarateng which refers to the homeland of speakers of Dagara. According to the 2021 population census report by the Ghana Statistical Service, Dagaare speakers in Ghana constitute 3.9% which represents 1.2 million. This figure in addition to the number of speakers in Burkina Faso and Ivory Coast puts the total number at approximately 2 million.

The historical background of the Dagaaba is quite unclear. As cited in Bodomo (1997), the general historical literature (e.g., Christaller 1889; Herbert 1975; Tuurey 1987) suggests that the ancestors of the Dagaaba are a subdivision or faction of the Mossi or the Dagomba or both, who moved into their present destination/place and then assimilated the new arrivals or got assimilated by the earlier settlers. In a slightly different account, rather than assuming that Dagaaba are a group that emerged from the Mossi or the Dagomba, Bodomo (1994, 1997) argues that the Dagaaba, the Dagomba, the Frafra, the Kusaasi, the Mampruli, the Mossi and many others are descendants of a common ethnolinguistic ancestor, the Mabia, thereby suggesting that Dagaaba are neither a subdivision of the Dagomba nor the Mossi. This discussion, though gives an idea about the origin of the Dagaaba, is still open for further historical investigation.

In political terms, Dagaaba had a more decentralised traditional system of government before the advent of the British Colonial administration. Prior to the advent of the Indirect Rule (a kind of political control by the colonial administration through indigenous chiefs), every village in Dagao (the Dagaaba homeland) was autonomous (Bodomo 1997) with the *tɪndaana* (first settler/landowner) being both the religious and political head who in consultation with elders made

laws and ensured the maintenance of law and order. The British policy of Indirect Rule between the 1890s and 1957, however, effectively and drastically changed the decentralised system of governance among the Dagaaba. The political system since then has been in the form of paramountcies or chiefdoms. At the apex of this system is the *Nàá* 'chief' who exercises authority over members of a particular village or over sub/divisional chiefs within a paramountcy.

Economically, Dagaaba predominantly engage in agriculture. A few engage in large-scale farming while the majority pursue subsistence farming. The major crops include corn, beans, millet, guinea corn and groundnuts (peanuts) while livestock include cattle, goats, sheep and fowls. Farming is so key to the economy of Dagao that virtually every family engages in at least some subsistence farming. In addition to agriculture, many Dagaaba are involved in trade and other businesses, particularly distribution of goods in the form of wholesale and retail. Moreover, a good number of Dagaaba are found in the tertiary sector providing services in teaching, health, administration, in the civil service, governance and a host of other services.

Finally in terms of culture, there is some variation among villages with respect to some cultural aspects such as marriage, specific festivals, and dance. This notwithstanding, there is some commonality when it comes to other aspects of the culture. One of the most recognizable cultural manifestations is in the traditional food called *sáó* or *sáábó or sáá* (also known as *T.Z* which is an abridged form of *tuozaafi* – the Hausa name for the same food; Bodomo 1997). It is a common delicacy across all Dagaaba communities. Another common cultural item which cuts across every Dagaaba community is the traditional alcoholic drink called *dǎázìé* (literally: red alcohol; also commonly referred to as *pito* – a loan version of the Hausa word *fitoo* for the same kind of drink). It is a drink that is considered a unifying and socialisation item; during evenings and/or weekends it is common to see people in local bars enjoying jokes over this drink.

Moreover, a visible cultural artefact among Dagaaba is the wearing of the smock known as *Dàgà-kpàróò* (literally: Dagaaba's shirt or the shirt of the Dagaaba) or *fugu* which represents victory. This smock was previously worn by the elderly mainly for war or solemn events such as funerals. In recent times however, the use of *Dàgà-kpàróò* has extended beyond just the elderly and beyond funerals and festivities. It has become more fashionable, and it is commonly worn for basically every event (e.g., festivals, church service, marriage ceremonies, funerals, at the work place or just

for no particular event). Its use has also gone beyond Dagao as other cultures in other parts of the country have resorted to the wearing of smock.

With regards to cultural instruments, the common instruments among Dagaaba include *ʤìlí* 'xylophone', *lŏŋò* 'hourglass drum' and *tùmpɔ́ɔ́ní* 'talking drum' and in terms of dance, the most common dance in many Dagaaba communities is *Bawaa.* This dance, which comes in various forms, is so common that it is gradually being performed as an annual festival in some communities. Finally, oral art particularly singing, and storytelling are popular cultural practices among Dagaaba. It is common to see groups of workers performing various activities while singing. The belief is that singing alleviates the fatigue that comes with the work and inspires productivity. As for storytelling, most Dagaaba stories are centred around *Bádɛ́rí* 'spider'. The spider is believed to always engage in sneaky, crafty, and cunning exploits which always lead to his downfall. These stories have been handed down through generations and they are believed to transmit good morals to children as they grow.

1.2.2 Dagaare Language
1.2.2.1 Dagaare, neighbours and status

Dagaare (ISO 639-3) is the major language spoken in northwestern Ghana (the Upper West Region and parts of the Savannah Region) and parts of Burkina Faso and Ivory Coast. Three other closely related varieties to Dagaare include Dagara, Waale and Birifo. They form a linguistic continuum (of various degrees of) intelligibility (Bodomo 1997) and are sometimes considered as one language. To the east, this linguistic group (the Dagaare-Dagara-Birifo-Waale continuum) is bordered by Sisaali, a Grusi language. Sisaali is the language with the closest inter-language contact with Dagaare. To the south, this language group is bordered by Gonja, Safaliba and Vagla. The language continuum also extends in various forms across the Black Volta in Burkina Faso, spoken in places including Dano, Diebougou and Dissin. A variant which is referred to as Wandari (Dakubu, 2005; Tchagbalé & Mensah, 1983) is reported to be spoken by about 3000 people in a small area in the north-eastern corner of Ivory Coast. Figure 1 shows the main areas in which the various forms of the language are spoken. It should be noted, however, that the language is not limited to its traditional homeland because it has spread across other parts of Ghana as a result of the movement or migration of native speakers.

Fig 1.1: Areas where the various varieties of the linguistic continuum are spoken (Credit: UBC Geography/Angsongna & Akinbo, 2022)

According to Dakubu (2005), the first ever known record of Dagaare was published in Christaller (1889) and it consisted of the numbers one to ten collected by the German trader Krause. Christaller, based on that data, classified Dagaare as belonging to the 'More' (now Moore/Mossi) sub-group. Following Christaller, Rattray (1932) documented the first ever fairly sizeable wordlists in Dagaare for what was termed 'Dagare' from Wa (now the capital town of the Upper West Region) and 'Lober' from Lawra (a major town in which Lobi, a variant of Dagara is widely spoken).

With regards to the study of Dagaare, it is reported to have begun in the 1950s during the advent of the Catholic missionaries in north-western Ghana with Durand's (1953) first ever Dagaare-English dictionary and Girault's (1962) work that resulted in a number of publications in French. Dagaare during that time was and is presently to a large extent, the language of evangelisation in northwestern Ghana. The start of the 1960s saw the beginning of linguistic work on Dagaare by

Protestant missionary linguists with works such as Kennedy (1966) and Hall (1973). These missionary linguistic works were followed by early works of academic linguists (mostly native speakers) such as Angkaaraba (1980); Dong (1981); Bemile (1983); Delplanque (1983); Somè (1983); Dakubu (1989); Bodomo, (1989, 1993, 1994, 1997); Saachi (1997) and many others.

With respect to language policy of education in Ghana, Dagaare holds an important status in the Ghana education system. Dagaare is one of the ten (10) regional languages used as an official language of instruction at the basic/lower levels (primary 1 – 3) and then it is studied as a school subject at the higher levels. In universities particularly the University of Ghana, the University of Education and other colleges of higher education, Dagaare is taught and offered for degree programs. Moreover, apart from the prominence of Dagaare at all levels of education in Ghana, it is a language of active research by linguists and other scholars in West Africa and other parts of the world.

1.2.2.2 Genetic/linguistic classification of Dagaare

The closest geographical neighbours (e.g., Sisaali, Gonja, Vagla) of Dagaare are not necessarily the closest relatives in terms of genetic relationship and classification. According to Bendor-Samuel (1971), Naden (1989) and Swadesh et al. (1966), Dagaare belongs to the northern branch of the so-called West Oti-Volta group of Gur languages. This means that its close genetic relatives are Safaliba, Moore and Gurenɛ (Farefare). With general regards to the Oti-Volta sub-group, Dagaare is related to other languages such as Dagbani, Kusaal, Mampruli, Buli, Konkomba, Bimoba among others. This group of languages has been referred to as 'Gur languages' a term that is considered as inappropriate because of its (neo-) colonialists' roots and so the term Mabia [*má* 'mother', *bía* 'child' = 'sibling'] has since been proposed (Bodomo 1993, 1994, 2005, 2020) to refer to all languages within the so-called Central Gur group. The term Mabia simply refers to the fact that these languages are believed to have descended from a common linguistic parent. Many of these languages are mutually intelligible and therefore grouping them does not mean there are clear boundaries between them (Bodomo 2005). This is because many of them form a continuum and the variation between them is gradual. They share similarities in terms of patterns such as vowel and consonant systems, tone, noun classes, word order etc. Figure 2 below (adopted from Bodomo 2020) shows Mabia languages of Ghana previously termed Gur languages.

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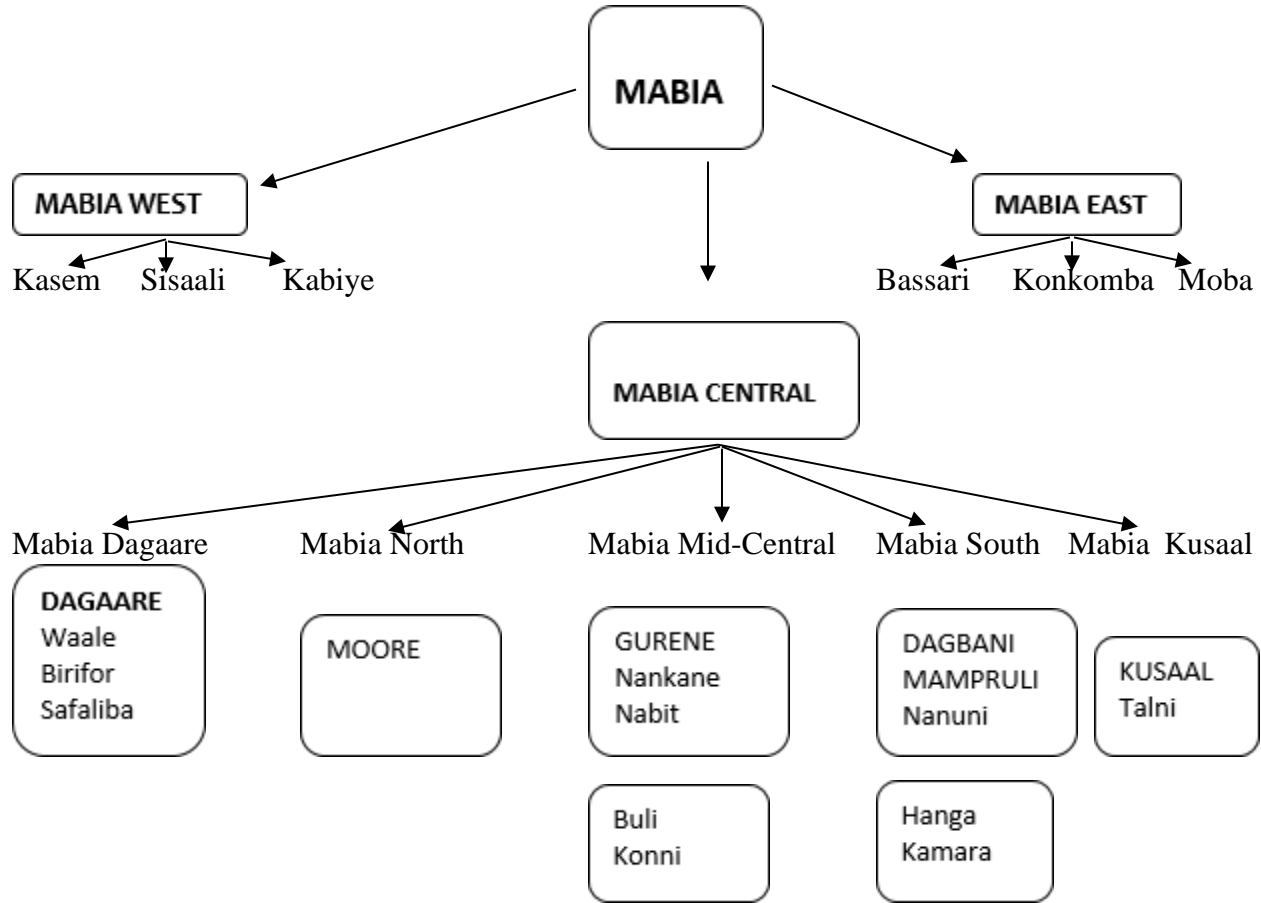
Figure 1.2: Mabia languages (Bodomo, 2020)

1.2.2.3 Varieties of Dagaare

Considering that Dagaare does not really have a unified standard form recognized by all, it is important that attention is always paid to the diversity that exists when describing the language. As noted in Bodomo (1997), the linguistic continuum involving Dagaare-Dagara-Waale-Birifor presents one of the most complex dialect situations in Ghana. From the north through to the south the dialects gradually overlap each other, thereby making it difficult to draw a distinction between one variety from another. More so, within each variety, there are internal variations even from one village to another. Crucially however, the thing that connects all varieties is some degree of intelligibility among them. Therefore, from a linguistic perspective, it is rather ideal to consider Dagaare, Dagara, Waale and Birifor as variants of one language instead of separate languages.

Four dialects have been identified (Bodomo, 1997; Dakubu, 2005; Angsongna & Akinbo 2022), namely Northern Dagaare, Central Dagaare, Southern Dagaare and Western Dagaare. These divisions are generally based on geographical criterion. According to Bodomo (1997; 1989), the distinctions are based on the assumption that certain major towns are the centres from which linguistic innovations and influence spread to surrounding areas.

The Northern Dagaare also known as Dagara is spoken in the major towns Lawra and Nandom and their surrounding villages. It is termed northern because it is located in the northmost part of the general language area. The majority of the speakers of this variety are found in Burkina Faso. It is observed (Dakubu 2005) that this variety is generally distinct from the others.

Central Dagaare covers approximately the middle area of the Dagaare-speaking area (Northwestern Ghana). It is spoken in towns including Jirapa, Ullo, Han, Daffiama, Nadowli, Sombo, Duong, Charikpong among others. It is the variety which has been more or less traditionally referred to as 'Dagaare'. This variety has a reasonable level of intelligibility by speakers of other varieties. It has been at the centre of early missionary linguistic work. It is also the variety commonly used on radio and television. More importantly, Central Dagaare is the variety generally used as a language of instruction and as a school subject in basic schools. It is often claimed that the 'Central' tag is not only in reference to its geographical location but also because of its role in education and the general intelligibility it enjoys from speakers of other varieties.

The Southern dialect starts from Kaleo through Loho to Wa and the surrounding towns of Wa such as Kperisi, Danko, Bamaahu etc. It is popularly referred to as *Waale*, a name derived from the name of the regional capital, Wa. Another variety within this dialect spoken in the Kaleo area is referred to as *Manlaale*. Just as the central variety is predominantly used as an education and literacy dialect, the southern dialect is used predominantly as a trade language; it is widely used as lingua franca in markets and on radio as well.

Finally, the Western dialect, which is also known as Birifor is spoken in and around Wa West district in places such as Lassie Tuolu and Gurungu and in some parts of the Savannah Region including Tuna, Kalba and Sawla. A good number of speakers of this variety are also found on the Western side of the Black Volta in Burkina Faso and Ivory Coast (Bodomo 1989, 1997; Dakubu 2005). The name Western Dagaare reflects the fact that the traditional homeland is on the western

side of the Black Volta. The speakers of the Western variety are believed to have migrated to their present place in Wa West fairly recently at the start of the twentieth century.

Overall, these varieties have some differences in lexical items, phonology and syntax. Also, in terms of general intelligibility and specific linguistic features, it is observed that the Central and Southern dialects are closely related, and the Northern and Western dialects are also closely related. Mutual intelligibility between these two main divisions is not very high.

Phonologically, all varieties exhibit some differences. For instance, with vowels both Central Dagaare (Angsongna & Akinbo, 2022; Ozburn et al., 2018; Saanchi, 1997) and Southern Dagaare (Abdul Moomin, 2015) are reported to have ten contrastive vowels while nine vowels are reported in both Northern and Western dialects. Also, while Central has twenty-three consonants including two glides (Angsongna & Akinbo 2022), Southern Dagaare has twenty-two consonants and two glides (Abdul-Moomin 2015) and both Northern and Western dialects have twenty-five consonants and two glides (Kuubezelle 2013; Dundaa 2013). In addition, there are differences in the types of consonants which occur in intervocalic positions. In Central Dagaare, [r] may be intervocalic or word-final especially in fast speech. In Southern Dagaare the fricative [h] replaces [r] in intervocalic position in some words while [r] occurs in word-final position in those same words for Northern and Western Dagaare. The alveolar fricative [z] in Central and Northern dialects is replaced with the palato-alveolar affricate [ʤ] in Southern and Western dialects. Note, however, that both Central and Northern varieties have both [z] and [ʤ] in their sound systems. This suggests that the Southern and Western dialects have merged the two sounds – they have lost the [z] – [ʤ] contrast (see Dundaa 2015; Abdul-Moomin 2015). Some examples are given below.

(1) Differences among dialects

Central	Northern	Western	Southern	Gloss
bíí-rí	bíír	bíír	bíí-hí	'children'
sáá-rì	sáàr	sáàr	sáá-hì	'broom'
zû	zú	ʤú	ʤû	'head'
zìɛ́	zíɛ́	ʤíɛ	ʤìɛ́	'red'

As observed in Angsongna & Akinbo (2022), the voiceless bilabial implosive [ɓ] and the voiceless glottalized lateral [ˀl] are attested in the Northern dialect and in the Western dialect. The voiceless

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glottalized palatal [ʔj] and labial-velar glide [ʔw] are found only in Western Dagaare, while the voiceless velar fricative [x] is attested only in the Northern dialect. None of these consonants are found in Central and Southern Dagaare.

1.2.2.4 Dagaare and language contact

Speakers of Dagaare do not usually speak the languages of their closest neighbours. So, some areas which are now Dagaare-speaking are thought to have shifted from another language. For instance, the ancestors of the Birifor are believed to have once spoken Lobi languages and some speakers of Southern Dagaare from Kaleo are believed to have previously spoken Moore (Dakubu 2005).

In terms of borrowing, Dagaare has had contacts with and borrowed from a number of languages including English, Akan, and Hausa. These are languages especially English and Akan, that Dagaaba in Ghana are likely to speak as second languages. As for the variety in Burkina Faso, Beyogle (2015), reports that French is the most likely second language for the speakers. Borrowing usually happen as a resolution for lexical gaps in a particular language. For instance, from English, words are borrowed denoting new technologies, unfamiliar items and activities. Examples include *k�à rènsiŋ* 'kerosene', *kìrísìmíì* 'Christmas', *hánʧìrì* 'handkerchief', *pòlísì* 'police', *bìríʧì/bìrídʒì* 'brick', *sùkúù/sàkúù* 'school', *sákìrì* 'bicycle' and many others. A lot of these forms are so common that they are easily treated as having number suffixes as in *bìríʧì-rí/bìrídʒì-rí* 'bricks.

A number of words are also borrowed from Akan. Some of them include names of fruits such as *àŋkàá* 'orange' (from Akan aŋkaa), *kòdú* 'banana' (from Akan word *kwadu*). These are fruits which are more commonly produced in the Akan-speaking regions of Ghana. Other words include *kàníè* 'lamp' (from the Akan kania), *pèríkó/pòríkó* 'pig' (this is borrowed from the Akan *prako* which in turn comes from the Portuguese word *porco*).

Dagaare words of Hausa origin are relatively less common. They are mostly words for abstract concepts which were also initially borrowed by Hausa from Arabic. Some examples include *dónéé* 'world' (from the Hausa word *duniya*), *hákílà* 'mind' (from the Hausa word *hankali*), *lã̀ã̀fíè* 'health/wellnesses'.

In addition, Dagaare is also believed to have had contact with languages such as Mande, Bambara and Arabic possibly through trade (Dakubu 2005). This is reflected in words such as *dʒìlí*

'xylophone', *kóríndʒóŋ* 'harp' (from the Mande word *koringyo*), *kàrìmá* diviner/seer' (from the Mande word *karamɔgɔ*). From Arabic, the words *fàŋá* 'power/strength' and *fɩntínà* 'oil lamp' are borrowed.

Finally, there are also borrowings among the Dagaare dialects. Particularly it is generally observed that Southern dialect (Waale) is spreading as second language due to the trading activities of its speakers across many areas and its use on radio. Some Waale words which have found their way into other varieties include *nátírí* 'sore', *dànlà* 'free speech', *sóŋgósó* 'storey building', *lùmgbúrì* 'orange', *sèlìŋá* 'toilet' etc.

It should be noted that borrowing is not always a case of lexical gap for a particular item but some of the loan words are common that Dagaare speakers switch to using them instead of the original Dagaare words. For instance, there are native Dagaare terms such as *dòbáá* for pig, *kpíéŋú* for 'power/strength' *jéŋ* for mind, *fɩlí* for sore, *bándʒíráá* for toilet, *tìndàá* for world, *m̀máá!róŋ* for health/wellness and many others.

1.2.2.5 Data sources and methods

Most of the data used in this research comes from the variety of Central Dagaare spoken in the Nadowli Kaleo district. Specifically, the data comes from the variety that is spoken in the Sombo area. The data collection was conducted in Ghana between March and April 2018. Though the data was generally collected from twenty-three (23) speakers, the majority of it came from ten speakers: seven males and three females. These speakers were between the ages of 31 and 70 years. The data elicitation of wordlists, phrases and sentences was based on the SIL Comparative African Wordlist (SILCAWL) (Snider & Roberts, 2004). It also included short stories, songs and description of local events/culture of the people. This data is supplemented by data from the existing literature. As a native speaker, I also provided supplementary data based on my own linguistic intuitions and judgements.

The elicitation was done with a Shure WH30XLR cardioid condenser (a headset microphone) and Rode NGT2 supercardioid condenser (a shotgun microphone) at the sampling rate of 48 kHz and bit depth of 16 bits. The microphones were attached to a Zoom Q8 camera.

1.3 Sketch of Dagaare syntax

Every language has a basic unit of utterance, the sentence. A sentence is a set of words containing a subject and a predicate. The predicate is the part of a sentence or clause which contains a verb and says something about the subject. In Dagaare, a sentence must consist of at least a clause. A simple sentence contains a single clause while a compound or complex sentence consists of more than one clause. In this section I give a brief descriptive sketch of the syntax of Dagaare. Since it is not going to be an exhaustive or a thorough discussion, I provide the basic word order of the sentence in Dagaare. I give a brief discussion of the pronominal system, the noun phrase, verb phrase, preverbal particles and the affirmative/focus particle. The main reason for this grammatical sketch is to provide some basic background that will be relevant for the discussion of nominal and verbal inflection in chapter 3 and the discussion of sentence level tonal alternations in chapter 5.

1.3.1 Basic sentence structure of Dagaare

Dagaare has a canonical word order of Subject-Verb-Object (SVO) (Bodomo 1993, 1997), although alternate word orders are permitted in certain contexts. In general. the subject precedes the verb, and the verb precedes the object. The sentence in Dagaare contains the following elements: the subject, verb, object and complement (subject, object or adverbial complement). The verb in a sentence may be preceded by a preverbal particle such as tense markers. Note that I consider the so-called perfective forms as default verbs, and I will be glossing them as V for verb. See chapter 3 for further argument in support of default verb form.

A simple sentence in Dagaare may involve just the subject and the verb followed by a post-verbal particle *lá/ná* or its clitic form *-ŋ.* In other words, a simple sentence may consist of a subject and an intransitive verb as in (2) below. The post verbal particle is referred to as an affirmative or factitive or focus marker. It is either *lá* or *ná* depending on the variety of Central Dagaare. In the Jirapa dialect it is *lá* and in other dialects such as that of sombo, Takpo and Sankana, it is *ná*. The data for this study comes primarily from the Sombo dialect, hence the use of *ná* as the postverbal particle. This particle is further discussed in section 1.3.5

(2) a. à bí-é dì-é-ŋ

DET child-SG eat.V-INTR-FOC

'The child has eaten'

b. Dàkʊ́ráá wà.V-ɛ́-ŋ

Dakoraa come-INTR-FOC

'Dakoraa has come'

It is possible to have a sentence containing a subject, a copula/linking verb and a subject complement. In Dagaare, these verbs constitute a small but important group. They are verbs which require a subject complement for a sentence to be complete. This is shown below.

(3) a. à dɔ́ɔ́ ì-ɛ́ kʊ́ɔ́!r-áá

DET man.SG COP-FOC farmer-SG

'The man is a farmer'

b. à kὂɔ̃́ wáá-!ɛ́ tʊ́l!ʊ́ŋ

DET water COP-FOC hot

'The water is hot'

For the sentence in (3a), the word *kʊ́ɔ́!ráá* 'farmer' is the complement for the subject *à dɔ́ɔ́* 'the man' while the adjective *tʊ́l!ʊ́ŋ* 'hot' complements the subject *à kὂɔ̃́* 'the water'. In effect the subject complement usually identifies or characterizes the subject.

A simple sentence may also contain a subject, a verb, and an adverbial complement. Although adverbials may be optional as in (4a), adverbial complements which convey similar information as adverbials are needed for a sentence to be complete.

(4) a. Dàkʊ́ráá dìèn-ɛ́ ná jèŋɛ́-ŋ

Dakoraa play-IPFV FOC outside-FOC

'Dakoraa is playing outside'

b. Dàkʊ́ráá bé ná jèŋɛ̂-ŋ

Dakoraa COP FOC outside-FOC

'Dakoraa is outside'

In (4a), it is possible for the sentence to occur without the adverbial *jèŋɛ́-ŋ*. This means that the adverbial is optional as in (5a) below. In (4b) however, without the word *jèŋɛ́-ŋ*, the sentence is incomplete. This means that *jèŋɛ́* is an adverbial complement as shown in (5b).

(5)   a.   Dàkʊ́ráá   dìèn-ɛ́   ná
               Dakoraa   play-IPFV   FOC
               'Dakoraa is playing'

        b.   *Dàkʊ́ráá   bé   ná
               Dakoraa   COP   FOC

Moreover, a simple sentence may consist of a subject, a transitive verb and a direct object as shown below.

(6)   Dàkʊ́ráá   dʊ́gí   !ná   bɛ́ŋɛ́
        Dakoraa   boil.V   FOC   beans
        'Dakoraa has cooked beans'

This sentence is a typical case of transitive construction in the language. In the next example (7), we see that a simple sentence could be made up of a subject, a ditransitive verb, an indirect object and a direct object.

(7)   Dàkʊ́ráá   kǒ   ná   ʊ̀   má   lìbí-rì
        Dakoraa   give.V   FOC   3SG   mother   money-SG
        'Dakoraa has given his mother money'

The above sentence is a case of ditransitive construction or double object construction where the verb takes two objects. The indirect object precedes the direct object.

In addition, a simple sentence in Dagaare can be made up of the subject, a transitive verb, a direct object and an object complement.

(8)   à   nʊ́-bà   írì   ná   Dàkʊ́ráá   nàá
        DET   person-PL   choose.V   FOC   Dakoraa   chief
        'The people have installed/elected Dakoraa a chief'

It is also possible to have a simple sentence consisting of a subject and a focus particle (negative or affirmative) as indicated in (9a-b).

(9)   a.   à   dɔ́ɔ́   ná
            DET   man.SG   FOC
            'It is the man'

       b.   à   dɔ́ɔ́   náání
            DET   man.SG   NEG.FOC
            'It is not the man'

Finally, a simple sentence in Dagaare may contain a subject, a focus particle or a negation particle and a subject complement.

(10)   a.   Dàkʊ́ráá   ná   à   nàá
              Dakoraa   FOC   DET   chief.SG
              'Dakoraa is the chief'

        b.   Dàkʊ́ráá   náání   à   nàá
              Dakoraa   NEG.FOC   DET   chief.SG
              'Dakoraa is not the chief'

The verb is always assumed to be the nucleus of the sentence and it constitutes the only obligatory part of the sentence. However, in the sentences in (9) and (10) above, there is no overt verb. These kinds of sentences are what Dakubu (1989) refers to as minor sentences while those that contain overt verbs as shown earlier as major sentences. Such sentences raise questions regarding the SVO word order in Dagaare. This section does not attempt to address these questions.

Aside from simple sentences, there are various kinds of compound and complex sentences in Dagaare including serial verb constructions, serial verb nominalisations, multi-aspect constructions, relativization, coordination and subordinate constructions. However, given the complexities in such complex/compound sentences, I do not provide descriptions for such constructions in this chapter as they are not directly related to the rest of this work.

1.3.2   Pronominal system

Pronouns are lexical categories which function as nouns or noun phrases. Unlike typical nouns, pronouns do not permit the presence of determiners. Generally, pronouns are divided into various categories, namely personal pronouns, reflexive pronouns, demonstrative pronouns, reciprocal pronouns, interrogative and relative pronouns.

1.3.2.1 Personal pronouns

Personal pronouns in Dagaare do not indicate any gender distinction and there is hardly any case marking. The only distinction in terms of nominative and accusative form is found with the first-person singular forms: $\grave{N}$ and *má*. As can be seen below there is also a distinction between strong/emphatic and weak pronouns. In addition, there is a tone distinction between subject and object pronouns in the sense that all subject pronouns are low-toned while all object pronouns are high-toned. Another important property of this system is that the third person pronoun has a three-way distinction involving a neutral singular form, human plural form and non-human plural form. The table below shows Dagaare personal pronouns.

Table 1.1: Personal pronouns in Dagaare

			Subject			Object		
Number	Person	Humanness	Weak	Strong	Gloss	Weak	Strong	Gloss
Singular	1	+human	Ǹ	mǎǎ̀	I	má	mǎǎ̀	me
	2	+human	fò/hò	fǒò̀/hǒò̀	you	fó/hó	fǒò̀/hǒò̀	you
Plural	1	+human	tì	tìníì	we	tí	tìníì	we
	2	+human	jὲ	jὲníì	you	jέ	jὲníì	you
Singular	Non-	±human	ò	ónɔ́/óná	s/he/it	ó	ónɔ́/óná	s/he/it
Plural	interactant	-human	à	áná	they	á	áná	they
	3ʳᵈ	+human	bà	báná	they	bá	báná	they

Note that the first-person pronoun is the nasal [n] but it is realized as [m] or [ŋ] when it precedes a bilabial or a velar consonant respectively.

1.3.2.2 Reflexive pronouns

In Dagaare reflexive pronouns are formed by the combination of the word *mìŋέ* (plural: mìn-ní) which is an intensifier meaning 'self' with any of the personal pronouns.

Table 1.2: Reflexive pronouns in Dagaare

Number	Person	Humanness	Weak form	Gloss	Strong form	Gloss
Singular	1	+human	Ǹ mìŋέ	myself	mǎá mìŋέ	me, myself
	2	+human	fʊ̀/hʊ̀ mìŋέ	yourself	fʊ̌ʊ̀/hʊ̌ʊ̀ mìŋέ	you, yourself
Plural	1	+human	tì mìn-ní	ourselves	tìníì mìn-ní	we, ourselves
	2	+human	jὲ mìn-ní	yourselves	jὲníì mìn-ní	you, yourselves
Singular	Non-	±human	ʊ̀ mìŋέ	him/her/itself	ʊ́nɔ́/ʊ́ná mìŋέ	s/he, him/herself
Plural	interactant	-human	à mìn-ní	themselves	áná mìn-ní	they, themselves
	3rd	+human	bà mìn-ní	themselves	báná mìn-ní	they, themselves

1.3.2.3 Reciprocal pronouns

Reciprocal pronouns express mutual relationship. They refer to situations where someone or something performs an action on another and receives the same action in return. In Dagaare the commonly used reciprocal pronoun is *táá/táábá* 'each/one another'. These two forms are in free variation in that they can be used interchangeably.

(11) a. tí ìn-nέ táá

   1PL respect-IPFV RECIP

   Lit: We should be respecting each other'

   'We should respect each other/Let's respect each other'

  b. à bíí-rí nʊ̌ŋ ná táá

   DET child-PL like.V FOC RECIP

   'The children like each other'

1.3.2.4 Demonstrative pronouns

These are pronouns that are used to refer to relatively near or, by contrast, relatively far referents. Those that describe referents that are near are proximal demonstratives (PXL) and those that describe referents that are far are distal demonstratives (DIST). Demonstratives in Dagaare have a four-way distinction: *ŋá* occurs with singular nouns; *bá-mà* which is a plural of *ŋá* occurs with only plural human nouns; *á-mà* is another plural of *ŋá* which occurs with only non-human nouns and *ná* is number neutral. Demonstratives that occur on their own in place of nouns are demonstrative pronouns. They include: *ŋá* 'this' and its plural forms *á-mà* and *bá-mà*, *ŋánɛ́ɛ́*; this one', *ŋɑ́ɑ̀* 'like this/this way', *lɛ́* '(like) that' They are illustrated in (12-13). The verb *bʊ́ɔ́-rɔ̀* is H-L but when it occurs in a sentence, preceding the focus particle, it is realized as H-!H.

(12)   a.   Ǹ   bʊ́ɔ́-!rɔ́   ná   ŋá

                 1SG   want-IPFV   FOC   DEM.PXL.SG

                 'I want this'

        b.   Ǹ   bʊ́ɔ́-!rɔ́   ná   á-mà

                 1SG   want-IPFV   FOC   NONHUM–DEM.PXL.PL

                 'I want these'

(13)   a.   Ǹ   bʊ́ɔ́-!rɔ́   ná   ŋánɛ́ɛ́

                 1SG   want-IPFV   FOC   DEM

                 'I want this one'

        b.   zìŋ   ŋɑ́ɑ̀

                 sit.V   DEM

                 'Sit like this/sit this way!"

        c.   ʊ̀   nʊ̆ŋ   ná   lɛ́

                 3SG   like.V   FOC   DEM

                 'S/he likes that'

1.3.2.5 Relative pronouns

Relative pronouns is a referent to an antecedent in a relative clause. That is the pronoun refers to the preceding noun in the clause. In English, relative pronouns include 'who', 'which', 'that' etc. In Dagaare there is one human-neutral relative pronoun *náŋ* which refers to both human and non-human referents.

(14)   a.   à   **pɔ́g-ɔ́ᵢ**   ná   **náŋᵢ**   mɔ̀ŋ   sáɔ́   kɔ̀   má

                DET   woman-SG   DEM   REL   stir.V   sao   give.V   1SG.O

                'The woman who has cooked sao for me'

        b.   à   **báᵢ**   ná   **náŋᵢ**   wúólì

                DET   dog.SG   DEM   REL   bark.V

                'The dog that has barked'

The relative pronouns and their antecedents in the above sentences are boldened and coindexed.

1.3.2.6 Interrogative pronouns

Interrogative pronouns are used to ask questions and they include who, what etc. In Dagaare, interrogative pronouns include: *ăŋ* 'who', *ăŋ mìné* 'who (plural) – human', *búò* 'which (one)/which (of them)', *bɔ̆ŋ* 'what', *bà-búò* 'which of them – human', *à-búò* 'which of them – non-human'. Like personal and demonstrative pronouns, plural interrogative pronouns show a distinction between human and non-humans.

(15)   a.   ăŋ   ná   zìŋ   bé

                who   FOC   sit.V   there

                'Who is sitting there?'

        b.   ăŋ mìné   ná   zìŋ   bé

                who PL   FOC   sit.V   there

                'Who are (those) sitting there?'

        b.   búò   ná   gâŋ   bé

                which   FOC   lie.V   there

                'Which of them is lying there?'

c.	bŏŋ	kà	Dàkɔ́ráá	dà
	what	C	Dakoraa	buy.V

'What has Dakoraa bought?'

d.	bà-búò	ná	wàà-ná
	HUM-which	FOC	come-IPFV

'Which of them is coming?'

e.	à-búò	ná	ŋmárì
	NONHUM-which	FOC	break.V

'Which of them is broken?'

Having given a description of the various pronouns in Dagaare, now the attention is on the noun phrase.

1.3.3 The noun phrase

A noun phrase (NP) is that part of the sentence headed by a noun. In Dagaare, a noun phrase consists of a head noun which could be a proper noun or a bare noun with optional elements which modify the head noun. Such elements include adjectives, quantifiers, demonstratives, possessive determiners/pronouns, or other nouns in associative constructions. A noun phrase can take as many adjectives as possible in Dagaare. Some adjectives in Dagaare include: *bílé* 'small', *kpêŋ/kpôŋ* 'big', *vìèláá/vìláá* 'nice/beautiful', *wégì/wógì* 'tall', *fáá* 'bad', *zìé* 'red', etc. Adjectives always occur post-nominally – they occur to the right of the noun head. When an adjective or a string of adjectives modifies a noun, the final adjective determines the shape of the number suffix. The following examples illustrate the number of number of adjectives following the noun head *pɔ́g-ɔ́* 'woman-SG'. The description of the noun phrase here is but a background introduction which will feed into the analysis of the structure of the noun phrase in chapter 3.

(16)   a.   pɔ̀g-bíl-é

            woman-small-SG

            'A young woman'

b.   pɔ̀g-bìl-íì
woman-small-PL
'Young women'

(17)   a.   pɔ̀g-bìl-wɛ́g-ì
woman-small-tall-SG
'A tall young woman'

b.   pɔ̀g-bìl-wɛ́g-rì
woman-small-tall-PL
'Tall young women'

A noun phrase may consist of the noun head. As shown earlier, demonstratives in Dagaare have a four-way distinction and this is illustrated in the following noun phrases. Anttila & Bodomo (2009), treat the final vowels after singular nouns such as *pɔ́gɔ́* 'woman', *bʊ́ɔ́* 'goat' as epenthetic but not actual singular suffixes. I consider the final vowel as a suffix. See chapter 3 for more discussion.

(18)   a.   pɔ̀g-ɔ́   ŋá
woman-SG   DEM.PXL.SG
'This woman'

b.   pɔ̀g-bɔ́   bá-mà
woman-PL   HUM-DEM.PXL.PL
'These women'

(19)   a.   bʊ́-ɔ́   ŋá
goat-SG   DEM.PXL.SG
'This goat'

b.   bʊ́ʊ́-rí   á-mà
goat-PL   NONHUM-DEM.PXL.PL
'These goats'

(20)   a.   pɔ́g-ɔ́   ná

woman-SG   DEM.DIST

'That woman'

    b.   pɔ́g-bɔ́   ná

woman-PL   DEM.DIST

'Those women'

(21)   a.   bʊ́-ɔ́   ná

goat-SG   DEM.DIST

'That goat'

    b.   bʊ́ʊ́-rí   ná

goat-PL   DEM.DIST

'Those goats'

Next are cardinal numbers (numerals) which appear to the right of noun heads in an NP. Cardinal numbers agree with the nouns they modify – they are number sensitive in the sense that a singular cardinal number occurs with singular nouns while plural cardinals (two and beyond) occur with plural nouns. In addition, cardinals show a distinction between human and non-human nouns. Consider the following examples with the nouns *bí-é* 'child-SG', *bíí-rí* 'child-PL'; *báá* 'dog.SG' and *báá-rí* 'dog-PL'.

(22)   a.   bì-jén(ì)

child-one

'One child'

    b.   bíí-rí   bá-jì

child-PL   HUM-two

'Two children'

(23)   a.   bà-jén(ì)

dog-one

'One dog'

b.   báá-rí   á-jì

       dog-PL   NONHUM-two

       'Two dogs'

It should be noted that when a singular cardinal occurs after a singular noun (as in 22a and 23a), the nominal number is always null, with the numeral for 'one' presumably taking the position of singular. That is, when a singular noun is modified by numeral that is cardinality of one, the singular on the noun is marked by the numeral. With a cardinality of two and beyond, there is number marking on the noun as illustrated in (22b and 23b). Observe that the cardinal numeral *jén(ì)* 'one' involves optional epenthesis – the final high vowel can be dropped without a change in meaning.

Another category of elements which forms part a noun phrase in Dagaare involve quantifiers which indicate uncounted quantity. Common quantifiers in Dagaare include *zàá* 'all'. This is shown below.

(24)   à   pɔ́g-bɔ́   zàá   wǎ   ná   ʧɛ̂

           DET   woman-PL   all   come.V   FOC   here

           'All the women have come here'

Finally, the elements that precede the noun head are the definite determiner *à* 'the' as in (25), possessive pronouns as in (26) and other nouns as shown in (27).

(25)   à   bí-é

           DET   child-SG

           'The child'

(26)   m̀   bí-é

           1SG.POSS   child-SG

           'My child'

(27)   nàá   bí-é

           chief   child-SG

           'Chief's child'

As shown with illustrative examples, the noun phrase in Dagaare is made up of the noun head with optional elements such as determiners, adjectives, quantifiers, numerals or even other nouns. Next is a brief description of the verb phrase in Dagaare.

1.3.4 The verb phrase

In this section, I present a brief description of the verb phrase (VP), its position in the sentence and its parts. We have already seen in section 1.3.1 that Dagaare has SVO word order. This basically means that the verbal component of a sentence occurs after the subject and before the object. The verbal component is made up of the main verb, pre-verbal and post-verbal particles. The main verb in Dagaare comes in three main forms, namely the citation form, which is a combination of the default form and the low toned *à* as in (28a), default form as in (28b) and the imperfective form as shown in (28c). There is also another form, *dʊ́g!éé* which is a combination of verb root and the clitic form of the focus particle as in (28d). These forms of the verb are discussed further in chapter 3. In line with the proposal of Anttila & Bodomo (2009), the final high front vowel after consonant-final (C-final) verbal roots in the default form is epenthetic because it is entirely predictable – it is simply a piece of phonological material and not really a suffix, especially as it contributes no meaning to the verb. This also shows why I refer to such verbs as default forms and gloss them as V.

(28)   a.   à   dʊ́gí

                INF   cook.V

                'to cook'

        b.   Dàkʊ́ráá   dà   dʊ́gí   ná   bɛ́ŋɛ̀

                Dakoraa   PST   cook.V   FOC   beans

                'Dakoraa cooked beans'

        c.   Dàkʊ́ráá   dà   dʊ́g-!rɔ́   ná   bɛ́ŋɛ̀

                Dakoraa   PST   cook-IPFV   FOC   beans

                'Dakoraa was cooking beans'

d.	Dàkʊ́ráá	dà	dʊ́g-!έέ	bέŋὲ
	Dakoraa	PST	cook-FOC	beans
	'Dakoraa cooked beans'			

The sentences in (28b-c) above contain the subject NP followed by a preverbal particle *dà* which expresses past tense. This is followed by the main verb and its suffix, and it is also followed by the postverbal particle *ná* which marks focus, and the object, e.g. [VP dà dʊ́gí/-rɔ̀ ná bέŋὲ]. For (28d), the verb root and the postverbal particle occur together as *dʊ́g-!έέ*.

1.3.5 Pre-verbal particles

According to Bendor-Samuel (1971) as cited in Bodomo (1997), all Gur/Mabia languages have some particles that optionally precede verbs in verb phrases. For instance, he identifies fifteen such particles in Dagbani while Dong (1981) identifies fifteen in Dagaare. I list the pre-verbal particles in Dagaare in the table below. These particles convey various information in terms of tense, aspect, modality, and polarity. These particles will be relevant in what constitutes the verbal spine in Dagaare discussed later in chapter 3.

Table 1.3: Pre-verbal particles in Dagaare

Preverbal particle	Interpretation
dà	simple past
dàŋ	remote past
nà	future
kòŋ	future negation
bá	negation
tá	imperative negation
tɔ́ɔ̀	imperative (progressive) negation
kɔ́ŋ	past irrealis negation
nááŋ	past irrealis
mǎŋ	habitual
yààŋ	as usual/once again
sìrìŋ	actually
díɛ̀	just
là	repetitive/again
nàŋ	still/not yet

This list has been put into categories including time depth, tense, modality and polarity particles (Bodomo 1997; Dakubu 2005). Each category is described with illustrative examples.

1.3.5.1 Tense and time depth particles

These are particles which express the time actions or events occurred. That is, they show the temporal force of actions/events. They include *dà*, *dàŋ, nà*. The particle *dà* marks actions/events that occurred in the past. It is used to mark nearly all past tense contexts with the exception of recent perfective, where no tense particle occurs (Griffin et al. in prep). It expresses recent past such as events that occurred a day ago or some years ago.

(29)	Dàkɔ́ráá	dà	sɛ́		ná	nɛ́nì	kò	à	bíí-rí
	Dakoraa	PST	roast.V		FOC	meat	give.V	DET	child-PL

'Dakoraa roasted meat for the children'

In this sentence, the past tense particle expresses past without specifically indicating the time in the past that event occurred, but it is not usually used to refer to recent past such as events that happened some hours ago within the same day. The particle *dàŋ*, like *dà,* generally occurs in the position immediately preceding the verb. It has been termed a remote-past maker (Saanchi 2008). Both tense markers appear to have the same distribution with respect to other pre-verbal particles. Griffin et al. (to appear) also consider *dàŋ* an experiential marker, rather than remote-past because it is typically used to talk about actions and events that occurred some long time ago (e.g., years ago), and is infelicitous in more recent contexts.

(30)   a.   Ǹ   dàŋ   dó   ná   à   táŋ-á

              1SG   REM.PST   climb.V   FOC   DET   mountain-SG

              'I have ever climbed the mountain'

      b.   *Ǹ   dàŋ   dó   ná   à   táŋá   zínè

              1SG   REM.PST   climb.V   FOC   DET   mountain.SG   today

              intended: I have ever climbed the mountain today

In terms of expressing actions/events that are yet to happen, the particle *nà* is used as exemplified below.

(31)   Ǹ   nà   dó   ná   à   táŋ-á

      1SG   FUT   climb.V   FOC   DET   mountain-SG

      'I will climb the mountain'

1.3.5.2 Modality particles

Modality particles express possibility, necessity, frequency, and ability. In Dagaare, modality particles include *măŋ, là, yàày, díὲ, nàŋ, náάŋ* and *sìrìŋ*. This is shown in the sentences below.

(32)   a.   m̀   măŋ   gàá   ná   sùkúù

              1SG   HAB   go.V   FOC   school

              'I always go to school'

b.	ǹ	là	gàá	ná	sùkúù
	1SG	REP	go.V	FOC	school

'I have gone to school again'

c.	ǹ	yààŋ	gàá	ná	sùkúù
	1SG	REP	go.V	FOC	school

'I have gone to school as usual'

d.	ǹ	díɛ̀	gàá	ná	sùkúù
	1SG	just	go.V	FOC	school

'I have just gone to school'

e.	ǹ	sìrìŋ	gàá	ná	sùkúù
	1SG	actually	go.V	FOC	school

'I have actually gone to school'

f.	ǹ	nàŋ	bá	gàà		sùkúù
	1SG	yet	NEG	go.V		school

'I have not yet gone to school'

g.	ǹ	nááŋ	gáá	ná	sùkúù
	1SG	should/would	go.V	FOC	school

'I should/would have gone to school'

Observe that the surface tone of the default verb form always alternates based on which elements it occurs with. For instance, when the verb *gaa* 'go' immediately follows the modality particles as in (32a-e), it is realized as LH. When it is immediately preceded by the negation marker *bá* as in (32f), it is realized as L and when it is preceded by the modality particle *nááŋ*, it becomes HH. The final H tone is what has been assumed as the perfective suffix (Anttila & Bodomo, in press)

1.3.5.3 Polarity particles

These particles express positive or negative actions. The positive polarity marker involves the post-verbal particle *ná* which marks affirmation or focus as in (33a). As for negative polarity particles, they include *bá* which is a non-future negative as illustrated in (33b). It can occur with the past tense *dà* to negate actions in the past. The particle *kòŋ* marks future negation – it indicates that an action will not occur and this is shown in (33c).

(33)　　a.　　Ǹ　　gàá　　　　ná　　sùkúù

　　　　　　　　1SG　　go.V　　　　FOC　　school

　　　　　　　　'I have gone to school'

　　　　　b.　　Ǹ　　bá　　gàà　　　　sùkúù

　　　　　　　　1SG　　NEG　　go.V　　　　school

　　　　　　　　'I have not gone to school'

　　　　　c.　　Ǹ　　kòŋ　　　　gáá　　　　sùkúù

　　　　　　　　1SG　　FUT.NEG　　　　go.V　　　　school

　　　　　　　　'I will not go to school'

There are also two particles that mark imperative negation; *tá* is used with the default verb form to stop an action from starting and with the imperfective to stop an action that is already in process. The other is *tɔ́ɔ̀* which occurs with the imperfective form of the verb to stop an action from beginning. It does not occur with the default verb form.

(34)　　a.　　tá　　　　　　zɔ̀

　　　　　　　　NEG.IMV　　　　run.V

　　　　　　　　'don't run!'

　　　　　b.　　tá　　　　　　zɔ̀-rɔ́

　　　　　　　　NEG.IMV　　　　run-IPFV

　　　　　　　　'don't run (i.e stop running)!'

(35)   a.   tɔ́ɔ̀   zò-rɔ́

           NEG.IMV   run-IPFV

           'don't run (i.e don't be running)!'

    b.   *tɔ́ɔ̀   zò

           NEG.IMV   run.V

When *tɔ́ɔ̀* occurs with the imperfective, it does not only mean stopping an already ongoing action. It is also used to prevent an action which one suspects may occur even if there may be no immediate indication of it.

1.3.6   The post-verbal particle

The post-verbal particle *lá/ná* occurs after the verb in Dagaare and in other Mabia languages such as Moore, Kusaal and Mampruli (Bendor-Samuel 1971; Dong 1981; Bodomo 1997). The particle has been termed a factitive particle or an affirmative marker (Bodomo 1997) or a focus particle (Dakubu 2005; Ali et 2021). As Hiraiwa & Bodomo (2008) notes, this particle is multi-functional, and its functions are not yet fully known. It has its clitic forms as *–ŋ, -e/-ɛ*. All these variants can occur optionally in the postverbal position of *lá/ná*, although some are restricted based on valency of the verb.

The main function of *lá/ná* is to mark focus and assertion (Bodomo 1997, Dakubu, 2005). It is an obligatory part of positive declarative sentences in Central Dagaare and thus it is usually in complementary distribution with the negation markers (e.g., *bá, kòŋ*). The *lá, ná*, and -ŋ variants occur following a DP or nominalized verb in clefting or contrastive focus constructions. It is commonly referred to as *lá* within some Central varieties such as Jirapa and surrounding communities. It is also commonly referred to as *ná* among some Central varieties in Nadowli-Kaleo district including Sombo, Sankana, Takpo etc. Given that the data for this dissertation is based on the variety spoken in Sombo (Nadowli-Kaleo district), the post-verbal particle in all instances is represented as *ná*. I will be glossing this particle and its allomorphs as a focus (FOC) particle, as that is its primary function.

The following constructions demonstrate the distribution of the post-verbal particle in Central Dagaare. In (36a) it occurs after the verb and before the object. In (36b) the preverbal negation *bá* appears before the verb and the object, whereas (36c) illustrates the complementary distribution

between negation *bá* and the post-verbal particle. Although this particle and *bá* occur in different linear positions in the sentence, I take them to be exponents of the same polarity head, as they are in complementary distribution.

(36) a. Dàkɔ́ráá   ɲú   ná   kɔ̀ɔ́
          Dakoraa   drink.V   FOC   water
          'Dakoraa has drunk water'

      b. Dàkɔ́ráá   bá   ɲú   kɔ̀ɔ́
          Dakoraa   NEG   drink.V   water
          'Dakoraa has not drunk water'

      c   *Dàkɔ́ráá   bá   ɲú   ná   kɔ̀ɔ́
          Dakoraa   NEG   drink.V   FOC   water

The particle occurs before noun phrase complements but not between noun phrases as shown below.

(37) a. Dàkɔ́ráá   dà   kò   ná   Dɛ́rí   gán-ì
          Dakoraa   PST   give.V   FOC   Dery   book-SG
          'Dakoraa has given Dery a book'

      b. *Dàkɔ́ráá   dà   kò   Dɛ́rí   ná   gán-ì
          Dakoraa   PST   give.V   Dery   FOC   book-SG

The particle can occur after the subject in order to make emphasis on the subject as shown in (38) below.

(38) Dàkɔ́ráá   ná   dà   dɔ́qí   bɛ́ŋɛ̀
      Dakoraa   FOC   PST   cook.V   beans
      'It was Dakoraa who cooked the beans'

It is important to mention that the precise analysis of *lá/ná* is not provided in this dissertation, but because it is a recurrent morpheme in many sentences, I only describe its distribution.

1.4 Theoretical foundations and assumptions

The focus of this dissertation is on the morphophonology of Dagaare as analysed within the framework of Optimality Theory – OT (McCarthy, 2011; McCarthy & Prince, 1993; Prince & Smolensky, 1993, 2004) and Minimalist Syntax (Radford 2008). With OT, the central basis is the interaction of universally ranked constraints on output (surface) forms which are evaluated in relation to each other to define the grammar of a language. OT seeks to give an account of how representational well-formedness determines the assignment of grammatical structure. Refer to chapter 4 for detailed overview of Optimality Theory.

Minimalist Syntax (Adger & Svenonius, 2011; Chomsky, 1993, 1995, 1998; Radford, 2004) has been developed with the goal of understanding the nature of language by modeling the speaker's knowledge in the form of a computational system. Grammar is to be treated as simple as possible and thus Minimalist Syntax has been developed as a reaction to the complexities involved in earlier syntactic analyses. Thus, minimalism is aimed at minimising the theoretical complexities in describing language. Chomsky (2005) suggests that language is a perfect system of optimal design in that natural language grammars create structures designed to interface with other components of the mind – language as the optimal way to link sound and meaning. More concretely, minimalism considers the grammar of language as involving various components: (i) the lexicon – a list of lexical items and their linguistic properties; (ii) the syntax which combines the lexical items by a series of syntactic computations; (iii) the semantic component which maps the syntax into corresponding semantic representations and (iv) the phonetic component which maps the syntactic structure into phonetic representation. This theory is applied in my analysis of the nominal and verbal inflectional morphology in chapter 3.

1.5 Structure of dissertation

The dissertation is organised as follows: Chapter 2 presents an introductory description of the general phonology of Dagaare. It presents the consonant and vowel inventories of the language, brief introduction of phonological processes such as vowel harmony, vowel elision and vowel assimilation. This section also presents the phonotactic and distributional restrictions on vowels and consonants. The syllable structure of the language is also discussed in this section.

Chapter 3 focuses on the morphology of the language, particularly inflectional morphology involving verbal and nominal inflection. I show evidence that the so-called perfective is a default verb. That is, the so-called perfective form does not have an inherent perfective meaning as it occurs in various environments. The chapter also shows various verbal and nominal root types and the kind of aspectual or number suffix they take. Moreover, noun classes are discussed and finally the syntax of the noun phrase in Dagaare is presented in this chapter.

In chapter 4, the patterns of harmony (tongue root and rounding/backness harmony) are described and analysed in terms of Optimality Theory. It presents an analysis of tongue root harmony involving both verbs and nouns and rounding harmony which is predominantly restricted to the imperfective form of the verb.

Chapter 5 gives an account of tone in Dagaare. It provides a more comprehensive description of the verbal and nominal tone systems of Dagaare. An analysis is presented in terms of Optimality Theory for the default verb forms, imperfective forms, simple nouns, nominalisations and complex cases like compounds and associative constructions.

Finally, in chapter 6, I present the conclusion, summarizing the entire dissertation, highlighting the contributions, limitations and raising some issues for future research.

Chapter 2: General introductory phonology

2.1 The sound system of **Dagaare**

2.1.1 Orthography

The standard orthography generally used in the writing of Dagaare is the system proposed by the Catholic Church in Ghana (Ali et al 2021). It is based on the Central dialect and generally used by various educational institutions teaching Dagaare. There are however other orthographies found in Nakuma (2002) for Central Dagaare and Somé (2004) which is specific to the Dagara spoken in Burkina Faso. I provide the orthographic representation of each sound and its corresponding International Phonetic Alphabet (IPA) value. What I give here is based on the system proposed in Ali et al. (2021) and that of Nakuma (2002). I include the orthographic representation of the advanced low vowel *a* and its phonetic realisation [ə] which is not included in previous proposals. This leads to a total of thirty-four (34) phonemes which contrasts with the thirty-one (31) in (Ali et al 2021) and the thirty-three (33) in Nakuma (2002). Note that both the retracted high vowel [ɪ] and the mid vowel [e] are represented with *e* in the orthography while [ʊ] and [o] are represented with *o* orthographically. Though Dagaare is a tone language, tone is usually not marked on the orthography. Hence, though spelled Dagaare or Dàgáárè, the name of the language is [dàgáárì]. In this dissertation, I will be using the orthographic form 'Dagaare'.

Table 2.1: Standard Dagaare alphabet

Alphabet	Orthography	IPA	Gloss
P, p	*pɔgɔ*	[pɔ́gɔ́]	'woman'
B, b	*bie*	[bíé]	'child'
T, t	*tuo*	[tùò]	'carry'
D, d	*daa*	[dàá]	'market'
K, k	*kaa*	[kàà]	'look'
G, g	*gaa*	[gàà]	'go'
M, m	*mɛ*	[mɛ̀]	'build'
N, n	*nɛne*	[nɛ́nì]	'meat'
F, f	*faa*	[fáá]	'bad'
S, s	*sɛ*	[sɛ́]	'roast'
V, v	*va*	[vá]	'hit'

Z, z	*zie*	[zíé]	'place'
L, l	*la*	[là]	'laugh'
R, r	*sare*	[sàrì]	'slip'
H, h	*haare*	[háárì]	'shoo'
W, w	*wa*	[wà]	'come'
Y, y	*yiri*	[jírì]	'house'
GB, gb	*gbiri*	[gbírì]	'sleep'
GY, gy	*gyɛlɛ*	[ʤélὲ]	'eggs'
KP, kp	*kpɛ*	[kpὲ]	'enter'
KY, ky	*kyɛ*	[ʧὲ]	'cut'
NG, ng	*dungo*	[dúŋó]	'animal'
NY, ny	nyɛ	[ɲέ]	'see'
NGM, ngm	*ngmane*	[ŋmání]	'calabash'
A, a	*wa*	[wà]	'come'
Ạ, ạ	hạạri	[hɔ́ɔ́rì]	'yawn'
I, i	*biri*	[bírì]	'seed'
E, e	*le*	[lé]	'tie'
E, e	de	[dî]	'take'
Ɛ, ɛ	*tɛ*	[tέ]	'spread'
O, o	*do*	[dó]	'climb'
O, o	ko	[kò]	'give'
Ɔ, ɔ	*ɔngɔ*	[ɔ̀ŋɔ́]	'mouse'
U, u	*tu*	[tú]	'dig'

In the orthography, there are six digraphs – sounds that are represented with two letters: *gb, gy, kp, ky, ny* and *ng* and one trigraph – sound that is represented with three letters: *ngm*. In this dissertation, all data are represented in broad phonetic transcription.

2.1.2 Consonant inventory

Dagaare is reported to have twenty-five (25) consonants and two glides (Bodomo, 1997). However, given that Dagaare has four main dialects, it is important to note that the number of consonants varies from dialect to dialect (Angsongna & Akinbo, 2022). In Central Dagaare, which

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is the main focus of this dissertation, there are twenty-three (23) consonants and two glides involving eight (8) main places of articulation. The consonants of the Central dialect are given in the chart below. Symbols in brackets are orthographic representations. There appears to be no orthographic representation for the glottal stop.

Table 2.2: Consonant Inventory of Central Dagaare

	Bilabial	Labial-dental	alveolar	Palato-alveolar	Palatal	Velar	Labial-velar	Glottal
Plosive	p b		t d			k g	k͡p g͡b	ʔ
Affricate				t͡ʃ d͡ʒ (ky) (gy)				
Fricative		f v	s z					h
Nasal	m		n		ɲ (ny)	ŋ (ng)	ŋm (ngm)	
Approx.			r		j (y)		w	
Lateral approx..			l					

The consonants /kp, gb/ are termed labial-velars because their production involves the simultaneous interaction and movements of both the velum and the lips. Also, in Dagaare when voiceless stops /p, t, k/ occur in word-initial position, there is some degree of aspiration – a strong burst of air that accompanies the release of a stop consonant. Phonetically aspiration is indicated by a superscript [ʰ] as in[pʰɔ́g-ɔ́] 'woman'.

With regards to the other dialects, the consonant inventories are as follows: in the Southern dialect (Waale), there are twenty-two (22) consonants and two glides. The voiced alveolar fricative /z/ that is present in Central Dagaare is not attested in the Southern dialect. In Northern dialect (Dagara) and Western dialect (Birifor), there are twenty-five (25) consonants with two glides in each of them. Though both Northern and Western dialects have the same number of consonants, it is not the case that both sets of consonants are entirely identical. For instance, as reported in (Angsongna & Akinbo 2022), the voiceless bilabial implosive / ɓ / and voiceless glottalized lateral /ʔl/ are attested in the Northern dialect and in the Western dialect. Then voiceless glottalized palatal /ʔj/ and the voiceless glottalized labial-velar glide /ʔw/ are found only in the Western dialect, while

the voiceless velar fricative /x/ is attested only in the Northern dialect. None of these consonants are found in the Central and Southern dialects.

2.1.3 Vowel inventory

Previous studies (e.g., Bodomo 1997; Nakuma 2002) report that Dagaare has nine vowels which are paired based on tongue root value except for the low vowel [a] which is claimed to be non-contrastive. Saanchi (1997) however reports that the language has ten vowels with the tenth vowel being an advanced low vowel. Consistent with Saanchi's observation, acoustic studies (Ozburn et al. 2018; Lloy et al. 2019; Angsongna & Akinbo 2022) have also reported the existence of a tenth vowel in Dagaare and this vowel is the advanced low vowel [ə], a contrastive counterpart of the retracted [a]. The vowel inventory of Central Dagaare is given in the table below, categorised in terms of tongue root position – advanced tongue root (ATR) and retracted tongue root (RTR) – height and backness.

Table 2.3: Vowels in Central Dagaare

		Front	Central	Back
High	ATR	i		u
	RTR	ɪ		ʊ
Mid	ATR	e		o
	RTR	ɛ		ɔ
Low	ATR		ə	
	RTR		a	

Below are some examples from Saanchi (1997), showing the distinction between an advanced low vowel /ə/ and a retracted low vowel /a/.

(1) Minimal pairs of advanced vs. retracted low vowels

    vɔ́   'scorch.ᴠ'   vá   'hit.ᴠ'

    hɔ́ɔrì 'yawn.ᴠ'   háárì 'shoo.ᴠ'

    hɔ́lí 'widen.ᴠ'   hálí 'stink.ᴠ'

Similar to what is observed in Central Dagaare, Waali (Southern Dagaare) is also reported to have a ten-vowel system (Abdul Moomin, 2015). As for the Northern and Western dialects, nine vowels are reported where the low [a] is neutral (Dundaa, 2013; Kuubezelle, 2013).

2.1.4   Tone

Tone involves the use of pitch to distinguish words in a language. In Central Dagaare, there are two contrastive tone levels: a high (H) tone which is symbolised with the acute accent as in *tú* 'dig' and a low (L) tone which is symbolised by the grave accent as in *tù* 'follow'. There are also cases of downstep – a process in which the second of two H tones is lower than the initial H tone. Downstep is usually marked with the exclamation mark (!) as in *súɔ́ŋ-!áá* 'rabbit-SG'. Moreover, there is the presence of contour tones in Dagaare. Contours are tones that shift from one pitch to another over the course of a syllable. There are two contour tones in Dagaare: (i) rising contour which involves a syllable that starts off with a L tone and ends with a H tone as in *wìé* 'farm.SG' and (ii) falling contour which involves a case where a syllable begins with a H tone and ends with a L tone as in *ní-ὲ* 'person-SG'. Contours tones (especially falling contours) can occur on a short vowel (light syllable) as well and not just long vs. diphthongs as in the preceding examples. An example of a light syllable with falling contour is *zû* 'head.SG'. With regards to other varieties of the language, Southern dialect (Waali) has two contrastive tones (H/L) and two contour tones just like the Central dialect. However, the Northern and Western dialects have three tones: high, mid, and low. Detailed description and analysis of tone particularly in Central Dagaare is presented in chapter 5.

2.2 Phonotactics

While focusing on some aspects of a language, it is often the case that the description of other aspects including commonly occurring phonemes, sequences of occurrence and co-occurrence restrictions is easily ignored by linguists. This section therefore identifies at least some co-occurrences in Dagaare involving simple words in Dagaare. By simple words I mean one- syllable and two- syllable words. Note that though I refer to the two-syllable words as simple, they are morphologically complex because they contain two morphemes – a root and a suffix. It should also be mentioned that some co-occurrences that are prohibited in simple forms might be possible with some compounds or borrowed words. However, at this point, the description and generalisations do not involve compounds and borrowed words. I present charts of co-occurrences

for both consonants and vowels. They include vowels co-occurring with consonants, consonants co-occurring with consonants and vowels co-occurring with vowels. As for vowel co-occurrence, it will be shown in later sections of this chapter that vowels of different tongue root values do not occur in the same simple word, but I show in this section the sequences that are prohibited or at least unattested even if they agree in the same tongue root feature. These restrictions will be relevant to the discussion of markedness and positional faithfulness.

2.2.1   Consonant – vowel co-occurrences

In this section, I show which vowels occur with which consonants, particularly in the initial position of consonant – vowel (CV) words. The alveolar approximant [r] does not occur in word-initial position and because of that it is omitted in the table, but in other instances like intervocalic position, [r] is present. The presence of a relevant consonant – vowel occurrence is marked with "√" while impossible co-occurrences have grey-shaded cells. I must mention that some impossible or unattested co-occurrences shown here may be possible in other dialects of Central Dagaare while some impossible combinations in other dialects may be possible in the current dialect under investigation.

Table 2.4: Occurrence of short vowels with consonants in CV words

	i	ɪ	e	ɛ	o	u	ɔ	ʊ	ə	a
p	√	√		√	√	√	√			√
b		√	√	√		√	√	√		√
t	√	√		√		√	√	√		√
d	√	√		√	√	√	√			√
k					√		√	√		√
g					√	√				√
kp	√	√		√						√
gb	√				√					√
ʧ	√	√	√	√			√			√
ʤ				√						
f								√		√
v	√					√	√		√	√
s		√		√	√	√	√	√		√
z				√	√	√	√			√
h										√
m	√			√			√			√
n	√	√								√
ɲ				√		√				
ŋ										√
ŋm		√		√						√
j	√			√			√			√
l			√	√						√
w				√						√

From the table some patterns are clearly distinguishable with CV forms. For instance, the low vowel [a] and the mid vowel [ɛ] have wider scope of distribution than the other vowels while their corresponding counterparts, the low advanced [ə] and the advanced mid [e] occur exclusively with [v] and [b, ʧ, l] respectively. The stop consonants [p, b, t, d] occur with more vowels than any other consonant while the fricative [h] and velar [ŋ] are the only consonants which exclusively occur with the retracted low vowel [a]. Given that the majority of Dagaare words are disyllabic, the next table shows the vowels that can occur in word final position and the consonants that precede the final vowels. That is, it shows which consonants can occur in intervocalic position and which vowels occur after such consonants.

Table 2.5: Occurrence of short vowels in final position: -C$_1$VC$_2$V

	i	ɪ	e	ɛ	o	u	ɔ	ʊ	ə	a
p										
b			√	√	√	√	√	√		√
t										
d										
k										
g	√	√	√	√	√	√	√	√		√
kp										
gb										
ʧ										
ʤ										
f										
v										
s										
z										
h										
m			√	√	√		√			√
n	√	√	√	√	√		√			√
ɲ										
ŋ			√	√	√		√			√
ŋm										
j										
l	√	√	√	√	√		√		√	√
r	√	√	√	√	√		√		√	√
w										

The above table shows that, in Dagaare, intervocalic consonants are restricted to the stops [b, g], the nasals [m, n, ŋ] and the liquids [r, l] with [g] having wider distribution than the rest, occurring with all vowels except for the advanced [ə]. This indeed is a striking reduction of inventory compared to the initial consonant (CV vs CVCV). The liquids are next to [g] in terms of their distribution. They occur with all vowels except for the high back vowels [u, ʊ]. Moreover, they occur in the same environments. That is, both [r, l] occur with same vowels. It is also observed that except for the low vowels which do not necessarily co-occur with same consonants, each other vowel and its contrastive counterpart co-occur with the same consonants. For instance, the high

front vowels [i, ɪ] co-occur with [g, n, r, l]; all mid vowels co-occur with [b, g, m, n, ŋ, r, l] and finally the back high vowels [u, ʊ] co-occur exclusively with the stops [b, g]. In the next table I show co-occurrence between consonants and long vowels. The focus is on CVV words.

Table 2.6: Occurrence of long vowels with consonants in initial position in CVV words

	ii	ɪɪ	ee	ɛɛ	oo	uu	ɔɔ	ʊʊ	əə	aa
p										
b		√								√
t						√	√			√
d						√	√			√
k										√
g										√
kp				√						√
gb				√						
tʃ						√				
dʒ										
f						√				√
v										
s										√
z							√			√
h										√
m							√			
n										√
ɲ							√			
ŋ										√
ŋm										√
j										√
l							√			√
w					√		√			√

As shown on the table, long low vowel [aa] has more distribution than other vowels in CVV cases just like the case with short low [a] in CV words. The long high vowel [ɪɪ] and the long mid vowels [ɛɛ, oo] are restricted to particular consonants – [ɪɪ] occurs with just the bilabial stop [b]; [ɛɛ] occurs with only the labial-velars [kp, gb] while [oo] occurs only with the glide [w]. There are never CVV forms involving [ii, ee, əə, ʊʊ]. Having seen long vowels in initial position, the next table shows long vowels in final position.

Table 2.7: Occurrence of long vowels in final position: -**C₂**VV

	ii	ɪɪ	ee	ɛɛ	oo	uu	ɔɔ	ʊʊ	əə	aa
p										
b										
t										
d										
k										
g										
kp										
gb										
ʧ										
ʤ										
f										
v										
s										
z										
h										
m										
n		√		√						
ɲ										
ŋ									√	
ŋm										
j										
l	√	√				√		√		√
r	√	√	√	√	√	√		√	√	√
w										√

Generally, in word-final position of disyllabic words, distribution of long vowels is quite limited. They occur only after sonorant consonants unlike the case of short vowels in final position which occur with some other consonants aside sonorants as in table 2.5. The table 2.7 above below shows this generalisation. The intervocalic consonant [r] occurs with all possible long vowels in final position except for [ɔɔ].

The co-occurrence of consonants and diphthongs is given next. There are four diphthongs in Dagaare: [ie, ɪɛ, uo, ʊɔ]. They occur in simple CVV words and the initial position of disyllabic words CVV(CV) but never in final position – the second syllable of disyllabic words.

Table 2.8: Occurrence of diphthongs in CVV (CV) words

	ie	ɪɛ	uo	ʊɔ
p	√	√	√	√
b	√	√	√	√
t		√	√	√
d	√	√	√	√
k			√	
g			√	√
kp		√		
gb	√	√		
ʧ		√		
ʤ		√		
f		√		
v			√	√
s		√	√	√
z	√	√	√	√
h				
m	√			√
n		√		√
ɲ		√	√	
ŋ				
ŋm		√		
j	√		√	
l		√		√
w	√	√	√	√

The table shows different restrictions in diphthongs than long vowels in that diphthongs do occur with a wider range of consonants than long vowels which occur with only sonorants. Each consonant occurs with at least a diphthong either in a CVV form or in the initial syllable of CVVCV forms except for the velar nasal [ŋ] and the fricative [h].[1]

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[1] It is important to mention the following nasalised long vowels: [ĩĩ], [ũũ], [ãã] which occur with [b, t, d, k] as in bĩí 'broth', tĩí 'medicine', kúú 'death' dáã 'alcohol' and káã 'oil'. There is also a nasalised diphthong [õɔ̃] as in kòɔ́ 'water'

2.2.2   Consonant – consonant co-occurrences

This section presents co-occurrences of consonants separated by a vowel. These cases involve CV(V)CV forms, and the focus is the consonants that can occur as first in the CV(V)CV form and those that can occur as second. With the sole exception of the [r], all consonants can occur in word-initial position but as seen below, the consonants that commonly occur in second syllables include the two stops [b, g]; nasals [m, n, ŋ] and the liquids [r, l].

Table 2.9: Co-occurrences of consonants $C_1V(V)C_2$

C2 / C1	p	b	t	d	k	g	kp	gb	ʧ	ʤ	f	v	s	z	h	m	n	ŋ	ŋm	j	l	r	w
p		√				√										√	√	√			√	√	
b						√										√	√	√			√	√	
t		√				√										√	√	√			√	√	
d		√				√										√	√	√			√	√	
k		√				√										√	√	√			√	√	
g																√	√	√			√	√	
kp		√				√										√	√	√			√	√	
gb						√										√	√	√			√	√	
ʧ		√				√										√	√	√			√	√	
ʤ						√										√	√	√			√	√	
f		√				√										√	√				√	√	
v		√				√											√				√	√	
s		√				√										√	√	√			√	√	
z						√										√	√	√			√	√	
h																					√	√	
m		√				√										√	√	√			√	√	
n		√				√										√	√	√				√	
ɲ		√				√															√	√	
ŋ																							
ŋm																√	√	√			√	√	
j						√										√	√	√			√	√	
l						√										√	√	√				√	
w		√				√															√	√	

The table above reveals that the velar [g], the nasals [m, n, ŋ] and the liquids [r, l] occur in the initial position of second syllables in disyllabic forms while the bilabial [b] has a relatively limited

distribution. In some cases, there is presence of C…C where both Cs are labials and in other cases there is absence of two labials co-occurring such as *b…b, *gb…b, *f…m, *ŋm…b, and *v…m. These are probably accidental gaps. The next section shows the co-occurrence restrictions on vowels.

2.2.3   Vowel – vowel co-occurrences

Aside from the fact that vowels of different tongue root features do not co-occur, there are also cases of co-occurrence restrictions between vowels of same tongue root features. This means that tongue root harmony is exceptionless with regards to VV co-occurrence. In the tables that follow, I show vowels that can occur in sequences without intervening consonants and those that are impossible even if they share the same harmonic feature. The cases here involve diphthongs. I do not consider long vowels as cases of VV co-occurrence because they are basically made up of single vowels that are long. I also show co-occurrences between vowels in disyllabic contexts, with a consonant intervening between the two vowels. First, let us look at the VV sequences in the table below.

Table 2.10: Co-occurrence of vowels in VV contexts

V2 \ V1	i	ɪ	e	ɛ	u	ʊ	o	ɔ	ə	a
i			√							
ɪ				√						
e					√					
ɛ						√				
u	√		√							
ʊ				√						
o			√							
ɔ				√						
ə										
a										

The observations are as follows: front high vowel as V1 and back high vowel as V2 never occur (*iu). However, there is at least one word in the language that has the back high vowel [u] as V1 and front high vowel [i] as V2 as in *mùí* 'rice'. Front high vowels never follow mid and low vowels (e.g., *ei, *ɛɪ, *ai). The next table shows vowel co-occurrences in CVCV contexts.

Table 2.11: Co-occurrence of vowels: CV₁CV₂

V1 \ V2	i	ɪ	e	ɛ	u	ʊ	o	ɔ	ə	a
i	√		√							
ɪ		√		√						
e	√		√							
ɛ		√		√		√				
u	√				√	√				
ʊ		√				√		√		
o	√					√				
ɔ		√						√		
ə	√				√				√	
a		√				√				√

A look at the above table reveals some interesting observations. First, apart from the cases involving the high front vowels [i/ɪ] as V2 where V1 and V2 disagree in rounding/backness, the only other case is ɛ/ʊ combination. The ɛ/ʊ combination is a rare occurrence in the sense that there is one word, *sèŋʊ́* 'mat' attested in this dialect as shown in my database. In a related dialect (Jirapa dialect), the word for mat is *sèŋí/sèŋέ* where there is agreement in rounding feature. Another observation notable is that the low vowel never co-occurs with a non-low vowel in either order other than with the high front vowel [i/ɪ] and [u/ʊ] as V2. It is however possible for [a] to co-occur as V2 with other vowels in the Southern dialect (Waale) as in *bòŋá* 'donkey', *lɔ́ŋá* 'frog'. Finally, the co-occurrence of the vowels [i/ɪ] is clearly unrestricted except for tongue root feature. Overall, except for the sequences u…i, i…e and u…o, there is identical co-occurrence of vowels.

2.3 Distribution of consonants and vowels

All consonants in Dagaare occur in word-initial position with the sole exception of the voiced alveolar approximant [r] and its allophonic variant [ɾ]. For instance, [r] occurs only intervocalically as in *kò-rɔ́* 'give-IPFV' and *tùùrì* 'pick.V'. In word medial position, it is occasionally realised as an alveolar tap [ɾ] after [g] as in *pέg-rí* 'shell-PL'. Another sound with restricted distribution is the allophonic variant of voiced velar [g]. In Bodomo (1997) the allophonic variant of this sound is described as voiced velar fricative [ɣ] as *pɔ́ɣɔ́* 'woman'. Recent acoustic, palatographic and ultrasound study (Akinbo et al., 2022) however suggests that the allophonic variant of /g/ is actually not a velar fricative but a velar with strong tap-like properties, a previously unattested

sound and the following symbol [ǧ] has been proposed as a representation for the velar tap in Akinbo et al. (2022) and Angsongna & Akinbo (2022). The realization of this sound is observed only in intervocalic position. Moreover, the velar nasal [ŋ] occurs in the initial position of just three words in the language and with the low vowel [a] only as in: *ŋá* 'this', *ŋã̌ã̌* 'like this', *ŋánɛ́ɛ́* 'this one'. In this section, I present the restrictions on consonants and vowels within words.

2.3.1 Word-medial position

The consonants that occur in word medial position in Dagaare include the velar stop [g]; bilabial stop [b]; nasals [m, n, ŋ] and the liquids [r, l]. Examples are given below.

(2) Velar stop [g] in medial position

     a. bùg-ó   'silo-SG'

     b. kóg-ó   'chair-SG'

(3) Bilabial stop [b] in medial position

     a. tò-bó   'ear-PL'

     b. kɔ́-bɔ́   'bone-PL'

(4) Nasals [m, n, ŋ] in medial position

     a. tʊ́m-á   'work-SG'

     b. gán-ì   'book-SG'

     c. tíŋ-ɛ́   'ground-SG'

(5) Liquids [r, l] in medial position

     a. bí-rì   'seed-SG'

     b. pɔ̀l-í   'path-SG'

2.3.2 Word-final position

In Dagaare, the most common word-final consonants are the nasals particularly [n, ŋ] as in (6) and liquids [r, l] as in (7). This mostly results from final vowel elision, though some nasals (particularly /n/ and /ŋ/) can occur in isolation word-finally as in (6c). Basically, sonorants are the only

consonants that can occur word-finally in Dagaare. In Dagara (Northern Dagaare) however, the bilabial stop [b] can occur word-finally in words like *déb* 'man', *nááb* 'cow'.

(6) Nasals in word-final position

    a. kpán   ~   kpán-í 'spear-SG'

    b. gân   ~   gán-ì 'book-SG'

    c. sòŋ   'help.V'

(7) Liquids in word-final position

    a. gól   ~   gól-í 'cudgel-SG'

    b. bíír   ~   bíír-í 'child-PL'

    c. wùl   ~   wùlì 'show.V'

2.3.3 Roots vs suffixes

A root is the core content of a word; it is the entity which may serve as the base for several lexical categories and the part which remains after all affixes are taken away. An affix is a morpheme that is attached to a root. Affixes in Dagaare are suffixes occurring after roots. With the exception of [r], all consonants in Dagaare can be root-initial and all vowels can be root-final but only a restricted class of consonants can be root-final. Consonants which occur root-finally are the velar stop [g]; the nasals [m, n, ŋ] and the liquids [r, l]. Similarly suffixes involve a restricted set of phonemes. Dagaare has both derivational and inflectional suffixes. Derivational suffixes are those that derive new words from existing words where the derived words belong to a grammatical class that is distinct from the original word. Inflectional suffixes express grammatical contrast between words without changing the word class.

Derivational suffixes in Dagaare derive nouns from verbs or from adjectives. Here is an exhaustive list of Dagaare derivational suffixes.

Table 2.12: Derivational suffixes in Dagaare

Form	Verb-to-noun suffix	Adjective-to-noun suffix
-VV	-uu/-ʊʊ	
-CV	-bu/-bʊ	
-CVV	-nuu/-nʊʊ	
-(C)VC	-uŋ/-ʊŋ	-uŋ/-ʊŋ, -luŋ/lʊŋ, ruŋ/rʊŋ

The suffixes which derive nouns from verbs only, include [-uu/-ʊʊ, -bu/-bʊ, -nuu/-nʊʊ]. The suffixes that derive nouns from both adjectives and verbs are [-uŋ/-ʊŋ, -luŋ/lʊŋ, -ruŋ/-rʊŋ]. These affixes show a restricted set of forms consisting of specific initial consonants [b, l, r, n]. The choice of consonant depends on the verbal root. For instance, b-initial derivational suffix occurs after V-final or g-final root and in this case the result g-b sequence actually involves two separate sounds and not a single labial-velar sound [gb]; r-initial suffix occurs after g-final roots and vowel suffixes occur after roots containing [r, l, n]. Finally, n-initial suffixes always come after CVN roots, resulting in long nasal consonant (geminates). If a suffix has a final consonant, it is always the velar nasal [ŋ]. No other vowel represents a derivational suffix in Dagaare aside from the high back vowel [-u/-ʊ]. Some examples are given below.

(8) Derived nouns from verbs

a.
Verb root	Gloss	Derived noun	Gloss
di-	'eat.v'	díí-bú	'eat-NMLZ'
kòòr-	'snore.v'	kòòr-ʊ́ʊ́	'snore-NMLZ'
zàn-	'learn.v'	zàn-nʊ́ʊ́	'learn-NMLZ'

b.
Verb root	Gloss	Derived noun	Gloss
dúòr-	'urinate.v'	dúór-!úŋ	'urine'
jíèl-	'sing.v'	jíél-!úŋ	'song'
vóòr-	'breathe.v'	vóór-!ʊ́ŋ	'breath'

c.
Adjective	gloss	derived noun	gloss
vìèlɛ́	'beautiful'	vìèl-ʊ́ŋ	'beauty'

| fáá | 'bad' | fàà-lôŋ | 'badness' |
| wέgì | 'tall' | wέg-róŋ | 'tallness' |

Inflectional suffixes inflect for aspect on verbs and number on nouns. Inflection on verbs marks default verb form and the imperfective form. Aspect could be zero-marked or overtly marked. If present, it is always a (C)V. The default aspectual inflection is either null or the high front vowel or CV with the vowel being the high front vowel [-i/-ɪ]. No other vowel occurs in this position. It is possible that the high front vowel [i/ɪ] is epenthetic as it is completely predictable. If there is a consonant in the default aspectual suffix, it is always the alveolar nasal [n] which always occurs in nasal context. The imperfective suffix is always a mid or low vowel but never a high vowel. The consonants that form part of the imperfective suffix are [r] and [n] which depends on the verbal root – V-final and ɡ-final roots always take -rV suffix while N-final roots always take -nV suffix. Below is a complete list of verbal inflectional suffixes.

Table 2.13: Inflectional suffixes in Dagaare verbs

	Form	**Suffixal allomorph**
Default	-V	{-i/-ɪ}
	-CV	{-ni/-nɪ}
	-∅	{-∅ }
Imperfective	-V	{-e/-ɛ, -o/-ɔ, -ə/-a}
	-CV	{-re/-rɛ, -ro/-rɔ,-rə/-ra, -ne/-nɛ, -no/-nɔ, -nə/-na}

Inflection on nouns mark singular and plural nouns. This involves vowels – V(V) only or consonant and vowels – CV(V). All vowels can mark number depending on the noun class. There are ten noun classes in Dagaare (Bodomo, 1997; Bodomo & Marfo, 2006) with each class categorised based on the suffixes that mark number – singular vs plural. The most recurrent consonant-initial suffixes in Dagaare is -ri/-rɪ and its allomorph -ni/-nɪ. The other consonant-initial suffix is -bV. Other suffixes include the dedicated *-nɛ́ɛ́* and *-mìné* which are both limited in their distribution. Here is a complete list of nominal suffixes.

Table 2.14: Inflectional suffixes in Dagaare nouns

N-class	suffix:SG	N-class	suffix:PL
C1a~HUMAN~ C1b~KIN.~	-ɪ, -e/-ɛ, -ɔ, -∅, -oo, -(b)a	C1a. C1b.	-be/-bɔ/-ba - mìnéC1.KIN
C2.	-i/-ɪ, -e/-ɛ, -o/-ɔ, -a	C2.	-ri/-rɪ , -ni/-nɪ
C3.	-i/-ɪ, -ii/-ɪɪ	C3.	-e/-ɛ, -o/-ɔ, -a
C4.	-bu/-bʊ	C4.	-ri/-rɪ
C5.	-∅	C5.	-ri/-rɪ
C6.	-ri/-rɪ	C6.	-e/-ɛ, -o/-ɔ, -a, -bo/-bɔ
C7.	-∅, -ɪ, -ɛ	C7.	-nɛɛ
C8.	-aa	C8.	-ɪ/-ɪɪ
C9.	-u/-ʊ/bu/-bʊ/-nuu/-nʊʊ	C9.	N/A
C10.	N/A	C10.	-uŋ/-ʊŋ, -luŋ/-lʊŋ, -ruŋ/-rʊŋ

The focus of this section has been to describe the distribution of consonants and vowels in roots and suffixes. More discussion on inflection is in chapter 3.

2.4 Consonant clusters

In Dagaare, it is possible for consonants to co-occur in sequences without an intervening vowel. Consonants in such sequences are referred to as clusters. In Dagaare, there are a few consonant clusters which usually result from concatenation of morphemes, particularly the final consonant of a root and the initial consonant of a suffix. Some of these clusters are obligatory or inseparable while others are optional or separable. The inseparable clusters involve consonants with the same place of articulation such as *mb* and /rn/ → [nn]. These clusters cannot be simplified with vowel insertion. Other clusters are non-obligatory in that they may be simplified with vowel insertion particularly in slow or careful speech. Note that the clusters *rr* and *ll* are associated with the variety of the Central dialect spoken in and around Jirapa while the *rh* and *lh* are the counterparts for the dialect spoken in and around Sombo (where the majority of the data for this research comes from).

Note also that the g-b sequence in *pɔ́g-bɔ́* 'woman-PL' cluster is different from gb the labial-velar as in the initial sound of ***gb**ág-á* 'basket-SG'. The attested clusters in Dagaare are listed below.

(9) Attested consonant clusters in Dagaare

    a. Inseparable clusters

m-b	→	mb	sáám-!bá	'stranger-PL'
n-r	→	nn	lɔ́n-ní	'frog-PL'
r-r	→	rr	kòr-rí	'village-PL'
l-r	→	ll	sìl-lí	'hawk-PL'

    b. Separable clusters

g-b	→	gb	pɔ́g-bɔ́	'woman-PL'
g-r	→	gr	pɛ́g-rí	'shell-PL'
g-l	→	gl	sɔ́glì	'hide.v'
r-l	→	rh	kòr-hí	'village-PL'
l-h	→	lh	sìl-hí	'hawk-PL'

Some clusters may differ in some features in the input, but the output is always a cluster of identical consonants, specifically /n-r/ ~ [nn]. Given these patterns, it is fair to say that adjacent consonants in an obligatory/inseparable cluster must have same place values while optional/separable clusters differ in place of articulation.

2.5 Syllable structure

A syllable in Dagaare consists of a vowel, with or without a consonant preceding or following it. A syllable may be light (one that ends in a short vowel as in a CV syllable) or it may be heavy (one that contains either a long vowel or a coda consonant – CVV or CVC, etc). The surface syllable types in Dagaare include N, V, VV, VC, CV, CVV, CVC, CVN CVVN, and CV.CV. Most of these syllables are attested in both verbs and nouns. The syllable types, CV, CVV, CVN and CVVN can occur as independent words; the others however require additional phonological content to make complete words. The syllable type V generally comprises a suffix marking verbal or nominal inflection, the third person pronoun, the definite determiner, or an agreement marker on cardinal numbers. The syllable type N which also has a limited distribution, is the first-person

singular pronoun used either as a subject or possessive pronoun. The syllable type VC also has limited distribution as it is present only in verbs. Syllable types are given below with illustrative examples. Each syllable type in an example is underlined.

Table 2.15: Syllable types in Dagaare

Syllable type	Example: verb	Gloss	Example: noun	Gloss
N			m bí-é	'my child- SG'
V	á	'hate.V'	ʋ̀ bí-é	'his/her child- SG'
VV	ɔ̀ɔ̀	'chew/eat.V'	ő̋ő̋	'a kind of pot (with holes)'
VC	ɔ̀ŋ	'fetch.V'		
CV	dì	'eat.V'	má	'mother. SG'
CVV	bàà	'grow.V'	báá	'dog. SG'
CVN	sòŋ	'help.V'	bôŋ	'thing. SG'
CVVN	dìèŋ	'play.V'	gʋ́!ɔ́ŋ	'sleep'
CV.CV	dì.ré	'eat-IPFV'	zú.rì	'head-PL'
CVV.CV	tùù.rì	'pick.V'	gbáá.lí	'large pot-SG'
CVC.CV	sɔ́g.lì	'hide.V'	kpág.lí	'bedbug-SG'
CVVC.CV			sáám.!bá	'stranger-PL'

The nasal in syllables like *sáám-!bá*, 'stranger-PL' is shown to be a coda rather than an onset to the following syllable given that CVVN syllables are found in isolation as complete words.

Syllables containing long vowels have limited distribution. There is generally a maximum of only one CVV or CVVC/N per word. A long vowel appears either in first syllable as illustrated in (10a) or a long vowel may appear in later part of the word as in (10b). There are also cases where long vowels appear in both syllables of a word as in (10c).

(10)   a. Long vowel in initial syllable

dáà	'push.V'	dàá	'market.SG'
sòòrì	'ask.V'	tàám-à	'shea fruit-PL'
kòòrì	'sell.V'	ŋmàáŋ-à	'monkey-SG'

b. Long vowel in second syllable

wál-áá	'antelope-SG'	bíl-áá	'anthill-SG'
gɔ́r-áá	'sickle-SG'	kpàl-áà	'sling-SG'
ʤɛ́l-íí	'egg-SG'	ŋmán-!íí	'dove-SG'

c. Long vowels in initial and second syllable

dààŋ-áá	'hearth-SG'	ííl-!íí	'horn-SG'
sʊ́ɔ́ŋ-!áá	'rabbit-SG'	pááŋ-áá	'cricket-SG'
vʊ́úr-ɔ́ɔ́	'bellow-SG'	kʊ́ɔ́r-!áá	'farmer-SG'

2.6 Minimal size of nouns and verbs

Minimality refers to the constraints imposed on the minimal size of words in a language (Akinbo, 2019; McCarthy & Prince, 1994, 2017). Many languages impose these restrictions on word size. In Dagaare, nouns have a minimal size of one syllable with a minimum of two moras (Anttila & Bodomo, 2009). A mora is the basic timing unit of a syllable. For instance, CVV and CVVC are monosyllabic but bimoraic. A light syllable in a Dagaare noun generally occurs as a final syllable or as a root to which another syllable is attached.

(11)   Minimal size of nouns

Singular		plural	
báá	'dog.SG'	báá-rí	'dog-PL'
bʊ́-ɔ́	'goat-SG'	bʊ́ʊ́-rí	'goat-PL'
jí-rì	'house- SG'	jí-è	'house- PL'
zí-é	'place-SG'	zíí-rí	'place-PL'
wɛ́g-ɛ̀	'log-SG'	wɛ́g-rì	'log- PL'

There are, however, five known nouns in Dagaare which are monosyllabic and monomoraic CV forms (e.g. *zû* 'head.SG', *nû* 'hand.SG'), however the vast majority of nouns in Dagaare have at least two moras.

In contrast to nouns, verbs in the default form have minimal size of one syllable and one mora. That is, when the verb is in the citation or default form, it is minimally monosyllabic and monomoraic. In effect, there are proportionally many more CV verb forms. With the imperfective, there may be length alternation involving the default verb forms. Even without length alternation,

since the imperfective always adds a syllable, it would always become bimoraic. Some examples are given below.

(12)   Minimal size of verbs in different contexts

default form   imperfective form

dì   'eat.v'   dì-ré   'eat-ɪᴘꜰᴠ'

dú   'climb.v'   dúó-rò   'climb- ɪᴘꜰᴠ'

jùò   'open.v'   jùò-ró   'open- ɪᴘꜰᴠ'

dáà   'push.v'   dáá-!rá   'push- ɪᴘꜰᴠ'

wùlì   'show.v'   wùl-ó   'show- ɪᴘꜰᴠ'

2.7 Phonological processes

This section presents a brief description of some phonological processes in Dagaare. These processes include vowel harmony, vowel assimilation, final vowel elision, and vowel length alternations: lengthening and diphthongisation.

2.7.1   Vowel harmony

Vowel harmony is an assimilatory process which involves the obligatory agreement of adjacent vowels in a particular value (Pulleyblank, 2002; Rose & Walker, 2011). By adjacent vowels, I mean vowels of adjacent syllables, not just immediate adjacency. It may be a tongue root, rounding, backness or height feature. In Dagaare, the ten vowels are categorised into two natural classes based on tongue root feature – [ATR] vs [RTR]. In this case, only vowels within a particular class are permitted to co-occur in a simple word. In other words, either all vowels in a simple word are [ATR] or all vowels are [RTR]. This is what is termed as tongue root harmony. This is exemplified below in (13) where the vowel in the root shares the same tongue root feature with the vowel in the suffix.

(13)   Tongue root harmony

ATR   ATR

bí-é   'child-sɢ'   tì-ɛ́   'tree-sɢ'

tíg-é   'feast-ᴘʟ'   tíŋ-ɛ́   'ground-sɢ'

dúŋ-ó 'animal-sɢ'   dóŋ-ɔ́   'mosquito-sɢ'

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Another form of harmony in Dagaare is rounding harmony, which involves a situation where all vowels within a simple word agree in lip rounding (Kaun, 1995, 2004). It is specifically productively associated with the imperfective form of the verb with few examples in nouns. With this harmony pattern, aside from agreeing in rounding, all vowels also agree in the backness feature. That is, either all vowels are back and round, or all vowels are front and unround. The following examples in (14) illustrate rounding harmony. For the central unrounded vowels, [a, ə], see the examples in (15).

(14)   Rounding harmony
        bùr-ó   'soak-IPFV'   bʊ̀r-ɔ́   'sow-IPFV'
        wùl-ó   'show/teach-IPFV' sɔ́r-ɔ̀   'count/read-IPFV'

        jíél-!é 'sing-IPFV'   jíɛ́l-!ɛ́ 'winow-IPFV'
        dì-ré   'eat-IPFV'   dí-!rɛ́ 'take-IPFV'

Moreover, there is agreement in height in that when a verb root has a low vowel, the imperfective suffix is always a low vowel. This is a case of complete harmony or vowel copy (Rose & Walker 2011) involving assimilation for all vowel quality features.

(15)   Complete harmony
        hə́ə́r-!ə́ 'yawn-IPFV'   háár-à 'shoo-IPFV'
        sə́ə́r-ə̀ 'gather-IPFV (in bulk)'   záá-rà 'throw-IPFV'

The questions of what triggers vowels to harmonise and why rounding and height harmony is found particularly in imperfective verbs are not addressed here. A more detailed description and analysis is provided in chapter 4.

2.7.2   Vowel Assimilation

In vowel harmony, we see that the agreement involves vowels within a domain whether they are immediately following each other or not. With vowel assimilation, the shape of a vowel is influenced by a nearby vowel without any intervening segment. That is, assimilation occurs when vowels are contiguous without a consonant between them. Consider the following examples in (16) below.

(16) a. nʊ́ʊ́-rì   á-tà   →   nʊ́ʊ́-r**á** á-tà

          hen-PL   NONHUM-three

          'three hens'

      b. ʧʊ́ʊ́-rì   ə́-jì   →   ʧʊ́ʊ́-r**ə́** ə́-jì

          month-PL   NONHUM-two

          'two months'

      c. lɔ́n-ní   à-náárì   →   lɔ́n-n**á** á-náárì

          frog-PL   NONHUM-four

          'four frogs'

      d. kɔ́-bɔ́   ə̀-núú   →   kɔ́b**á** á-núú

          bone-PL   NONHUM-five

          'five bones'

      e. Ǹ   jὲlì   [ká   ʊ́]   wà   →   kʊ́-ʊ́ wà

          1SG say.V   C   3SG come.V

          'I said that s/he should come'

The examples above show that when a word ends with a vowel and is immediately followed by a vowel-initial word, the final vowel of the preceding word assimilates to the initial vowel of the following word. This is usually observed in fast speech or singing. Vowel assimilation is not further discussed in this dissertation.

2.7.3 Final vowel elision

Final vowel elision, also known as apocope, is the deletion or omission of a final vowel preceded by a consonant in a word or phrase. This process is pervasive in Dagaare (Kennedy 1966; Anttila and Bodomo 1996; Bodomo 1997) and other Mabia/Gur languages such as Dagbani (Hyman 1993) and Konni (Cahill 1999). In Dagaare, it is common for final vowels to be dropped for some words without any change in the meaning of the word. Similar to vowel assimilation, this is a process

that also results from fast speech or singing. In the examples below, final vowels are dropped resulting in shortened forms of the words.

(17)　　bíí-rí　　　～　　bíír　　　'child-PL'

　　　　nʊ́ʊ́-rì　　　～　　nʊ́ʊ̀r　　　'hen-PL'

　　　　bʊ́ʊ́-rí　　　～　　bʊ́ʊ́r　　　'goat-PL'

　　　　gàŋ-á　　　～　　găŋ　　　'kraal-SG'

　　　　lɔ́ŋ-ɔ́　　　～　　lɔ́ŋ　　　'frog-SG'

　　　　sɔ́rí　　　　～　　sɔ́r　　　'count.V'

　　　　vɔ́lí　　　　～　　vɔ́l　　　'swallow.V'

　　　　wùlì　　　　～　　wùl　　　'show.V'

Note however that, this process is not applicable to cases involving inseparable consonant clusters. In inseparable cluster situations, dropping the final vowel will lead to impossible forms as in (18). It is however possible for final vowel elision to occur in cases involving what seems to be non-obligatory clusters as in (19) particularly clusters involving sonorants [r, l]. This is probably because only coronals and others such as nasals are allowed word-finally, so [r,l] are possible but [b] is not. Moreover, the deletion of the final high vowel [i/ɪ] suggests that it is epenthetic.

(18)　　pɔ́g-bɔ́　　　～　　*pɔgb　　　'woman-PL'

　　　　sáám-!bá　　～　　*saamb　　'stranger-PL'

(19)　　kpáglí　　　～　　kpágl　　　'bedbug.SG'

　　　　sɔ́glì　　　～　　sɔ́gl　　　'hide.V'

　　　　lígrì　　　～　　lígr　　　'tickle.V'

It is also important to note that in verbs, final vowel deletion is applicable to the default verb form only. That is, only the final vowel of the default verb can be elided and still have the same default meaning. For instance, when the final high [ɪ] is dropped from the verb *sɔ́rì*, it results in *sɔ́r* which still carries the same meaning 'count'. In the case of the imperfective form *sɔ́r-ɔ̀* 'count-IPFV', if the final [ɔ] is dropped, its shortened form *sɔ́r* does not carry the imperfective meaning 'counting'. Rather, it effectively changes the meaning to the default meaning 'count'. For the imperfectives that involve diphthongs or long vowels, dropping the final vowel either changes the meaning of the word and its lexical category or it makes the word ill-formed. For instance, with *dúó-rò* 'climb-

IPFV', if the final vowel is dropped, it becomes *dúòr* which means 'urinate'. With *túú-rò* 'dig-IPFV', eliding the final vowel results in *túùr. This therefore suggests that the high vowel in the default form (previously termed perfective form) does not carry any meaning aside from satisfying some phonotactic requirements, but the vowel in the imperfective is actually meaningful, hence dropping the imperfective suffix totally changes the meaning of the verb.

 Similarly, when the final vowel in a noun like *kpágl-í* 'bedbug-SG' is deleted, the resultant form is *kpágl* which denotes only the singular form 'bedbug'. In the case of the plural form *kpágl-á*, omission of the final vowel does not denote a plural reading. Generally, sounds that are not functionally distinctive are the ones that are easily dropped without a change in the meaning in the original word. These cases are discussed later in chapter 3.

2.7.4   Vowel length alternations: lengthening and diphthongisation

In Dagaare, there are some surface reversals in root shape between verbs involving the default forms and the imperfective forms and also between singular and plural nouns. For the verbs, vowels can be short or long in the default form, and they can be short or long in the imperfective form. In some cases, short vowels in the default verb correspond to long vowels in the imperfective form. That is when the imperfective suffix is added to the verb root, we see vowel lengthening in the root as illustrated below. These cases involve either a high or a low vowel but not always.

(20)	Default form		Imperfective form	
	tí	'hold.V'	tíí-rè	'hold-IPFV'
	ví	'demolish. V'	víí-rè	'demolish-IPFV'
	sì	'skin.V'	sìì-rέ	'skin-IPFV'
	tú	'dig.V'	túú-rò	'dig-IPFV'
	dà	'buy.V'	dàà-rá	'buy-IPFV'
	là	'laugh.V'	làà-rá	'laugh-IPFV'
	vɔ́	'scorch.V'	vɔ́ɔ́-rɔ̀	'scorch-IPFV'

The examples in (21) show high and low vowels in the default form becoming long vowels in the imperfective. There are short vowels in the default verbs which alternate with diphthongs in the imperfective form.

(21)   Default form   Imperfective form

        tɛ́   'spread.v'   tíɛ́-rɛ̀   'spread-IPFV'

        kpɛ̀   'enter.v'   kpìɛ̀-rɛ́   'enter-IPFV'

        dó   'climb.v'   dúó-rò   'climb-IPFV'

        sò   'bathe.v'   sùò-ró   'bathe-IPFV'

        dɔ́   'weed.v'   dúɔ́-rɔ̀   'weed-IPFV'

The observation in the above examples is that a short mid vowel in the default verb becomes a
diphthong in the imperfective. There are also cases where long vowels in the default form
consistently correspond with long vowels in the imperfective. This is always the case when the
default verb contains a long vowel. This shown in the examples below.

(22)   Default form   Imperfective form

        ɔ̀ɔ̀   'chew/eat.v'   ɔ̀ɔ̀-rɔ́   'chew/eat-IPFV'

        mɔ́ɔ́   'wrestle.v'   mɔ́ɔ́-rɔ̀   'wrestle-IPFV'

        zɔ̀ɔ̀   'fight.v'   zɔ̀ɔ̀-rɔ́   'fight-IPFV'

        kàà   'look.v'   kàà-rá   'look-IPFV'

        fáà   'seize.v'   fáá-!rá   'seize-IPFV'

        dáà   'push.v'   dáá-!rá   'push-IPFV'

Similarly, diphthongs in the default verb form remain as diphthongs in imperfective as illustrated
below.

(23)   Default form   Imperfective

        tìɛ̀   'push.v'   tìɛ̀-rɛ́   'push-IPFV'

        díɛ̀   'receive.v'   díɛ́-!rɛ́   'receive-IPFV'

        jùò   'open.v'   jùò-ró   'open-IPFV'

        tùò   'carry.v'   tùò-ró   'carry-IPFV'

Finally, there are instances where short vowels in the default form remain short in the imperfective.
There are short high or low vowels that fail to lengthen in the imperfective and there are short mid
vowels that fail to diphthongise in the imperfective. Here are some examples.

(24) Default form   Imperfective form

    jí   'leave.v'   jí-rè   'leave-IPFV'

    dì   'eat.v'   dì-ré   'eat-IPFV'

    dî   'take.v'   dí-!ré   'take-IPFV'

    lè   'fall.v'   lè-ré   'fall-IPFV'

    kò   'give.v'   kò-rɔ́   'give-IPFV'

    tá   'reach.v'   tá-rà   'reach-IPFV'

Overall, in verbs, short vowels in the default verb may remain short or become long/diphthongised in the imperfective. As shown above, long vowels in the default form remain long in the imperfective; diphthongs in the default form remain diphthongs in the imperfective. What is unattested are cases involving diphthong in the default form and short vowel in the imperfective. Moreover, apart from the verb alternation, *gàà* 'go.v'- *gè-ré* 'go-IPFV' which involves long vowel in the default form but short vowel in the imperfective, there are no other cases involving long default vs. short imperfective forms in the language.

With nouns, when the number suffix [-ri/-rɪ] occurs after a high vowel root specifically CV-, that root vowel in the singular form becomes half of what appears like a diphthong – the singular suffix contributes the second part of the diphthong while the root of the plural becomes long. The final vowel in the singular form has been argued to be an epenthetic vowel due to minimality (see Anttila & Bodomo 2009).

(25) Singular   Plural

    bí-é   'child-SG'   bíí-rí   'child-PL'

    zí-é   'place-SG'   zíí-rí   'place-PL'

    sí-ɛ́   'waist-SG'   síí-rí   'waist-PL'

    kú-ó   'field mouse-SG'   kúú-rí   'field mouse-PL'

    bʊ́-ɔ́   'goat-SG'   bʊ́ʊ́-rí   'goat-PL'

There are also cases where the singular form involves a diphthong, and where this corresponds to a short vowel in the plural form (26), while conversely a short vowel in the singular may correspond to a diphthong in the plural form (27). Finally, there are nouns which contain long vowels in both singular and plural forms as in (28).

(26)   Singular   Plural

        gbìé   'forehead.SG'   gbé-rì   'forehead-PL'

        dìé   'room.SG'   dè-rí   'room-PL'

        dùó   'warthog.SG'   dò-rí   'warthog-PL'

        tùó   'baobab.SG'   tò-rí   'baobab-PL'

(27)   Singular   Plural

        bí-rì   'seed-SG'   bí-è   'seed-PL'

        jí-rì   'house-SG'   jí-è   'house-PL'

        mí-rì   'rope-SG'   mí-è   'rope-PL'

(28)   Singular   Plural

        túú   'forest.SG'   túú-rí   'forest-PL'

        ʧúù   'month.SG'   ʧúú-rì   'month-PL'

        báá   'dog.SG'   báá-rí   'dog-PL'

The difference between the diphthongs in the imperfectives and those in nouns is that the diphthong in nouns get split between the root and the suffix while the diphthongs in the imperfective forms always constitute the root with a separate suffix. These alternations raise questions about why aspectual marking in verbs and number marking in nouns result in long vowels and diphthongs with some but not all roots. These are questions for further investigation and are therefore not discussed further in this chapter.

2.8 Summary

In summary, this chapter has given a general introduction to some phonological aspects of Dagaare. The relevant aspects include consonant, vowel and tone inventories, phonological processes such as harmony, assimilation and vowel length. It provides a brief description of the co-occurrence restrictions involving consonants and vowels, syllable and minimality requirements of nouns and verbs in Dagaare. This overview will be relevant in the analysis of various morphophonological patterns presented in subsequent chapters of this dissertation.

Chapter 3: Inflectional morphology

3.1 Setting the scene

In Dagaare, inflectional morphology is found on verbs and nouns. In both verbal and nominal contexts, it is realized as suffixal morphology. On verbs, these suffixes mark an aspectual contrast, which is usually described as a perfective/imperfective contrast (Bodomo, 1997; Dakubu, 2005; Saanchi, 2003). This is illustrated in (1) for the verb *sɔ́r-* 'read'. The perfective form is realized with a high vowel suffix, which harmonizes in ATR value; in (1a) this corresponds to *-í*. With the verb 'read', the imperfective form is likewise realized as a non-high suffixal vowel, but here it is non-high and agrees in rounding and tongue root value with the vowel of the verbal root; see (1b). The perfective/imperfective allomorph are but two of the many alternations recruited to mark aspect; I return to this below.

(1) a.   Dàkɔ́ráá   sɔ́r-í   !ná   gánì

         Dakoraa   read-PFV   FOC   book.SG

         'Dakoraa has read a book'

     b.   Dàkɔ́ráá   sɔ́r-!ɔ́   ná   gánì

         Dakoraa   read-IPFV   FOC   book.SG

         'Dakoraa is reading a book'

Parallel to suffixal verbal aspect, there is suffixal number marking. On nouns, number is usually described as marking a singular/plural contrast. A remarkable property of Dagaare is that both singular and plural can be morphologically marked, as in (2), where the singular form of *gán-* 'book' involves the addition of the high vowel suffix *-í*, while the plural form involves the addition of the low vowel suffix *-à*. While plural is always marked, singular may be null or marked.

(2)   a.   Dàkɔ́ráá   sɔ́r-í   !ná   gán-ì

         Dakoraa   read-PFV   FOC   book-SG

         'Dakoraa has read a book'

b.   Dàkʊ́ráá   sɔ́rí   ná   gám-à

       Dakoraa   read.PFV   FOC   book-PL

       'Dakoraa has read books'

There is regular correspondence between the suffixed verb forms and noun forms illustrated in (1) and (2) and the syntactic context that hosts them. By hypothesis, an aspectual marked verb form occurs in a syntactic frame that involves the functional category Aspect in combination with a verbal projection, as in (3). In a parallel fashion, a number marked noun form occurs in a syntactic frame that involves the functional category Number in combination with a nominal projection, as in (4).

(3) Tree showing V + Asp
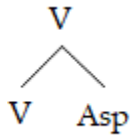
(4) Tree showing N + Num
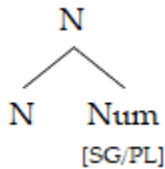
The functional projection, Asp is the head that contains either default or imperfective aspect. Similarly, the projection Num hosts the number partitions singular/plural.

3.1.1   How the problem presents itself with verbs

For verbs, taking the interaction of the phonology, syntax, and semantics into account points to an asymmetry between the so-called perfective aspect (which has semantic and syntactic properties of a default verb form) versus imperfective aspect (which behaves like a semantically specified aspectual verb form).

3.1.1.1 The 'perfective' as default verb form

As previously discussed, a given verb form must be inflected for either perfective or imperfective aspect. This is shown in (5) and (6) for 'read' and 'eat'. I however consider the so-called perfective verbs as default and gloss them as V.

(5)	a.	Dàkɔ́ráá	sɔ́rí	!ná	gán-ì
		Dakoraa	read.V	FOC	book-SG
		'Dakoraa has read a book'			

	b.	Dàkɔ́ráá	sɔ́r-!ɔ́	ná	gán-ì
		Dakoraa	read-IPFV	FOC	book-SG
		'Dakoraa is reading a book'			

(6)	a.	Dàkɔ́ráá	dì	ná	tàám-à
		Dakoraa	eat.V	FOC	shea fruit-PL
		'Dakoraa has eaten shea fruits'			

	b.	Dàkɔ́ráá	dì-ré	ná	tàám-à
		Dakoraa	eat-IPFV	FOC	shea fruit-PL
		'Dakoraa is eating shea fruits'			

A notable difference between the two types of aspectual inflection is that while perfective verb forms can be zero-marked, as in (6a), imperfective verb forms always require overt suffixation. This is a first clue that there may be a difference in the kind of inflection the two aspectual forms recruit. Closer inspection supports conclusion that the so-called perfective form is in fact a kind of default verbal form.

For instance, in the following examples (7a-7e), the verb *dì* 'eat' which is zero-marked is recruited for perfective context (7a), imperative context (7b), citation context (7c), past context (7d) and future context (7e). That is, in all these contexts, the verb form is the same regardless of whatever syntactic situation it expresses. This goes to confirm the hypothesis of a default verb form.

(7)   a.   Dàkɔ́ráá   dǐ   ná   tàám-à   PERFECTIVE

Dakoraa   eat.V   FOC   shea fruit-PL

'Dakoraa has eaten shea fruits'

b.   dì   à   tàám-à   IMPERATIVE

eat.V   DET   shea-PL

='Eat the shea fruits!'

≠ 'have eaten the shea fruits'

c.   à   dì   CITATION

INF   eat.V

='to eat'

≠ 'to have eaten'

d.   Dàkɔ́ráá   dà   dǐ   ná   tàám-à   PAST

Dakoraa   PST   eat.V   FOC   shea fruit-PL

='Dakoraa ate shea fruits'

≠ 'Dakoraa has eaten shea fruits'

e.   Dàkɔ́ráá   nà   dí   ná   tàám-à   FUTURE

Dakoraa   FUT   eat.V   FOC   shea fruit-PL

'Dakoraa will eat shea fruits'

≠ 'Dakoraa will have eaten shea fruits'

For the examples in (8a-8e), the verb root *sɔ́r-* 'read' which occurs with the harmonic high front vowel [ɪ] is used to denote perfective context (8a), imperative context (8b), citation context (8c), past context (8d) and future context (8e). In line with Anttila & Bodomo (2009), this final high vowel can be predicted from considerations of minimality after C-final roots. It remains unchanged in all the contexts of (8); it performs no particular syntactic function and does not have any particular meaning. This final high vowel can therefore be analyzed as epenthetic, not suffixal.

(8) a. Dàkúráá   sɔ́rí   !ná   gán-ì   PERFECTIVE

         Dakoraa   read.V   FOC   book-SG

         'Dakoraa has read a book'

     b. sɔ́rí   à   gán-ì   IMPERATIVE

         read.V   DET   book-SG

         = 'Read the book!'

         ≠ 'have read the book!

     c. à   sɔ́rí   CITATION

         INF   eat.V

         = 'to read'

         ≠ 'to have read'

     d. Dàkúráá   dà   sɔ́rí   !ná   gán-ì   PAST

         Dakoraa   PST   read.V   FOC   book-SG

         = 'Dakoraa read a book'

         ≠'Dakoraa has read a book'

     e. Dàkúráá   nà   sɔ́rí   !ná   gán-ì   FUTURE

         Dakoraa   FUT   read.V   FOC   book-SG

         = 'Dakoraa will read a book'

         ≠'Dakoraa will have read a book'

In all cases (7-8) shown above, none of the verbs *dì* 'eat' or *sɔ́rí* 'read.V' show any evidence of being perfective given that none of the sentences has a perfective reading other than (7a) and (8a). Moreover, the verbs do not show inherent perfective meaning when they occur with the past and future particles. As seen in (7d-e & 8d-e), the verbs express simple past and simple future respectively. The tense particles only determine the temporal force of the action. If the verbs were dedicated perfective forms, then with the combination of the past and the future particles, we would expect interpretations like 'Dakoraa has eaten shea fruits' for a case like (7d) and 'Dakoraa will have eaten shea fruits' for (7e). But that is not case as there is no perfective meaning; it basically takes the meaning of whatever position in which it occurs, simply suggesting a default verb form.

3.1.1.2 The imperfective as semantically specified verb form

The imperfective form is made up of the verbal root and a (C)V suffix. The suffix always harmonises for both tongue root and rounding/backness harmony. It is a semantically specified form in contrast to the so-called perfective. Unlike the so-called perfective, the imperfective suffix always changes its shape based on the verbal root to which it is attached. Crucially, it always has a dedicated progressive meaning regardless of the context, as shown in (9a and 10a) for progressive aspectual meaning and (9b and 10b) for imperative but with progressive meaning.

(9)	a.	Dàkɔ́ráá	dì-ré	!ná	tàám-à	IMPERFECTIVE
		Dakoraa	eat-IPFV	FOC	sheafruit-PL	
		'Dakoraa is eating shea fruits'				

Context: speaker instructs addressee to continue performing an action

	b.	dì-ré	à	tàám-à	IMPERATIVE
		eat-IPFV	DET	shea fruit-PL	
		'Continue/Keep eating the shea fruits!'			

(10)	a.	Dàkɔ́ráá	sɔ́r-!ɔ́	ná	gán-ì	IMPERFECTIVE
		Dakoraa	read-IPFV	FOC	book-SG	
		'Dakoraa is reading a book'				

Context: speaker instructs addressee to continue performing an action

	b.	sɔ́r-ɔ̀	à	gán-ì	IMPERATIVE
		read-IPFV	DET	book-SG	
		'Continue/Keep reading the book!'			

In (7d) and (8d) above, we see that when the past particle occurs with the default form, it only determines the temporal force of the action. In contrast, a combination of the imperfective and the past tense particle expresses both a temporal and an aspectual (progressive) meaning as shown in (11a) and (12a). This works the same way for the sentences with the future tense and the imperfective suffix as in (11b). In effect the imperfective has a meaningful content and when it occurs with past or future particle, it indicates an ongoing action.

(11) a. Dàkʊ́ráá   dà   dì-ré   !ná   tàám-à   PAST

          Dakoraa   PST   eat-IPFV   FOC   shea fruit-PL

          'Dakoraa was eating shea fruits'

     b. Dàkʊ́ráá   nà   dí-ré   !ná   tàám-à   FUTURE

          Dakoraa   FUT   eat-IPFV   FOC   shea fruit-PL

          'Dakoraa will be eating shea fruits'

(12) a. Dàkʊ́ráá   dà   sɔ́r-!ɔ́   ná   gán-ì   PAST

          Dakoraa   PST   read-IPFV   FOC   book-SG

          'Dakoraa was reading a book'

     b. Dàkʊ́ráá   nà   sɔ́r-!ɔ́   ná   gán-ì   FUTURE

          Dakoraa   FOC   read-IPFV   FOC   book-SG

          'Dakoraa will be reading a book'

Further evidence supporting our claim of a default vs. an imperfective form can be seen in a phonologically motivated pattern, final vowel deletion or apocope. That is, it possible to delete the final high vowel in the so-called perfective form and yet the semantics of the word remains unchanged. Consider the following examples in (13-14) for the default forms *sɔ́rí ~ sɔ́r* 'read' and *zèlì ~ zèl* 'lift'.

(13) a. Dàkʊ́ráá   sɔ́rí   !ná   gán-ì

          Dakoraa   read.V   FOC   book-SG

          'Dakoraa has read a book'

     b. Dàkʊ́ráá   sɔ́r   !ná   gán-ì

          Dakoraa   read.V FOC   book- SG

          'Dakoraa has read a book'

(14) a. Dàkóráá zèlí !na à bí-é

    Dakoraa lift.V FOC DET child-SG

    'Dakoraa has lifted the child'

  b. Dàkóráá zĕl ná à bí-é

    Dakoraa lift.V FOC DET child-SG

    'Dakoraa has lifted the child'

The verbs with the final high vowel in (13a) and (14a) function exactly same way as those without the vowel (13b and 14b). In effect, deleting the final high vowel has no semantic consequence on the verb and the sentence as a whole. This simply suggests that the vowel has no particular meaning apart from satisfying a phonotactic constraint, namely epenthesis. Now in the examples that follow, deletion is not allowed in the imperfective form since the suffix vowel is always non-high. Deleting the vowel of the imperfective suffix will effectively lead to change in the semantics of the verb. This is shown in the examples (15-16).

 (15) a. Dàkóráá sór-!ó ná gán-ì

    Dakoraa read-IPFV FOC book-SG

    'Dakoraa is reading a book'

  b. Dàkóráá sór !ná gán-ì

    Dakoraa read.V FOC book-SG

    ='Dakoraa has read a book'

    ≠'Dakoraa is reading a book'

 (16) a. Dàkóráá zèl-ɛ !ná à bí-é

    Dakoraa lift-IPFV FOC DET child-SG

    Dakoraa is lifting the child'

b.	Dàkóráá	zĕl	ná	à	bí-é
	Dakoraa	lift	FOC	DET	child-SG

=‘Dakoraa has lifted the child’

≠Dakoraa is lifting the child’

In (15a) and (16a), the presence of the imperfective suffix makes the action denoted by the verb progressive. In (15b) and (16b), the meaning of the verb effectively changes. It does not maintain the progressive reading. Rather it conveys the meaning of the default verb form. This therefore adds further support to the claim that the final high vowel in the default form has no meaning and is not a suffix while the imperfective is an actual suffix.

In terms of the phonology, the default form only agrees in tongue root harmony, but the vowel remains unchanged as a high unrounded front vowel irrespective of the form of the root vowel. In contrast, the vowel of the imperfective changes according to the vowel of the root though its properties are exactly as predictable as those of the default.

Morphosyntactically, the perfective is default as it occurs in different syntactic environments. Semantically, it is default because it denotes a wide range of meanings whereas the imperfective has a dedicated meaning – always expresses progressive in all contexts.

The observations with the high vowel in the default verbs seems to be similar to other Mabia languages like Buli. In Buli (personal conversation with Darius Adjong), the high vowel in so-called perfective forms does not have any meaning and can easily be omitted from the verb without any effect on the overall meaning of the verb, thereby suggesting an epenthetic vowel. Though, there is no known report in other Dagaare varieties, it is possible that the behaviour of verbs in the central dialect might be similar to the other varieties.

3.1.2   How the problem presents itself with nouns

In nouns, inflectional morphology is based on number marking which is partitioned into singular and plural forms. The problem for nouns presents itself in the following fashion. The selection of number suffix is based on the noun class (Bodomo, 1997; Bodomo & Marfo, 2006), and may be determined by phonological, morphosyntactic and semantic factors. The noun classes involve count, mass and event nouns. Full data set and detailed discussion of the Dagaare noun class system is presented in section 3.2.2.3.

The sentences given in (17) and (18) involve count nouns. Examples are given in (17) for noun class three and in (18) for noun class eight. These examples are phonologically determined in the sense that, there is regular number marking for both singular and plural nouns. That is, both singular and plural are marked with a vowel. For the examples in (17), singular is marked with the high front vowel [-i/-ɪ] while the plural vowel is always based on the quality (e.g., backness feature) of the root vowel. For the nouns in (18), singular is marked with the long low vowel [-aa] while plural is marked with the high front vowel [-i/-ɪ]. All number suffixes always agree in tongue root feature with the roots to which they are attached.

(17) a. ǹ dǎ ná ʤé!l-íí

    1SG buy.V FOC egg-SG

    'I have bought an egg'

  b. ǹ dǎ ná ʤél-ɛ̀

    1SG buy.V FOC egg-PL

    'I have bought eggs'

(18) a. à lóɔ́r-áá kpì-é-ŋ

    DET tiger-SG die.V-INTR-FOC

    'The tiger has died'

  b. à lóɔ́r-íí kpì-é-ŋ

    DET tiger-PL die.V-INTR-FOC

    'The tigers have died'

In the next examples (19-20), number marking is not regular as compared to the preceding examples. I propose that number in these nouns is phonologically and semantically conditioned. That is, the number suffix here involves an underlying form which gets modified by various phonological rules. This is discussed subsequently section 3.2.2.3.2. In some cases, singular is marked with a vowel and the plural is marked with a CV, particularly *-ri/-rɪ*. In other cases, singular is marked with *-ri/-rɪ* while plural is marked with a vowel. This phenomenon is termed inverse number marking (Grimm, 2010, 2012, 2018, 2021), a case in which the same morpheme marks

singular in some nouns and then marks plural in other nouns. The default CV suffix is *-ri/-rɪ* but it is phonologically realised as *-ni/-nɪ* when it follows a nasal consonant to mark plural. This is shown below. The examples in (19) belong to noun class two and those in (20) belong to class six.

(19)   a.   à   bí-é   dì-é-ŋ

                DET   child-SG   eat.V-INTR-FOC

                'The child has eaten'

        b.   à   bíí-rí   dì-é-ŋ

                DET   child-PL   eat.V-INTR-FOC

                'The children have eaten'

(20)   a.   à   bì-rí   lè-é-ŋ

                DET   seed-SG   fall.V-INTR-FOC

                'The seed has fallen'

        b.   à   bìé   lè-é-ŋ

                DET   child.SG   fall.V-INTR-FOC

                'The seeds have fallen'

These nominal suffixes involving inverse marking have been analyzed as a reflection of lexical semantics. According to Grimm (2012), nouns involving this number inverses are semantically conditioned based on individuation – a semantic notion in which the structure of nouns reflects countability based on individuality. Those that occur in single units are likely to have the CV, *-ri* for plural while nouns that are treated as groups take *-ri* as singular.

Finally, there is a set of nouns which are semantically conditioned. For instance, there are cases involving nouns whose singular is generally marked with a vowel and the plural is marked with a dedicated morpheme, either *-ba/bɔ* for **human** nouns or *-mine* for **kinship** nouns. These nouns belong to class one. Below are examples. In (21a) the singular is marked with the vowel *-ɔ* and the plural with the human suffix *-bɔ*. In (22a) singular is marked with the high vowel *-ɪ* and the plural with the morpheme *-mìné*.

(21)　　a.　à　　pɔ́g-ɔ́　　　dì　　　　ná　　sáʊ́

　　　　　　　DET　　woman-SG　　eat.V　　　　FOC　　sao

　　　　　　　'The woman has eaten sao'

　　　　b.　à　　pɔ́g-bɔ́　　dì　　　　ná　　sáʊ́

　　　　　　　DET　　woman-PL　　eat.V　　　　FOC　　sao

　　　　　　　'The women have eaten sao/TZ'

(22)　　a.　Ǹ　　bíɛ́r-ì　　　wǎ　　　　ná　　ʧɛ̂

　　　　　　　1SG　　brother-SG　　come.V　　　FOC　　here

　　　　　　　'My brother has come here'

　　　　b.　Ǹ　　bíɛ̀r-mìné　　wǎ　　　　ná　　ʧɛ̂

　　　　　　　1SG　　brother-PL　　come.V　　　FOC　　here

　　　　　　　'My brothers have come here'

There are some nouns which are derived from the suffix [-u/ʊ, -bu/-bʊ]. These are the nouns termed **event/action** nouns. They are perceived as singular though the suffix is not really a number marker. Examples are provided in (23). In addition, there are nouns which are interpreted as plural and marked with the suffix [-uŋ/-ʊŋ]. They are **mass non-count** nouns and are exemplified below in (24).

(23)　　kʊ́ɔ́-bʊ̀　　　táá　　　!ná　　tɔ̀nɔ́

　　　　　Farm-NMLZ　　have.V　　FOC　　benefit

　　　　　'Farming is profitable/beneficial'

(24)　　à　　búúl-úŋ　　　bá　　tʊ́lì

　　　　　DET　　porridge-NUM　NEG　　hot

　　　　　'The porridge is not hot'

Finally, there are others in which the singular is null, but the plural is marked with a dedicated suffix -*nɛɛ* denoting 'kinds/types of'. These are **mass count-nouns**. They are mass count because it is possible to count them as groups/collections of a particular noun. Here are examples.

(25)   a.   à   kʊ̀ʊ̌   bá   tʊ́lì
        DET   water.SG   NEG   hot

        'The water is not hot'

        b.   à   kʊ̀ɔ̀-nɛ́ɛ́   bá   tʊ́lì
        DET   water-PL   NEG   hot

        'The water (types) is not hot'

In summary, with the nouns, it is a case of inverse number, dedicated singular and dedicated plural marking. That is, the problem involves morpho-phonology, morphosyntax and morphosemantics. The nouns therefore seem to present a much more complex case compared to the pattern observed in verbs. These observations, which are not clearly distinguished in previous studies, will be the integral issues this chapter aims to address.

3.1.3   Where inflection occurs

In Dagaare inflection is found on verbal and nominal expressions. As seen already, with verbs, it involves aspect marking leading to default and imperfective/progressive aspect. With nouns, inflection occurs via number marking. In both verbal and nominal environments, inflection is suffixal.

For the default verb forms, there may be a zero-marked form or a form with a final high vowel [i/ɪ] and for the imperfective forms, the suffix is always morphologically present. In the examples that follow, I show verbs in their default form with zero marking (26a) and their corresponding overtly marked imperfective forms. In (26b), the default form has the final high vowel [i/ɪ] and the corresponding overtly marked imperfectives. The difference between (26a) and (26b) is phonological: the zero marking is possible because the verb root ends in a vowel in (a) and then we get [i/ɪ] in (b) because the verbs end in a consonant (e.g., CVC).

(26)   a.   Unmarked default   Imperfective
        dì   'eat.V'   dì-ré   'eat-IPFV'
        lè   'fall.V'   lè-ré   'fall-IPFV'
        tú   'dig.V'   túú-rò   'dig-IPFV'
        dó   'climb.V'   dúó-rò   'climb-IPFV'
        vá   'hit.V'   váá-rà   'hit-IPFV'

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	b.	Marked default form		Imperfective	
		kpérí	'slice.V'	kpér-è	'slice-IPFV'
		wùlì	'show.V'	wùl-ó	'show-IPFV'
		háárì	'shoo.V'	háár-!á	'shoo-IPFV'
		zànnì	'learn.V'	zàn-ná	'learn-IPFV'

With nouns, inflection may be morphologically null or present with the singular forms. Plural forms are always morphologically marked. This is shown in (27).

(27)	a.	Unmarked singular		Plural	
		zû	'head.SG'	zú-rì	'head-PL'
		nû	'hand.SG'	núú-rì	'hand-PL'
	b.	bí-é	'child-SG'	bíí-rí	'child-PL'
		dúŋ-ó	animal-SG'	dún-ní	'animal-PL'

The shape of the nominal suffix is in various forms and will be described in detail in section 3.2.2. As shown in the examples, inflection in Dagaare involves vowel harmony in which the suffix agrees in a particular harmonic feature of the root. For instance, both aspectual and number suffix always agrees in tongue root feature of the root to which it is attached while the imperfective and some nominal suffixes agree in rounding feature of the preceding root.

3.1.4 Inflection and tone

3.1.4.1 Tone spreading

While the tone of the default verbs is lexical (i.e., it is the same as that of the verb root's), the tone of the imperfective and number suffixes is derived. The default forms involve a final vowel which can be totally optional. The root tone remains the same on the surface. That is, the suffix is assumed to be toneless and then the last or rightmost tone of the root (in case of HL roots) simply spreads to the suffix if it is not a zero suffix. This is shown below.

(28)   Tone spread in default verbs

    a. L-roots

Verb root	Default	Gloss
tùò-	tùò	'carry.v'
wùl-	wùlì	'show.v'
sòr-	sòrì	'beg.v'

    b. H-roots

Verb root	Default	Gloss
kpér-	kpérí	'slice.v'
sór-	sórí	'count/read.v'
síg-	sígí	'descend.v'

    c. HL-roots

Verb root	Default	Gloss
díὲ-	díὲ	'receive.v'
kɔ̂r-	kɔ́rì	'cough.v'
fáà-	fáà	'seize.v'

In nouns, surface high tones have roots that are toneless and suffix that is underlyingly H. What then results in the surface H-H is the leftward spreading of the suffix H tone onto the root. This is similar to what is observed in Moore (Kenstowicz et al. 1988).

(29)   Tone spread in nouns

Nominal root	Singular	Plural	Gloss
bi-	bí-é	bíí-rí	'child'
kog-	kóg-ó	kóg-rí	'chair'
taŋ-	táŋ-á	tán-ní	'mountain'

3.1.4.2 Tone polarity

With imperfectives, the tone on the suffix is always opposite in height to the tone of the preceding root. H roots have L suffix; L roots take H suffix and HL roots have !H suffix tone. With nouns, H roots take on L number suffix; L roots have H suffix tone. This pattern of opposite tones between

roots and suffixes is what is termed as tonal polarity. The following examples illustrate this pattern in verbs (30a-c) and with nouns in (31a-b).

(30)   Tone polarity in imperfective verbs

    a. L-root; imperfective L-H

Verb root	Imperfective	Gloss
dì-	dì-ré	'eat-IPFV'
wùl-	wùl-ó	'show-IPFV'
sòr-	sòr-ɔ́	'beg-IPFV'

    b. H-root; imperfective H-L

Verb root	Imperfective	Gloss
kpér-	kpér-è	'slice-IPFV'
sór-	sór-ɔ̀	'count/read-IPFV'
síg-	síg-rè	'descend-IPFV'

    c. HL root; imperfective H-!H

Verb root	Imperfective	Gloss
dî-	dí-!rɛ́	'take-IPFV'
díɛ̂-	díɛ́-!rɛ́	'receive-IPFV'
vʊ́ɔ̂-	vʊ́ɔ́-!rɔ́	'uproot-IPFV'
kôr-	kór-!ɔ́	'cough-IPFV'
fáâ-	fáá-!rá	'seize-IPFV'

(31)   Tone polarity in nouns: singular/plural

    a. L-root; L-H – singular vs plural

Nominal root	Singular	Plural	Gloss
pì-	pì-é	pìì-rí	'rock'
ɲù-	ɲù-ó	ɲùù-rí	'navel'
tòò-	tòò-rí	tò-bó	'ear'
bùg-	bùg-ó	bùg-rí	'silo'
gòŋ-	gòŋ-ó	gòn-ní	'silk cotton'

b. H-root; H-L – singular vs plural

Nominal root	Singular	Plural	Gloss
jí-	jì-rí	jì-é	'house'
dʊ́g-	dʊ́g-ì	dʊ́g-rì	'pot'
nɛ́-	níɛ́-rì	nɛ́-ɛ̀	'grinder'
jó-	júó-rì	jó-è	'name'
kóg-	kóg-ò	kóg-rì	'mahogany'

Tone is presented here in descriptive terms to show how inflectional suffixes behave tonally. Further description and analysis of tone is presented in chapter 5.

3.2 Morphology

Morphologically, a verb in Dagaare is identified based on the kind of aspect (default and imperfective) which is signaled by aspectual suffix on the verb root. The verb is made up of the verb root and the aspectual suffix. In terms of nominal morphology, a simple noun is made up of the nominal root and a number suffix. In the next sections I discuss the allomorphs that mark aspect and those that mark number on nouns. sɔ́r(í)

3.2.1 Verbal morphology

The structure of a minimal verb is schematised below with corresponding examples.

(32) [[ROOT] – [(IPFV)]SUFFIX]VERB

(33) Default form

[[dì]root – [-∅] suffix]default form

(34) Imperfective form

[[dì]root – [-ré] suffix] imperfective form

Following the Bare Phrase Structure hypothesis (Chomsky, 1995), structurally a Dagaare verb is as follows with corresponding examples for default and imperfective forms of the verbs 'eat' and 'read/count'.

(35)   Structure of Dagaare verb

```
        Verb
        /\
   V-root  Asp
```

(36)   Default form

a.

```
        Verb
        /\
   V-root  Asp
      |      |
      di     Ø
```

b.

```
        Verb
        /\
   V-root  Asp
      |      |
    sór(í)   Ø
```
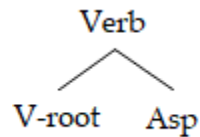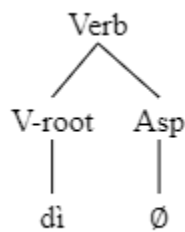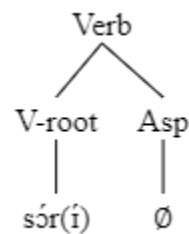
(37)   Imperfective form

```
        Verb
        /\
   V-root  Asp
      |      |
      di    -ré
```
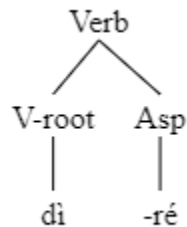
As seen in the default forms in (36), there is a root (a) involving zero suffix and (b) involving a high vowel suffix. What determines this is simply the form of the root. If the root is CV or CVV, it does not overly inflect for aspect. If the root is consonant final, there is an epenthetic final high vowel though that can be elided in fast speech. For the imperfective, as in (37), there must always be a suffix.

3.2.1.1 Verbal allomorphs

While categories like tense, polarity and modality are syntactically coded with pre-verbal particles as mentioned in chapter 1, aspect is in Dagaare is expressed morphologically. Inflectional suffixes are used to characterise default vs. imperfective form of verbs. There are twelve (12) allomorphs

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for verbs, consisting of three (3) allomorphs for the default form and nine (9) allomorphs for imperfective aspect.

Table 3.1: Inflectional allomorphs in verbs

	Form	Suffixal allomorph
Default form	-V	{-i/-ɪ}
	-CV	{-ni/-nɪ}
	-Ø	{-Ø }
Imperfective	-V	{-e/-ɛ, -o/-ɔ, -ə/-a}
	-CV	{-re/-rɛ, -ro/-rɔ,-rə/-ra}, {-ne/-nɛ, -no/-nɔ, -nə/-na}

The -V and -CV suffixes for the imperfective as in the preceding table constitute three main separate allomorphs: /-V$_{[-high]}$/, rV$_{[-high]}$ and nV$_{[-high]}$ with each consisting of three suffixal forms. Then whatever shape the suffix takes on the surface is determined by the phonology. In other words, the selection of each allomorph depends on the vowel quality of the verbal root. The following section presents the verbal root types and the form of allomorphs they select.

3.2.1.2 Selection of verbal allomorphs

The selection of the final vowel in the default form is predictable. For instance, the selection of -ni/-nɪ is the result of a nasal-final root conditioned by the phonology while the selection of the null -Ø is determined by a V-final root (e.g. CV, CVV). Finally, the selection of the high vowel [i/ɪ] is determined by C-final roots. For the imperfectives however, the choice of the suffix is based on the phonological shape of the of the verbal root. There are five main root types: CV, CVV, CVC, CVVC and CVCC. Each of the roots: CVC, CVVC and CVCC are further split into specific roots ending in the sonorants [r, l, n] and the velar obstruent [g]. Thus, CVC involves CVR, CVL, CVN and CVG; CVVC involves CVVR, CVVL and CVVN while CVCC consists of CVGR and CVGL. In terms of selecting an aspectual allomorph for the imperfective form, all vowel final and ɡ-final roots always take the CV suffix, [-rV]; all roots ending in the liquids [r, l] always select a vowel as the suffix. Finally, nasal-final roots may select a vowel or an -nV suffix. The shape of the suffix vowel is always determined by the shape of the root vowel. The table below shows the shape of

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verbal roots and the allomorphs they select to inflect for aspect. These are morphological sets whose shape are determined by the phonology.

Table 3.2: Verb root and allomorph selection

	Default form				Imperfective form		
Form	Root	suffix	Example	Gloss	Suffix	Example	Gloss
CV	CV	-∅	dì	'eat.V'	-rV	dì-ré	'eat-IPFV'
			tú	'dig.V'		túú-rò	'dig-IPFV'
CVV	CVV	-∅	tùò	'carry.V'	-rV	tùò-ró	'carry-IPFV'
			dáà	'push.V'		dáá-!rá	'push-IPFV'
CVC	CVN	-∅	sòŋ	'help.V'	-(N)V	sòn-nɔ́	'help-IPFV'
			mòŋ	'stir.V'		mòn-ɔ́	'stir-IPFV'
	CVN	-ni/-nɪ	kpìnnì	'quench.V'	-nV	kpìn-né	'quench-IPFV'
			zànnì	'learn.V'		zàn-ná	'learn-IPFV'
	CVG	-i/-ɪ	síɡí	'descend.V'	-rV	síg-rè	'descend-IPFV'
			dɔ́ɡí	'cook/boil.V'		dɔ́g-rɔ̀	'cook/boil-IPFV'
	CVR	-i/-ɪ	kpérí	'slice.V'	-V	kpé-rè	'slice-IPFV'
			sɔ́rí	'read.V'		sɔ́r-ɔ̀	'read-IPFV'
	CVL	-i/-ɪ	wùlì	'show.V'	-V	wùl-ó	'show-IPFV'
			zèlì	'lift.V'		zèl-ɛ́	'lift-IPFV'
CVVC	CVVR	-i/-ɪ	tùùrì	'pick.V'	-V	tùùr-ó	'pick-IPFV'
			sòòrì	'ask.V'		sòòr-ɔ́	'ask-IPFV'
	CVVL	-i/-ɪ	jíélì	'sing.V'	-V	jíél-!é	'sing-IPFV'
			tʊ́ɔ́lì	'send.V'		tʊ́ɔ́l-!ɔ́	'send-IPFV'
	CVVN	-i/-ɪ	gùùnì	'stalk.V'	-V	gùùn-ó	'stalk-IPFV'
			vòònì	'vibrate.V'		vòòn-ɔ́	'vibrate-IPFV'
CVCC	CVGR	-i/-ɪ	bìgrì	'describe.V'	-V	bìgr-é	'describe-IPFV'
			dɔ́grì	'punish.V'		dɔ́gr-!ɔ́	'punish-IPFV'
	CVGL	-i/-ɪ	zìglì	'seat.V'	-V	zìgl-ɛ́	'seat-IPFV'
			sɔ́glì	'hide.V'		sɔ́gl-!ɔ́	'hide-IPFV'
	CVNL	-i/-ɪ	tànlì	'hurry.V'	-V	tànl-á	'hurry-IPFV'
			pànlì	'weave.V'		pànl-á	'weave-IPFV'

The default form basically consists of a root and a final high vowel as a whole and that combination does not form additional base for suffixation. When it is expressed, no attention is paid to any internal temporal structure of the event/action being referred to.

Observe that there are CV(V)R, CV(V)L, CVNL, CVGR and CVGL verbal roots as in *sɔ́r-í* 'read/count, *wùl-ì* 'teach/show', *pànl-ì* 'weave', *dɔ́gr-ì* 'punish' and *sɔ́gl-ì* 'hide' respectively. At

first sight, it is easy to assume that the final R or L in such words constitutes part the suffix and so we will expect forms like *só-rí, wù-lì, pàn-lì, dóg-rì* and *sóg-lì*. However, I argue that these forms involve roots and a final vowel that is epenthetic. Evidence for my claim is based on agentive nominalisation via reduplication. Consider the following examples. If the verb is reduplicated, the final vowel is dropped.

(38)	Verb	Gloss	Root-RED-suffix	Gloss
	sórí	'read/count	sór-sór-ò	'one who reads/counts'
	wùlì	'teach/show'	wùl-wúl-ó	'one who teaches/shows'
	pànlì	'weave'	pànl-pánl-á	'one who weaves'
	dôgrì	'punish'	dôgr-dógr-!ó	'one who punishes'
	sóglì	'hide'	sôgl-sógl-!ó	'one who hides'

If we assume CV as the root for the CVR and CVL forms and consider CVG for the CVGR and CVGL forms, then we will predict incorrect forms such as *[só-só-rò], *[wù-wúl-ó], *[pàn-pán-lá] *[dôg-dóg-!ró] and *[sôg-sóg-!ló]. Additional evidence supporting my choice of root representation comes from final vowel deletion. In fast speech it is possible to delete the final vowel in all these cases, leading to *sór, wùl, pànl, dôgr* and *sôgl*. I should also mention that in some dialects, especially the one spoken in and around Jirapa, the word for 'weave' involves geminates as in *pàllì*. So, one would expect a reduplicated form like *pàll-páll-á* for 'one who weaves'.

With the imperfective, the suffix is always morphologically present unlike that of the default verb form. The suffix is made up of either just vowel or a consonant and a vowel. Some Mabia languages like Kɔnni (Cahill 1999); Suyire (Carlson 1994) and Buli (Kroger 1992) are reported to have two types of the suffixes marking imperfective. For Dagaare however, there are three allomorphs for the imperfective suffix with each having three variants. The suffix consonant is always a sonorant – either the liquid /r/ or the nasal /n/ which is completely determined by the verb root. The one major distinction between the default and imperfective suffix is that the default, if present is always the high front vowel [i/ɪ] irrespective of the form/shape of the vowels in the preceding root while the imperfective suffix is completely phonologically determined. For instance, the imperfective is consistently [-high] which is equally as predictable as the high front

vowel property of the default form and it harmonises with the root vowel in not only in [±ATR] but also [±round] and [±low] feature. Next is a discussion of the nominal morphology of Dagaare.

3.2.2   Nominal Morphology

A minimal noun in Dagaare contains a noun root and number suffix – singular or plural. The suffix may be overt or null if singular. A simple noun is schematised below with a corresponding example

(39)   [[ROOT] – [(SG/PL)]ₛᵤғғɪₓ]ₙₒᵤₙ

(40)   [[pɔ́g]ᵣₒₒₜ – [-ɔ]ₛᵤғғɪₓ]ₙₒᵤₙ

Structurally a Dagaare noun is as follows with corresponding examples for singular and plural forms of the noun 'woman'.

(41)   Structure of Dagaare noun
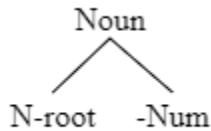
(42)   Examples
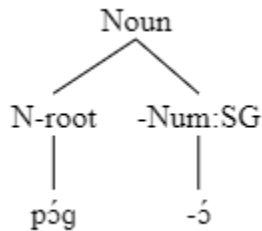
a.   Singular   b.   Plural
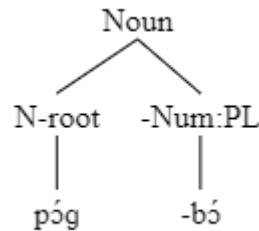
3.2.2.1 Nominal allomorphs

Dagaare involves a system of number suffixes which categorise nouns into ten classes (Ali et al., 2021; Bodomo, 1997; Bodomo & Marfo, 2006). The suffix allomorphs correspond to the class to which a given noun belongs. A learner may therefore be able to predict singular and plural suffixes for a particular noun by virtue of their knowledge of the noun class. Nominal inflection in Dagaare is coded by various morphemes. The form the allomorphs take to mark singular, and plural are given below and the exhaustive list corresponding to each form provided in table 3.4.

Table 3.3: Morphological expressions of noun classes

N-class	Form:SG	N-class	Form:PL
C1a$_{HUMAN.}$	-V	C1a$_{HUMAN}$	-bV$_{MID/LOW}$
C1b$_{KIN}$	-∅/-V/bV$_{Low}$	C1b$_{KIN}$	-mìné
C2.	-V	C2.	-ri/-rɪ , -ni/-nɪ
C3.	-V	C3.	-V$_{MID/LOW}$
C4.	-bV	C4.	-rV
C5.	-∅	C5.	-rV
C6.	-rV	C6.	V$_{MID/LOW}$, -bV$_{MID}$
C7.	-∅/V$_{HI/MID}$	C7.	-nɛɛ
C8.	-V	C8.	-V
C9.	-V/-bV/-nV	C9.	N/A
C10.	N/A	C10.	-Vŋ

This list of allomorphs is an illustration of each noun class and the form of morpheme they take to mark singular and plural. In the next table, the allomorphs are further listed explicitly demonstrating the segments that constitute each allomorph.

Table 3.4: List of N-classes in terms of allomorphy

N-class	Allomorph: SG	N-class	Allomorph: PL
C1a$_{HUMAN}$	-ɪ, -e/-ɛ, -ɔ	C1a.	-be/-bɔ/-ba
C1b$_{KIN.}$	-∅, -ɪ, -ɛ, -oo, -(b)a	C1b.	- mìné$_{C1.KIN}$
C2.	-i/-ɪ, -e/-ɛ , -o/-ɔ, -a	C2.	-ri/-rɪ , -ni/-nɪ
C3.	-i/-ɪ, -ii/-ɪɪ	C3.	-e/-ɛ, -o/-ɔ, -a
C4.	-bu/-bʊ	C4.	-ri/-rɪ
C5.	-∅	C5.	-ri/-rɪ
C6.	-ri/-rɪ	C6.	-e/-ɛ, -o/-ɔ, -a, -bo/-bɔ
C7.	-∅, -ɪ, -ɛ	C7.	-nɛɛ
C8.	-aa	C8.	-ɪ/-ɪɪ
C9.	-u/-ʊ/bu/-bʊ/-nuu/-nʊʊ	C9.	N/A
C10.	N/A	C10.	-uŋ/-ʊŋ

This list gives a clear view of the form of the consonants and vowels that occur as number suffixes in Dagaare. Unlike in the verbs which have a null or (C)V, in nouns, singular suffix is minimally null and maximally CV while the plural is minimally -V. These allomorphs will guide our

discussion of the noun class system of Dagaare. In the next section, I present the various nominal roots and the form of number suffixes they select.

3.2.2.2 Selection of nominal allomorphs

Similar to verbs, there are five main root types in Dagaare nouns: CV, CVV, CVC, CVVC and CVCC. Inside the CVC roots, there are CVR, CVL, CVN and CVG and within the CVVC roots, there exist CVVR, CVVL and CVVN but never a CVVG while the only case of CVCC involves a CVGL root. Selection of number allomorph depends on the shape of the nominal root. For CV roots, there are four patterns: one involves roots that have zero (-ø) number suffix for the singular form and -ri/-rɪ for plural form (= class 5). Another pattern involves CV roots which select -V suffix for the singular and -ri/-rɪ for the plural (= class 2). The third pattern involves CV roots which select -ri/-rɪ to mark singular and select -V to mark plural (= class 6). This pattern is what is referred to as inverse number– a system in which a number morpheme which encodes singular interpretation for some nouns while for other nouns it encodes plural interpretation (Grimm 2012, 2020). Finally, there is a small set of nouns in which CV roots select -bu/-bʊ to mark singular and -ri/-rɪ for plural (= class 4). With CVV roots, there are roots that have a null suffix for the singular and for the plural they select -ri/-rɪ or -nɛɛ depending on the class of the noun. This involves class 5 or class 7. There is another pattern involving a CVV root that always has the mid long vowel [oo/ɔɔ]. This root selects -ri/-rɪ to mark singular and -bo/-bɔ for plural – a subset of class 6.

As stated above, both CVC and CVVC roots involve roots ending in the consonants [r, l, n]. All roots ending with [l, r] – CVR, CVL, CVVR, CVVL – select -V to mark singular and plural. Similarly, the root CVGL always selects -V suffix for the singular and plural. The -V here can either be a high front vowel or a non-high vowel agreeing in back, rounding and low feature. As for CVG roots, there are two main patterns: (i) one involves roots that select a vowel to mark singular and *-ri/-rɪ* for the plural (ii) another pattern involves CVG roots that select *-ri/-rɪ* to encode singular and a vowel for plural. This is another case of inverse number marking. For CVN roots, they select a -V to mark singular and may select a (N)V for the plural. There are also some two CVN roots which select -V to mark singular and *-nɛɛ* for plural particularly for granular mass nouns. Moreover, CVN roots that end with the bilabial nasal may select *-bu/-bʊ* for the singular and -V for the plural. With CVVN roots, both singular and plural are signaled with a -V. In the table below, I show the shape of nominal roots and the kinds of number suffixes they select. It

represents the more general and productive and regular non-human nouns in the language. Human, kinship, event, mass and abstract nominals are presented in a separate table due to their special semantic nature.

Table 3.5: Nominal roots and allomorph selection

		Singular			Plural		
Form	Root	suffix	Example	Gloss	Suffix	example	Gloss
CV	CV	-∅	zû	'head.SG'	-ri/-rɪ	zú-rì	'head-PL'
		-V	bí-é	'child-SG'	-ri	bíí-rí	'child-PL'
		-ri/-rɪ	bí-rì	'seed-SG'	-V	bí-è	'seed-PL'
CVV	CVV	-∅	túú	'forest.SG'	-ri/-rɪ	túú-rí	'forest-PL'
		-∅	dáầ	'alcohol.SG'	-nɛɛ	dáá-!nɛ́ɛ́	'alcohol(types)-PL'
		-ri/-rɪ	kɔ́ɔ́-rí	'bone-SG'	-bɔ	kɔ́-bɔ́	'bone-PL'
CVC	CVR	-V	ɲír-áá	'ant-SG'	-V	ɲír-í	'ant-PL'
	CVL	-V	pɔ̀l-í	'path-SG'	-V	pɔ̀l-ɔ́	'path-PL'
	CVN	-V	pɛ̀n-í	'abdomen-SG'	-V	pɛ̀m-ɛ́	'abdomen-PL'
		-V	lɔ́ŋ-ɔ́	'frog-SG'	-ni/-nɪ	lɔ́n-ní	'frog-PL'
		-V	tɛ́n-í	'soil-SG'	-nɛɛ	tɛ́n-!nɛ́ɛ́	'soil (types)-PL'
		-bʊ	zɔ́m-bʊ́	'fish-SG'	-V	zɔ́m-à	'fish-PL'
	CVG	-V	pɛ́g-í	'shell-SG'	-ri/-rɪ	pɛ́g-rí	'shell-PL'
		-ri/-rɪ	lúg-rí	'pillar-SG'	-V	lúg-ó	'pillar-PL'
CVVC	CVVR	-V	fʊ̀ʊ̀r-áá	'lung-SG'	-V	fʊ̀ʊ̀r-íí	'lung-PL'
	CVVL	-V	ʤìíl-í	'tendon-SG'	-V	ʤììl-é	'tendon-PL'
	CVVN	-V	ŋmààŋ-à	'monkey-SG'	-V	ŋmàán-ì	'monkey-PL'
CVGL	CVGL	-V	kpágl-í	'bedbug-SG'	-V	kpágl-á	'bedbug-PL'

Human and kinship nouns, which constitute distinct semantic class, have similar root shapes as the other nouns but they have dedicated plural suffixes. Human nouns have the following roots: CVV, CVN, CVG, CVVR and CVVN. With the exception of the CVV root which has a zero-singular suffix, all other roots of the human nouns select a -V to mark singular and then they select the dedicated suffix -bɔ/-ba to mark plural. Similarly, kinship nouns have the roots: CV, CVV, CVR, CVVR, CVVN. The CV and CVV roots of kinship nouns are zero-marked for singular while the

other roots generally select a vowel for singular. There is also one example of kinship noun that takes *-ba* to mark singular. For the plural, all roots for kinship nouns select the morpheme *-mine*. Though this morpheme *-mine* is used to express plurality for kinship nouns, it is not clear if it is actually a suffix, given that it fails to harmonise with the root to which it is attached. It seems like a word-level morpheme unlike -ri/-rɪ etc which are root-level.

Table 3.6: Human and kinship nouns and allomorph selection

	Singular			Plural		
Root	Suffix	Example	Gloss	Suffix	Example	Gloss
CVV	-∅	dɔɔ́	'man.SG'	-bɔ	dɔ́-bɔ́	'man-PL'
CVN	-V	sɛ́n-í	'fiancé-SG'	-ba	sɛ́n-bá	'fiancé-PL'
CVG	-V	pɔ́g-ɔ́	'woman-SG'	-bɔ	pɔ́g-bɔ́	'woman-PL'
CVVR	-V	kʊ́ɔ́r-áá	'farmer-SG'	-bɔ	kʊ́ɔ́r-bɔ́	'farmer-PL'
CVVN	-V	sáán-à	'stranger-SG'	-ba	sáám-!bá	'stranger-PL'

Root	Suffix	Example	Gloss	Suffix	Example	Gloss
CV	-∅	má	'mother.SG'	-mìné	má-mìné	'mother-PL'
		bâ	'father.SG'		bâ-mìné	'father-PL'
CVV	-∅	jɔ́ɔ̀	'sibling.SG'	-mìné	jɔ́ɔ́-mìné	'sibling-PL'
CVVR	-V	bíɛ́r-ì	'brother-SG'	-mìné	bíɛ́r-mìné	'brother-PL'
CVVN	-V	kpíɛ́m-ɛ́/-á	'sister-SG'	-mìné	kpìɛ̀m-mìné	'sister-PL'

Event or action nominals are also distinct from the regular nouns in some ways. Event nominals never occur in plural form. They have a particular dedicated singular suffixal allomorph. All V-final roots for event/action nominals always take the suffix *-bu/-bʊ* to derive nouns. Thus, CV and CVV roots always select *-bu/-bʊ* with the CV root always resulting in vowel lengthening if the root vowel is high or low and diphthongisation if the root vowel is mid. All roots ending with [r, l] may select the high back vowel *-u/-ʊ* or *-bu/bʊ*. All nasal-final roots with alveolar [n] always select the suffix *-nuu/-nʊʊ* and the /ŋ/ in ŋ-final roots become [m] after selecting *-bu/-bʊ* as suffix. Finally, CVG roots select *-bu/-bʊ*. Here is a table showing the selection of nominalizing suffixes by various root types.

Table 3.7: Event/action nominals and allomorph selection

Form		Root	Gloss	Suffix	Example	Gloss
CV	CV	tú-	'dig'	-bu/-bʊ	túú-bù	'dig-NMLZ'
		tʊ́-	'insult'		tʊ́ʊ́-bʊ̀	'insult-NMLZ'
		zá-	'throw'		záá-bʊ̀	'throw-NMLZ'
CVV	CVV	tùò-	'carry'	-bu/-bʊ	túó-bú	'carry-NMLZ'
		jɔ́ɔ́-	'pay'		jɔ́ɔ́-bʊ̀	'pay-NMLZ'
CVC	CVR	fìr-	'force'	-bʊ	fír-bʊ́	'force-NMLZ'
		vár-	'castrate'		vár-bʊ̀	'castrate-NMLZ'
	CVL	vɔ́l-	'swallow'	-bu/-bʊ	vɔ́l-bʊ́	'swallow-NMLZ'
		wùl-	'show/teach'		wúl-bú	'show/teach-NMLZ'
	CVG	pùg-	'praise'	-bu/-bʊ	púg-bú	'pray-NMLZ'
		dʊ́g-	'cook'		dʊ́g-bʊ̀	'cook-NMLZ'
	CVN	kpìn-	'extinguish'	-nuu/-nʊʊ	kpìn-núú	'extinguish-NMLZ'
		zàn-	'learn'		zàn-nʊ́ʊ́	'learn-NMLZ'
		nòŋ-	'like/love'	-bu/bʊ	nʊ́m-bʊ́	'like/love- NMLZ'
CVVC	CVVR	tùùr-	'pick'	-uu/-ʊʊ	tùùr-úú	'pick-NMLZ'
		kòòr-	'snore'		kòòr-ʊ́ʊ́	'snore-NMLZ'
	CVVL	fúòl-	'whistle'	-uu/-ʊʊ	fúól-!úú	'whistle-NMLZ'
		mààl-	'make'		mààl-ʊ́ʊ́	'make-NMLZ'
	CVVN	gùùn-	'stalk'	-uu/-ʊʊ	gùùn-úú	'stalk-NMLZ'
		vòòn-	'vibrate'		vòòn-ʊ́ʊ́	'vibrate-NMLZ'
CVCC	CVGR	dɔ̂gr-	'punish'	-uu/-ʊʊ	dɔ́gr-!ʊ́ʊ́	'punish-NMLZ'
	CVGL	sɔ̂gl-	'hide'	-uu/-ʊʊ	sɔ́gl-!ʊ́ʊ́	'hide-NMLZ'

The choice of the nominalizing suffix is dialect-specific. In some varieties of Central Dagaare such as the Jirapa dialect, the high back vowel [-u/ʊ] is generally selected by all root types except for roots ending in [m] which may select -mu/mʊ to derive nouns from verbs. For instance, *túú-bù* in our present data is represented as *túú-ù* and *nʊ́m-bʊ́* is transcribed as *nʊ́m-mʊ́* in other dialects. Moreover, observe that the suffix is generally long after sonorant-final roots. This is in slight

contrast to what Anttila & Bodomo (2019) observed in the Jirapa dialect where the nominalizing suffix is long after a C-final root.

Mass non-count nouns involve CVVC (i.e. CVVR, CVVL) roots with the dedicated suffix -uŋ/-ʊŋ. The suffix is perceived as encoding plurality as there is no marker of singularity. With abstract nouns, there CVV, CVG, CVN and CVVL roots. The suffix is (C)Vŋ – uŋ/-ʊŋ, -luŋ/-lʊŋ, -ruŋ/-rʊŋ, -nuŋ/-nʊŋ. CVV root recruit -luŋ/-lʊŋ to signal singular, CVG take -ruŋ/-rʊŋ suffix, CVN take -nuŋ/-nʊŋ and CVVL roots take -uŋ/-ʊŋ. The suffix here involves marking singular given that abstract nominals do not have plural forms. Table 3.8 gives an illustration of the above description.

Table 3.8: Mass non-count and abstract nouns

Form		Root	Gloss	Suffix	Example	Gloss
CVVC	CVVR	vóòr-	'breathe'	-ʊŋ	vóór-!óŋ	'breath'
	CVVL	buul-	'stir'	-uŋ	búúl-úŋ	'porridge'
Form		Root	Gloss	Suffix	Example	Gloss
CVV	CVV	fáá-	'bad'	-lʊŋ	fàà-lôŋ	'badness'
CVC	CVG	wêg-	'tall'	-rʊŋ	wɛ́g-!róŋ	'tallness'
	CVN	sôŋ-	'good'	-nʊŋ	sòn-nóŋ	'goodness'
CVVC	CVVR	tíɛr-	'think'	-ʊŋ	tíɛr-!óŋ	'thought'
	CVVL	vìèl-	'beautiful'	-ʊŋ	vìèl-óŋ	'beauty'

Observe that the mass non-count nouns are derived from verbs while abstract nouns are derived from adjectives and verbs. Having presented the nominal root types and the form of allomorphs they select; I now present the various noun classes in Dagaare.

3.2.2.3 Noun classes and number

This section examines noun classes and how number is marked in Dagaare. A noun class system may be said to manifest in a particular language if that language has grammatical gender or if the nouns can be categorized in terms of concord or affix marking. The classification and discussion of nouns has been a subject of interest in a number of Mabia languages. Some of these languages include Lama (Ourso, 1989a), Buli (Kröger, 1992), Supyire (Carlson, 1994, 2011), Konni (Cahill, 1999), Gurene (Nsoh, 2002), Waali (Brindle, 2015), Kusaal (Abubakari, 2021) and others. For a general typological discussion of noun classes in languages within and outside of Africa, see Heine

et al (1981), Dixon (1986), Creissels (2000), Heine & Nurse (2000), Hurskainen (2000), Grinevald & Seifart (2004). In terms of typological studies of noun classes in specific language families, see Katamba (2003) and Maho (1999) for Bantu languages, Güldemann & Fiedler (2019) and Hepburn-Gray (2020) for Niger-Congo languages in general, De Wolf, (2017) for Benue-Congo and (Creissels, 2019) for Atlantic-Congo languages.

In Dagaare, various studies of the nominal system are found in Angkaaraba (1980), Bodomo (1997), Bodomo & Marfo (2006), Grimm (2012, 2021). The criterion for categorizing nouns in Dagaare is based on number – singular and plural marking. There are two ways by which nouns can be categorized in Dagaare. One method is by classifying nouns in terms of similarity of their singular and their plural suffixes. The other method is by classing nouns based on the similarity of both the singular and the plural. Following the former criterion, Angkaaraba (1980) establishes nine noun classes based on singular marking and eleven noun classes based on plural marking in Dagaare. Bodomo (1997) and Bodomo & Marfo (2006) proposes a ten-noun class system (summarised in the table 3.9 below) in Dagaare based on the latter criterion, arguing that number formation occurs via morphophonological properties in which phonological rules apply to underlying morphological structures which lead to the true surface lexical representations.

Table 3.9: Dagaare noun classes (Bodomo 1997; Bodomo & Marfo 2006)

Singular classification	Plural classification	
1. V-suffix	1.-bV	
2. V-suffix	2.-ri/-rɪ	
3. -i/-ɪ	3. V-suffix	
4. -rʊ	4.-rɪ	
5. -∅ suffix	5.-ri/-rɪ	
6. -ri	6. -V	
7. Nasalized-NV	7. Nasalized-NV	
8. -aa	8.-i/-ɪ,	
9. -ʊ		
	9. -uŋ/-ʊŋ,	

From a lexical semantic point of view, Grimm (2010, 2012, 2021) proposes four main classes, namely basic singular, basic plural, non-count singulative and mass. This analysis shows that inverse number patterns in Dagaare reflects lexical semantic contrasts based on individuation and based on which nouns mark singular/plural with -ri/rɪ or with a vowel. Thus, according to Grimm, nouns describing entities typically occurring singly are basic singular and are individuated. Such nouns mark plural with [-ri/-rɪ] e.g., *zû - zú-rì* 'head – head-SG'. Then nouns that are likely viewed in pairs or groups are basic plural. In these cases, the suffix [-ri/-rɪ] codes singular as in *bí-rì - bí-è* 'seed – seeds' while mass nouns combine with the distinctive and dedicated morpheme *-nɛɛ* to designate 'types of X' for granular and liquid mass nouns such as *kʊ̀ɔ́ – kʊ̀ɔ̀-nɛ́ɛ́* 'water (types)'.

This chapter builds on the proposals of previous studies and presents a discussion of the noun classes in Dagaare with the aim of integrating the morphophonological and lexical approaches to the analysis of nominal allomorphy. The description is based on the second method in which nouns in the same class must have similar singular suffixes and similar plural suffixes. As stated in chapter 1, it is crucial to reiterate that the data presented here is primarily based on the variety of Central Dagaare spoken in the Sombo area (Nadowli-Kaleo district, Ghana). Therefore, although there may be major similarities in terms of properties such as tone and tongue root harmony between the data in this variety and data in other Central Dagaare varieties, it must be noted that there is bound to be slight segmental variations.

Moreover, while agreeing with previous claims (e.g. Bodomo 1997) that Dagaare has a ten-noun-class system, I propose that these ten classes are categorised into three major classes: (i) a phonological class which consists of class 3 and class 8 (ii) a phono-semantic class which is made up of classes 2, 4, 5, 6 and finally (iii) a semantic class which is made up of the classes 1, 7, 9 and 10. All classes have equipollent contrast except class 9 which has privative singular and class 10 which has both privative singular and plural cases. By equipollent, it simply means that each noun in a particular class is distinguished by different number features – singular vs plural. With privative contrast, the nouns in class 9 are characterized by the presence of singular and the absence of plural and those in class ten 10 are characterized by absence of singular and presence of plural. In the table below I show each noun class and its properties in terms of semantics, contrast, singular and plural allomorphs.

Table 3.10: Dagaare noun class summary

I.	**Phonologically conditioned number marking**						
Class	**Semantic**	**Contrast**	**Root**	**-SG suffix**	**allomorphs**	**-PL suffix**	**Allomorphs**
3	count	equipollent	CVC{C=R, L,N} CVGL CVVC{C=R, L,N}	-V	-i/-ɪ	-V	-e/-ε, -o/-ɔ, -a
8	count	equipollent	CVC{C=r, l, n} CVVC{C=R, L, N}	-V	-aa	-V	-i/-ɪ
II.	**Phono-semantically conditioned number marking**						
Class	**Semantic**	**Contrast**	**Root**	**-SG suffix**	**allomorphs**	**-PL suffix**	**Allomorphs**
2	Count; individuated	equipollent	CV CVN CVG	-V	-i/-ɪ, -e/-ε, -o/-ɔ, -a	-CV	-ri/-rɪ -ni/-nɪ
4	Count: individuated	equipollent	CV	-CV	-bu/-bʊ	-CV	-ri/-rɪ
5	Count: individuated	equipollent	CV CVV	-∅		-CV	-ri/-rɪ
6a 6b	Count: non-individuated	equipollent	CV CVV CVG	-CV	-ri/-rɪ	-(C)V	-e/-ε, -o/-ɔ, -a -bɔ
III.	**Semantically conditioned contextual number marking**						
Class	**Semantic**	**Contrast**	**Root**	**-SG suffix**	**allomorphs**	**-PL suffix**	**Allomorphs**
1a 1b	count: human count: kinship	equipollent	CV, CVC, CVVC	-V -(C)V, -∅	-ɪ, -e/-ε, -ɔ,-a -oo, -ba	-CV -CVCV	-be/-bɔ/-ba -mine
7a 7b	mass: liquid mass: solid	equipollent	CVV CVC	-∅ -V	- -ɪ, -ε	 -CV	 -nεε
9	event nominalisation	privative: SG	CVV, CVC, CVVC	-(C)V	-bu/-bʊ, -nuu/nʊʊ -uu/-ʊʊ	N/A	N/A
10a	mass: liquid/solid	privative: PL	CVC, CVVC	N/A	N/A	-VC	-uŋ/-ʊŋ
10b	abstract nouns	privative: SG	CVV, CVC, CVVC	N/A	N/A	-(C)VC	-luŋ/-rʊŋ

The major phonological general rules as proposed in Bodomo & Marfo (2006) that result in the surface representations of nouns in each class include.

(43)   Major rules

    a. Vowel harmony: V_{sfx} →   [±ATR] / V_{ROOT} _____

                                            [±ATR]

    b. Vowel lengthening: i. V   →   VV / C ____ ri/rɪ

                                  ii. V   →   VV / C ____ (b) u/ʊ

In (43a) the vowel harmony determines that suffixal vowels agree in tongue root value of the root to which it is attached. For the vowel lengthening rule, a short vowel in a CV root for specific noun classes lengthens when it takes the suffix -ri or -bu. The vowel harmony is present in all classes except for kinship nouns. In kinship nouns, the root does not always agree with the plural morpheme *-mine*. The lengthening rule will be observed with some specific noun classes such as class 2 and class 9. There are also local rules for each class, and this will be illustrated.

3.2.2.3.1 Phonological class

This group contains nouns whose root always end in sonorant consonants [r, l, n] with both singular and plural marked with a vowel but with contrast in vowel quality. It is the only class with nouns which mark both singular and plural with vowels. It is made up of class 3 and class 8. First, I present class three.

3.2.2.3.1.1 Class 3: singular: -i/-ɪ; plural: V{-e/-ɛ, -o/-ɔ, -a}

A high front vowel is added to the noun root to form singular, and the plural is formed by adding a non-high vowel. The singular vowel may be short or long, and aside from agreeing in tongue root feature, the suffix does not agree in whatever shape the preceding root vowel assumes. This is similar to what is observed with the high front vowel in the default verb forms. Thus, it appears the high vowel in these nouns do not really have any semantic content, given that by themselves the roots can express complete meaning. For instance, *pɔ̌l* without the final high *-ɪ* expresses the same meaning 'path' as *pɔ̀l-í*. The plural vowel however is phonologically conditioned by the quality of the preceding root vowel. For instance, when the root contains a round vowel, the plural suffix is realised as round and when the root has a low vowel, the suffix vowel is always low. In other words, the plural is marked by a vowel that is underlyingly [-high] where, [round] and [low]

values are determined by the root. This is the exact same pattern observed with the imperfective suffix on verbs. The plural suffix is obligatory, and it carries a meaning. Therefore, dropping the plural suffix vowel does not retain the plural meaning; rather it changes to mean singular. The root of each noun is determined by modifying the noun with an adjective.

Root	Singular	Plural	Gloss	Evidence for root representation	
bìr-	bìr-í	bìr-έ	'breast'	bìr-bíl-é	'small breast'
ʤìíl-	ʤìíl-í	ʤìíl-é	'tendon'	ʤìíl-bíl-é	'small tendon'
kper-	kpér-íí	kpér-éé	'gizzard'	kpèr-bíl-é	'small gizzard'
fer-	fér-íí	fér-éé	'air potato'	fèr-bíl-é	'small air potato'
pòl-	pòl-í	pòl-ɔ́	'path'	pòl-ŋmáá	'short path'
jùòn-	jùòn-í	jùòm-ó	'year'	jùòn-fáá	'bad year'
dòɔ́l-	dòɔ́l-í	dòɔ́l-ɔ̀	'mudfish'	dòɔ̂l-bìl-é	'small mudfish'
pan-	pán-í	pám-á	'door'	pàm-bíl-é	'small door'
màn-	màn-í	màm-á	'sea/ocean'	màm-bíl-é	'small sea/ocean'
gán-	gán-ì	gám-à	'book'	gám-bíl-é	'small book'
kpagl-	kpágl-í	kpágl-á	'bedbug'	kpàgl-bíl-é	'small bedbug'

In addition, the plural marker is always a copy of the immediately preceding root vowel if the root vowel is non-high. So, in a case where the root contains a diphthong, the plural suffix is always a copy of the second vowel in the diphthong. However, when the root vowel is high, then the plural vowel is always mid. In this class, I propose that the singular formation involves deletion of underlying /r/. That is, /r/ in underlying /ri/ is deleted after a root-final sonorant consonant. The following rule ensures this deletion: /r/ → [∅] / [+son, +cons] ____ #. An illustration of how this rule works is provided below.

(44)   Singular formation via r-deletion

UR:	/bɪr-rɪ/	/ʤiil-rɪ/	/man-rɪ/
r-deletion:	bɪr-ɪ	ʤiil-ɪ	man-ɪ
ATR harmony:	-	ʤiil-ɪ	-
SR:	[bìr-í]	[ʤìíl-í]	[màn-í]
Gloss:	'breast'	'vein'	'sea/ocean'

An observation in the nasal-final roots is the presence of [m] in the plural forms as in *gán-ì - gám-à* 'book'. That is, the root final /n/ in the singular becomes [m] in the plural. This raises the question of how the final alveolar nasal /n/ in the singular form becomes a bilabial nasal [m] in the plural form. One way of approaching this is to assume that the plural suffix has an underlying floating [+LAB] feature and a vowel specified as [-high]. Then the [+LAB] feature gets linked to the root node in order to be realized on the surface. The following representation captures the cases in class three above.

(45)   Floating [+LAB] linking leading to plural suffix

C]   V

+nas   +LAB   [+lo, -high]

Another possible explanation is that the plural suffix has an underlying /mV/ attached to the n-final root. Then due to assimilation, the final /n/ is realized as [m]. Moreover, as a result of harmony the suffix surfaces identically as the final vowel in the root. Finally, nasal shortening leads to the surface representation of the noun. This is illustrated below.

(46)   Plural formation

UR:	/gan-mV/	/juo-mV/
Vowel copying:	gan-ma	juom-mo
Nasal assimilation:	gam-ma	juom-mo
Nasal shortening:	gam-a	juo-mo
SR:	[gám-à]	[jùòm-ó]
Gloss	'book'	'year'

A third analytical possibility is to assume that the labial is part of the root as in /gam-rɪ/. Then we see assimilation happening in the singular for as follows: /gam-rɪ/ → ganrɪ → [gánì]. This approach does not involve the assumption of a suffix allomorphy with -mV suffix. In terms of the plural, what we see is the usual non-high vowel which is a copy of the last root vowel.

3.2.2.3.1.2 Class 8: singular: -əə/-aa; plural -i/-ɪ

In this class nouns mark singular by a long low vowel, [-əə/-aa] and mark the plural with a front high vowel -i/-ɪ which may be long or short. As mentioned already roots in this class are sonorant-final with [r,l, n] just like the class discussed before.

Root	singular	plural	Gloss		Evidence for root representation
ɲɪr-	ɲír-áá	ɲír-í	'ant'	ɲìr-zìɛ́	'red ant'
bɪl-	bíl-áá	bíl-íí	'anthill'	bìl-bíl-é	'small anthill'
gɔr-	gɔ́r-áá	gɔ́r-íí	'sickle'	gɔ̀r-bíl-é	'small sickle'
bɛr-	bɛ́r-áá	bɛ́r-íí	'trap'	bɛ̀r-bíl-é	'small trap'
dààŋ-	dààŋ-áá	dààn-í	'hearth'	dààm-bíl-é	'small hearth'
paaŋ-	pááŋ-áá	páán-í	'cricket'	pààm-bíl-é	'small cricket'

With the plural suffix in this class, some speakers of the dialect under investigation may alternate the high front vowel -i/-ɪ with the CV suffix, -hi/-hɪ. Therefore, it is possible to have forms like *bíl-íí ~ bíl-hí* 'anthill',*kpăl-îì ~ kpăl-hì* 'sling', *sìl-íí ~ sìl-hí* 'hawk' . These alternations in the plural marking contrasts with consonant doubling (gemination) in some dialects for the same nouns. For example, in the Central dialect spoken in and around Jirapa, the plural for 'anthill' is *bíl-lí*; sling is *kpăl-lí* and hawk is *sìl-lí*.

3.2.2.3.2 Phono-semantic class

Nouns in this group involve vowel final and consonant-final roots. Singular may be coded by ø, or (C)V suffix while plural is marked by (C)V suffix. The CV suffix is realised as -ri/-rɪ when attached to a root with a final oral segment or it becomes -ni/-nɪ after a nasal-final root. I refer to the nouns in this group as phono-semantic because on the one hand, in their number marking processes, they exhibit some phonological properties such as assimilation, vowel length and harmony and on the other hand they display lexical semantic contrasts based on individuation – a semantic notion in which the structure of nouns reflects countability based on individuality.

3.2.2.3.2.1 Class 2: singular V{-i/-ɪ, -e/-ɛ, -o/-ɔ, -a}; plural: CV{-ri/-rɪ, -ni/-nɪ}

The nouns in this class involve vowel-final and consonant final roots. As the data shown below, the singular nouns are formed by adding a vowel and the plural by adding a CV suffix which may either be *-ri* or *-ni* depending on the root. Consonant-final roots in this class either end with the velar stop [g] or velar nasal [ŋ]. The plural suffix is realized as *-ri/rɪ* when the final root consonant is [g] and it surfaces as *-ni/-nɪ* when the root ends with [ŋ]. V-final roots ending with non-low vowels become diphthongs when the singular suffix is added while the plural takes *-ri/-rɪ* accompanied by high vowel lengthening. Roots with low vowels generally add low vowels to mark the singular, though there are some cases in which some low-vowel roots take high back vowels as singular suffix as in *wà-ʊ́ - wàà-rí* 'yam'; *dà-ʊ́ – dàà-rí* 'stick/wood'.

Root	Singular	Plural	Gloss	Evidence for root representation	
bi-	bíé	bíí-rí	'child'	bì-fáá	'bad child'
zi-	zíé	zíí-rí	'place'	zì-fáá	'bad place'
tò-	tùó	tò-rí	'baobab'	tò-kpêŋ	'big baobab'
dò-	dùó	dò-rí	'warthog'	dò-bíl-é	'small warthog'
ɲá-	ɲáà	ɲáá-rì	'chest'	ɲá-!bíl-é	'small chest'
bà-	bàá	bà-rí	'river'	bà-bíl-é	'small river'
sɪg-	sígí	síg-rí	'hut'	sìg-bíl-é	'small hut'
gòŋ-	gòŋó	gòn-ní	'silk cotton'	gòŋ-wɛ́g-ì	'tall silk cotton'
dʊŋ-	dʊ́ŋɔ́	dòn-ní	'mosquito'	dòm-bíl-é	'small mosquito'
taŋ-	táɲá	tán-ní	'mountain'	tàm-bíl-é	'small mountain'

A noun in Dagaare is minimally bimoraic (Anttila & Bodomo 2009). Therefore, the vowel addition or insertion in the CV roots is a response to the bimoraicity requirement in Dagaare nouns.[2]

In addition to tongue root harmony between roots and suffixes, other phonological processes that manifest in this noun class include rounding harmony and [±low] in the singular form: /V/→ [αrnd] / αrnd ___. There is also high vowel lengthening before *-ri/-rɪ* involving plurals: $V_{[+high]}$ → VV/ C ___ -ri and finally there is total assimilation in which an onset takes on the features of a preceding

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[2] Note that there are a few nouns (5) that are monomoraic as in *zû* 'head', *nû* 'hand', but the general tendency is that majority of Dagaare nouns are minimally bimoraic.

nasal coda. So, /r/ in /-ri/- becomes [n] after a nasal consonant: /r/ → [n]/ nasal __. This assimilation therefore results in geminates (double consonants) as the data shows.

In Bodomo (1997) and Bodomo and Marfo (2006), the nouns with nasal geminates are categorized in what they term as 'nasal class' probably on the grounds that all the nouns in that class have nasal-final or nasalized roots and affixes. However, in this study, I categorize some of the nouns in the 'nasal class', especially those that have suffixal *-ni/-nɪ,* in the same class with the nouns having *-ri/-rɪ* as plural suffix. This idea is based on the fact that the two suffixes are phonologically regular variants of the same morpheme. They only change shape based on the phonological environment in which they occur. That is their surface forms are phonologically conditioned by the neighbouring sound segments. In effect, while nouns such as *dʊ́ŋɔ́ – dʊ́n-ní* 'mosquito' belong to nasal class 7 under Bodomo and Marfo, I treat such nouns as belonging to the same class 2 as those that mark plural with -ri/rɪ. Now let us turn our attention to class 4 below.

3.2.2.3.2.2 Class 4: singular: -bu/-bʊ; plural: -ri/-rɪ

Root	Singular	Plural	Gloss	Evidence for root representation	
wá-	wáá-!bʊ́	wíí-rì	'snake'	wá-bíl-é	'small snake'
vá-	váá-!bʊ́	váá-rì	'leaf'	vá-zìɛ́	'red leaf'
gǒ-	gùó-bú	gùó-rì	'kola'	gǒ-tʊ́ɔ́	'bitter kola'

This class constitutes a small set of nouns where the singular is marked with a -bV and the plural with -ri/-rɪ. In other closely related dialects such as Jirapa (see Bodomo 1997; Bodomo and Marfo 2006), the singular in this class is marked with the high back vowel, *-u/-ʊ* like *wáá!ʊ́* 'snake', *gùóú* 'kola' and and Waali (see Brindle, 2015) the suffix is *-hu/-hʊ* as in *wáá-!hʊ́*. The presence of the -bu suffix is possibly a repair strategy against sequence of more than two vowels in this variety of the Central dialect. Therefore, based on our current data, it is clear that this dialect disallows vowel sequences like CVVV. Also note the instance of regressive harmony or metaphony in a root like *wa-* 'snake' which raises to *wíí-* when it precedes the high vowel suffix, *-rɪ* leading to *wíí-rì*. The change of the root vowel therefore appears to be influenced by the suffix in the process of assimilation. This raising of the vowel may be attributed to some diachronic property that this word historically involved high vowels.

3.2.2.3.2.3 Class 5: singular: ø; plural: CV{-ri/-rɪ,-ni/-nɪ}

In class 5, the singular forms are exactly the same as the roots. There appears to be no alternation, so a zero suffix is assumed for the singular forms. The plural is marked by -ri/-rɪ and sometimes accompanied by high vowel lengthening. Though the CV forms in this class counters the claim that nouns in Dagaare are minimally bimoraic, the general idea is that the majority of nouns have at least two moras.

Root	Singular	Plural	Gloss	Evidence for root representation	
zú	zû-ø	zú-rì	'head'	zú-!bíl-é	'small head'
nú-	nû-ø	núú-rì	'hand'	nú-wɛ́g-ì	'long hand'
gbó-	gbô-ø	gbó-rì	'heart'	gbó-!bíl-é	'small heart'
wɔ́ɔ́-	wɔ́ɔ̀-ø	wɔ́ɔ́-rì	'elephant'	wɔ́ɔ́-!bílé	'small elephant'
laa-	láá-ø	láá-rí	'bowl'	làà-bíl-é	'small bowl'

In summary, except for the tongue root harmony which manifests in all classes with the exception of kinship nouns of class 1, the phonological properties observed in these classes include nasal assimilation with the plural suffix for class 2 and 5; rounding harmony with singular suffix for class 2 and intervocalic b in the singular forms of class 4 as a repair strategy against CVVV vowel sequences. Class 4 also shows regressive harmony which may be a result of diachronic reasons.

In terms of semantic properties, these classes (2, 4, 5) are what Grimm (2010, 2012, 2021) describes as individuated. In the sense of Grimm, these are nouns which are described as **basic singular** because they denote entities typically occurring singly. Nouns that occur singly always mark plural with *-ri/-rɪ* as in *bíí-rí* 'child-PL*, zú-rì*, 'head-PL', wíí-rì 'snake-PL'. The next class provides examples that are precisely opposite to the classes described above.

3.2.2.3.2.4 Class 6: singular: -ri/-rɪ; plural: -V{-e/-ɛ, -o/-ɔ, -a}, -bV{bo/-bɔ}

This is a morphologically regular class. Here roots combine with the suffix *-ri/-rɪ* to form the singular and they combine with a mid-vowel to form the plural. This class in direct inverse relation to class two in which vowels mark singular and *-ri/-rɪ* marks plural. The nouns in this class are categorized into three subclasses. As will be shown below, there is a subclass in (a) involving V-final stems; if the final vowel is high, it sometimes gets lengthened when the singular suffix *-ri* is attached. If the final vowel is mid, it becomes a diphthong when the singular suffix is added. In

terms of the plural formation, there is vowel shortening regardless of whether the vowel is high or mid. If the root ends with a low vowel [a], the final vowel in the plural is created by a coalescence of low and mid vowel (e.g. sáárì – sɛ́-ɛ̀ [= sá-ɛ̀] 'broom')

Class 6a: Singular: -ri/-rɪ; plural: -e/-ɛ

Root	Singular	Plural	Gloss	Evidence for root representation	
jí-	jí-rì	jí-è	'house'	jí-!bíl-é	'small house'
mí-	mí-rì	mí-è	'rope'	mí-!ŋmáá	'short rope'
zɛ̀-	zìɛ̀-rí	zɛ̀-ɛ́	'soup'	zɛ̀-nɔ̀ɔ́ŋ	'tasty soup'
nɛ́-	níɛ́-rì	nɛ́-ɛ̀	'grinder'	nɛ́-!bíl-é	'small grinder'
sá-	sáá-rì	sɛ́-ɛ̀ (sá-ɛ̀)	'broom'	sá-!bíl-é	'small broom'
dá-	dá-rì	dɛ́-ɛ̀ (dá-ɛ̀)	'ladder'	dá-!ŋmáá	'short ladder'

Another subclass of class six involves roots that always contain long mid vowel *-oo/-ɔɔ*. The singular is then formed by adding *-ri/-rɪ* and plural by adding *-bo/-bɔ*. The examples below can all fit into the templates $CVV_{[+rd, -hi]}$ - $rV_{[+hi]}$ for the singular and $CV_{[+rd, -hi]}$ - $bV_{[+rd,-hi]}$ in the plural. The phonological processes involved in these cases are vowel lengthening and vowel shortening after the plural suffix.

Class 6b: Singular: -ri/-rɪ; Plural: -bo/-bɔ

Root	Singular	Plural	Gloss	Evidence for root representation	
tòò-	tòò-rí	tò-bó	'ear'	tòò-bíl-é	'small ear'
kɔɔ-	kɔ́ɔ́-rí	kɔ́-bɔ́	'bone'	kɔ̀ɔ̀-kpɛ̂ŋ	'big bone'
sɔɔ-	sɔ́ɔ́-rí	sɔ́-bɔ́	'liver'	sɔ̀ɔ̀-bíl-é	'small liver'
ɲɔɔ-	ɲɔ́ɔ́-rí	ɲɔ́-bɔ́	'intestine'	ɲɔ̀ɔ̀-bíl-é	'small intestine'
jɔ̀ɔ̀-	jɔ̀ɔ̀-rí	jɔ̀-bɔ́	'termite'	jɔ̀ɔ̀-bíl-é	'small termite'

In these examples, I argue that they are formed through the rules: C-deletion (b/r-deletion), vowel lengthening forced by the suffix *-ri/-rɪ* to derive the singular forms, vowel shortening and rounding harmony. I assume the following underlying form: /kɔb-rɪ/ which eventually results in the surface form via the preceding rules.

(47)   UR: /kɔb-rɪ/   /tob-ri/

        b-deletion: kɔ-rɪ   to-ri

        vowel lengthening kɔɔ-rɪ   too-ri

        SR: [kɔ́ɔ́-rí]   [tòò-rí]

        Gloss: 'bone'   'ear'

For the plural forms, their formation results from r-deletion and vowel shortening as shown below

(48)   UR: /kɔb-rɔ/   /tob-ro/

        r-deletion: kɔbɔ   tobo

        SR: kɔ́-bɔ́   tò-bó

I assume that the deletion of the bilabial [b] in the singular and the deletion of the alveolar [r] in the plural is a response to the prohibition against [br] sequence in the language. The third sub-class involves C-final stems which select *-ri/-rɪ* to mark singular and a back mid or low vowel to mark plural. In this set, rounding harmony occurs when the plural suffix is attached to the root.

Class 6c: singular: -ri/-rɪ; plural: -o/-ɔ/-a

Root	Singular	Plural	Gloss	Evidence for root representation	
lug-	lúg-rí	lúg-ó	'pillar'	lùg-bíl-é	'small pillar'
bàg-	bàg-rí	bàg-á	'shrine'	bàg-fáá	'bad shrine'
ɲag-	ɲág-rí	ɲág-á	'root'	ɲàg-bíl-é	'small root'

Number formation in this class is characterised by various phonological rules including vowel lengthening, shortening, and rounding harmony. Nouns in this class are described as **basic plural** and non-individuated in the sense of them occurring in groups or in pairs and coding singular with *-ri/-rɪ* because the base form is plural.

Overall, different semantic groups contrast in their likelihood of occurring as singles or multiples. For instance, as Grimm (2010, 2012) claims, large animals are basic singular while nouns for insects are typically basic plural. Body parts that are inherently singular are likely basic singular with *-ri/-rɪ* marking plural as in *zû - zú-rɪ* 'head' whereas body parts that come in pairs are likely basic plural. Such nouns mark the singular with *-ri/-rɪ* as in *nímbí-rì – nímbí-è* 'eye'. Though there

are fuzzy boundaries and exceptions to this claim, the general tendency is clear in terms of semantic categorization of Dagaare nouns.

3.2.2.3.3   Semantic class

Nouns in this class belong to particular semantic categories including **human**, **kinship**, **mass** count and non-count (e.g. liquid and granular items), **event** and **abstract** nominals. Four sub-classes constitute the semantic group: class 1, class 7, class 9 and class 10. I posit that this class is semantically motivated along with phonological constraints. This is because there are some phonological regularities such as harmony. As will be discussed below, there is a semantic reasoning for grouping these nouns together. Class 1 is examined below.

3.2.2.3.3.1 Class 1: singular: (b)V{-ɪ, /-e/-ɛ, -ɔ, -ᴏᴏ, -ba }; plural: bV{-be/-bɔ/-ba}, -mine

Class 1 is made up of two sub-categories: one consisting of human nouns and one consisting of nouns referring to kin terms. The fact this class is exclusively associated with humans and kinship relations shows its uniqueness and that is one significant reasoning for classifying these nouns as a semantically determined class. Singular human nouns are coded with vowel suffixes while plural human nouns take the dedicated human suffix -bV. This is a class that is present in Mabia languages. Consider the examples below.

Class 1a: Singular: -ɪ, -e/-ɛ, -ɔ; Plural: -be, -bɔ, -ba

Root	Singular	Plural	Gloss	Evidence for root representation	
dɔɔ	dɔ́ɔ́-Ø	dɔ́-bɔ́	'man'	dɔ̀ɔ̀-ŋmáá	'short man'
pɔg-	pɔ́g-ɔ́	pɔ́g-bɔ́	'woman'	pɔ̀g-sɔ̌ŋ	'good woman'
níŋ-	ní-ɛ̀	nʊ́-bà	'person'	níŋ-fáá	'bad person'
sɛn-	sɛ́n-í	sɛ́n-bá	'fiancé'	sɛ̀n-fáá	'bad fiance'
sáán-	sáán-à	sáám-!bá	'stranger'	sáá-!fáá	'bad stranger'
nɜ̀ɲìg-	nɜ̀ɲìg-é	nɜ̀ɲìg-bé	'thief'	nɜ̀ɲìg-fáá	'bad thief'

With the human nouns, the rules that underlie their formation include vowel shortening, assimilation, rounding harmony, nasal assimilation and nasal deletion. With vowel shortening, CVV nominal root gets shortened when the number suffix is added. Nasal assimilation occurs when the final alveolar nasal /n/ becomes [m] before the suffix -bV. With rounding the vowel of

the number suffix becomes round when the root vowel is round and low when the root is low. Some examples are illustrated below.

(49) UR: /dɔɔ-ba/   /pɔg-a/   /saan-ba/

      Rounding   dɔɔ-bɔ   pɔg-ɔ   -

      Vowel shortening   dɔ-bɔ   -   -

      Nasal assimilation -   -   saam-ba

      SR: [dɔ́-bɔ́]   [pɔ́g-ɔ́]   [sáám-!bá]

      Gloss   'man'   'woman'   'stranger'

Class 1b: singular: -∅, -ɪ, -ɛ/-a, -oo, -ba; plural: -mine

For the kinship nouns, singular may be unmarked, or it may be marked with a vowel based on arbitrary choice and the plural forms are always marked with the morpheme *-mine*. This morpheme denotes relations between people. It is always LH regardless of the tonal melody of the root to which it is attached. Also, the vowels of this morpheme remain advanced irrespective of the quality of the root vowels. It therefore raises questions as to whether *-mìné* is actually a suffix as it looks like a word-level morpheme unlike plurals like [-ri/-rɪ].

Root	Singular	Plural	Gloss	Evidence for root representation	
mà-	má-∅	má-mìné	'mother'	mà-sɔ́ŋ	'good mother'
bá-	bâ-∅	bâ-mìné	'father'	bá-!sɔ́ŋ	'good father'
jɔ́ɔ̀	jɔ́ɔ̀-∅	jɔ́ɔ̀-mìné	'sibling'	jɔ́ɔ̀-sɔ̌ŋ	'good sibling'
bìèr-	bìèr-í	bìèr-mìné	'brother'	bìèr-kpêŋ	'big brother'
kpìèm-	kpíɛ́m-ɛ́/á	kpìèm-mìné	'sister'	kpìèm-wɛ́gì	'tall sister'
pùr-	pùr-óó	pùr-mìné	'aunt'	pùr-fáá	'bad aunt'

The next class under the broader semantic class involves mass count nouns which denote liquid and granular entities. The nouns here though mass, are equipollent in that they have both singular and plural forms. Specifically, the granular forms have their singular forms marked with a vowel and the plural marked with the unique suffix, *-nɛɛ*. This morpheme denotes 'types/kinds of'. Liquid entities under this category are not marked for singular but always marked with *-nɛɛ* for plural which is always high-tone irrespective of the tonal melody of the preceding root. These nouns form a small group representing class 7, and they are shown below. The data in (7a) end in long

nasal vowel for the singular and then nasalization disappears in the plural. The data in (7b) have nasal-final roots with a short vowel. The cases in (7a) seem to suggest that a final nasal in the root has been absorbed into the vowel.

3.2.2.3.3.2 Class 7: singular: -∅, -ɪ, -ɛ; plural: -nɛɛ

Class 7a: Singular: -∅; Plural -nɛɛ

Root	Singular	Plural	Gloss	Evidence for root representation	
tĩ̀-	tĩ̀-∅	tìì-nɛ́ɛ́	'types of medicine	tĩ̀-tʊ́ɔ́	'bitter medicine'
zĩ̀-	zĩ̀-∅	zìí-nɛ́ɛ́	'types of blood'	zĩ̀-tʊ́l!ʊ́ŋ	'hot blood'
bĩ̀-	bĩ́-∅	bíí-!nɛ́ɛ́	'types of broth'	bĩ̀-nʊ̀ɔ́ŋ	'tasty broth'
dáã̀-	dáã̀-∅	dáá-!nɛ́ɛ́	'types of alcohol'	dáã̀-zìɛ́	'red alcohol/pito'
káã́-	káã́-∅	káá-!nɛ́ɛ́	'types of oil'	káã́-tʊ́l!ʊ́ŋ	'hot oil'

Class 7b: singular: -ɪ, -ɛ; plural: -nɛɛ

Root	Singular	Plural	Gloss	Evidence for root representation
tɛn-	tɛ́n-í	tɛ́n-nɛ́ɛ́	'types of soil'	tɛ̀n-sŏŋ 'good soil'
bɛ́ŋ-	bɛ́ŋ-ɛ̀	bɛ́n-!nɛ́ɛ́	'types of beans'	bɛ́n-zìɛ́ 'red beans'

The next category under the semantic class involves class 9 which consists of event nouns. With a syntactic criterion, these nouns are formed via derivation by adding the suffix [-uu/-ʊʊ, -bu/-bʊ, -nuu/-nʊʊ] to a verb root. Semantically, they are lexicalized from abstract concepts and as a result they are only privative singular as they do not have plural counterparts. Some significant morphophonological realizations observed in the derivation of these nouns is high vowel lengthening and diphthongization of mid vowels. That is, CV roots with high or mid vowels gets lengthened and diphthongized respectively when the suffix is attached. There is also root-final nasal assimilation – velar alveolar becomes bilabial before the -bV suffix.

3.2.2.3.3.3 Class 9: singular: -uu/-ʊʊ, -bu/-bʊ, -nuu/-nʊʊ; no plural

Root	Gloss	Action/event nominal	Gloss
wììr-	'smoke'	wììr-úú	'smoke-NMLZ'
mààl-	'make'	mààl-ʊ́ʊ́	'make-NMLZ'

di-	'eat'	díí-bú	'eat-NMLZ'
tú-	'dig'	túú-bù	'dig-NMLZ'
dó-	'climb'	dúó-bù	'climb-NMLZ'
dʊ́g-	'cook/boil'	dʊ́g-bʊ̀	'cook/boil-NMLZ'
nʊɴ-	'like/love'	nʊ́m-bʊ́	'like/love-NMLZ'
zàn-	'learn'	zàn-nʊ́ʊ́	'learn-NMLZ'

3.2.2.3.3.4 Class 10: no sg; pl: -uŋ/-ʊŋ;
sg: -uŋ/-ʊŋ, -ruŋ/-rʊŋ, -nuŋ/-nʊŋ; no plural

Finally, under the semantic group is class 10. This class consists of two set of nouns of different semantic properties. The nouns here include mass non-count nouns and abstract nouns. They are both marked with the same suffix [-uŋ/-ʊŋ, -ruŋ/-rʊŋ, -luŋ/-lʊŋ, -nuŋ/-nʊŋ] based on the root. Similar to the nouns in class 9 above, some of the nouns in this class are derived from verbs though the nouns involve more concrete forms. When the suffix is attached to a verbal root, it usually but not always results in a mass noun of liquid or granular form. When the suffix is attached to an adjectival root, it leads to abstract nouns of varying qualities. In previous studies (Bodomo 1997; Bodomo & Marfo 2006), this class is reported to contain only mass nouns with no mention of abstract nouns, so I provide data representing these nouns. The mass nouns here conceptually fit into the plural aspect of number and as a result, they are considered privative plural. This is shown below.

Class 10a: no singular; plural: -uŋ/-ʊŋ

Root	Mass noun	Origin of noun
bùùl-	búúl-úŋ	bùùl 'to stir' – liquid resulting from the act of stirring – porridge
vʊ́ʊ̀r-	vʊ́ʊ́r-!ʊ́ŋ	vʊ́ʊ̀r 'to breathe' – air from the act of breathing – breath'
dúʊ̀r-	dúʊ́r-!úŋ	dúʊ̀r 'to urinate – liquid from this action – urine
jààr-	jàòr-ʊ́ŋ	jàòr 'to mine' – particles/items obtained from this action – salt

In the next set of examples, abstract nouns resulting from adjectives or verbs are shown. These nouns are syntactically derived by the addition of the derivational suffix to the adjectival root. Nouns in this group are conceptualized as not having plural forms and they therefore fit into the singular part of the number grid. They are privative singular forms.

Class 10b: singular: -uŋ/-ʊŋ, -luŋ/-lʊŋ, -ruŋ/-rʊŋ, -nuŋ/-nʊŋ; No plural

Root	Gloss	Abstract noun	Gloss
fáá-	'bad'	fàà-lʊ́ŋ	'badness'
bààl-	'soft/weak'	bààl-ʊ́ŋ	'sickness'
vìèl-	'beautiful'	vìèl-ʊ́ŋ	'beauty'
wɛ́g-	'tall'	wɛ́g-!rʊ́ŋ	'tallness'
sŏŋ-	'good'	sòn-nôŋ	'goodness'
tíɛ̀r-	'think'	tíɛ́r-!ʊ́ŋ	'thought'

In summary, the noun classes in Dagaare display an interplay of various phonological, phonological, syntactic and semantic processes. Nouns are made up of roots and suffixes which form the basis on which they are categorized into classes. They are classified based on the similarity of the singular suffixes and the similarity of plural suffixes. Three broad classes constitute the nominal system in Dagaare: phonological, phono-semantic and semantic class. In general, while recognizing that nouns and number formation is a product of the interaction between morphology and phonology, it is important to note that some syntactic and semantic factors contribute to the classification of Dagaare nouns.

3.2.3 Alternative proposal for Dagaare nominal morphology

The proposal made in this dissertation is that there is number marking on nouns partitioned on the basis of singular and plural marking involving -V and -CV suffixes. I assume singular nouns to involve both -V and -CV suffixes. There is however an alternative way of looking at this as proposed in Anttila & Bodomo (2009). In this proposal, they claim that Dagaare number arises from two sources: phonology and morphology. Thus, the additional vowels in singular nouns are described as epenthetic for a number of reasons: (i) the presence of the additional vowel is phonologically predictable as it is required to satisfy minimality – a word must be minimally bimoraic; (ii) the quality of the vowel is predictable because it copies the harmonic features of the root to which it is attached; and (iii) the location of the vowel is predictable. Therefore, a case like *bíé* 'child' involves the addition of the vowel /e/ after the /bi-/. A case like *tùó* 'baobab' involves the insertion of the high vowel /u/ in the middle of the root. In this case, the vowel /u/ is not a suffix and not an infix either. Rather, according to Anttila and Bodomo, it is a meaningless filler with no morphological affiliation. Finally, a case like *wɛ́gɛ̀* 'log' involves an additional vowel [ɛ]

which is a copy of the root vowel. In contrast, the plural vowel is considered a piece of morphology – a suffix with underlying -V specified as [-round].

This proposal seems to work for nouns in some classes though it raises questions in others. For instance, one of the reasons for considering singular vowels as epenthetic is that they share the same harmonic features (e.g., tongue root, rounding, backness and height) with the vowel in the root. Also, the additional vowel for the singular is a copy of the preceding root vowel but if the root vowel is high [i, ɪ, u, ʊ], then the additional singular vowel is mid. This does not appear to always be the case because there are nouns whose root and suffix/added vowels do not necessarily share all harmonic features such as the following.

(50)	Root	Singular	Plural	Gloss
	bɪl-	bíl-áá	bíl-íí	'anthill'
	ɲɪr-	ɲír-áá	ɲír-í	'ant'
	gɔr-	gɔ́r-áá	gɔ́r-íí	'sickle'
	vuur-	vúúr-ɔ́ɔ́	vúúr-íí	'bellow'
	ʤɛ́l-	ʤɛ́l-!íí	ʤɛ́l-ɛ̀	'egg'
	kper-	kpér-íí	kpér-éé	'gizzard'
	fer-	fér-íí	fér-éé	'air potato'
	dààŋ-	dààŋ-áá	dààn-í	'hearth'
	ŋmàáŋ-	ŋmàáŋ-à	ŋmàán-ì	'monkey'

Though there is general tongue root agreement, there is no systematic agreement in other features such as rounding, backness and height. Also, none of these additional vowels in the singular forms is a copy of the root vowel. Moreover, even roots with high vowels which are expected to have mid vowels (according to the above proposal) as the singular marker, instead have low vowels. Another issue that arises with these nouns is whether the epenthetic vowels can be long. It must be mentioned that the differences may be dialect specific.

The suffix of some plural forms such as *ɲír-í* 'ant-PL' is a copy of the root vowel which probably suggests that some plural nouns may be epenthetic vowels and not actual suffixes. So, in effect though these cases are consistent with some of the phonological generalisations made in Anttila and Bodomo (2009), some detailed assessment of the phonological conditions is probably still required. That is, in order to really assess this proposal, there is the need to look at conditions

where there is the presence or absence of the vowel, the quality of the vowel – conditions that involve final vowel deletion; conditions that involve vowel epenthesis and conditions that involve both deletion and epenthesis. The discussion here is not meant to establish which proposal is appropriate or otherwise. Rather it invites further examination of nominal morphology in Dagaare.

3.3 Syntax of aspect and number

3.3.1   Syntactic spine

The traditional domain of investigating aspect and number in many languages has always been morphology – inflectional morphology. In studies of Dagaare, aspect and number are classified as inflectional in the sense of morphological typology. It is therefore necessary to show that aspectual and number marking is syntactically significant. An approach that is relevant in developing a formal analysis of verbal and nominal inflection is the syntactic spine hypothesis as proposed in Déchaine et al., (2014) and Wiltschko (2014). The syntactic spine has to do with the elements that can occur with a particular syntactic head and where those elements occur. The spine consists of a set of functional categories which are hierarchically organized. In the proposals of Déchaine et al. and Wiltschko, each of the verbal and nominal spines is divided into sub domains which are associated with abstract grammatical functions including outer typing, anchoring, classification, and inner typing.

3.3.1.1 Verbal spine

Under this hypothesis, the verbal spine is like a template which houses the elements that occur with a verb, and in which position these elements occur. Within the clause/spine, the abstract grammatical functions – classification, outer typing, anchoring and inner typing – correspond respectively to vP, AspP, I(inflectional)P, and C(complementizer)P as shown below. Thus, classification is done at the vP level, providing a set of different events that are used grammatically to denote eventualities. The elements that are introduced at the AspP level provides different points of view to classes of events such as progressive, inchoative, perfective, etc. At the IP level, the eventuality perceived at AspP is placed with respect to some external dimension and at the CP level the whole clause is related to the wider context such as topic, focus, theme etc. In (51a-b), the core set of categories are shown in bracketed and tree structures respectively.

(51)   V-SPINE (Déchaine et al., 2014; Wiltschko, 2014)

a. Core domain

[CP Comp   [IP Infl   [ASP Aspect   [vP V   ]]]]

b.
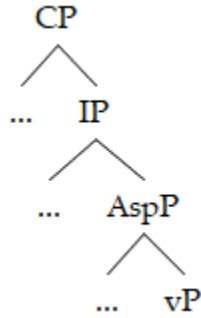
c. Prolific Domain

[CFORCE [CFINITE   [ITENSE [IMODALITY   [OuterVAsp [InnerVAsp   [vP V   ]]]]]]

The core set of categories in (51a-b) are claimed to be universally apparent but individual languages are different in terms of how prolific their categories are. As seen in (51c), C-domain is sub-divided into CFORCE and CFINITENESS; I-domain splits into Tense and Modality while Aspect in many languages is divided into outer and inner aspect. Bringing this approach to Dagaare, the elements that occur with the verb include tense, modality, aspect and polarity. In Dagaare, tense is split into past and future; polarity divides into negation and affirmation; modality involves habitual and repetitive marking while aspect splits into default and imperfective aspect. Consider the following examples illustrating the positions of functional categories.

(52) a. Dàkóráá   dà   bá   là   dì   sáó
          Dakoraa   PST   NEG   REP   eat.V   sao
          'Dakoraa did not eat sao again'

      b. Dàkóráá   dà   bá   là   dì-ré   sáó
          Dakoraa   PST   NEG   REP   eat-IPFV sao
          'Dakoraa was not eating sao again'

(53)   a.   Dàkʊ́ráá   dà   mǎŋ   sʊ́rí   ná   gán-ì

       Dakoraa   PST   HAB   read.V   FOC   book-SG

       'Dakoraa always read a book'

       b.   Dàkʊ́ráá   dà   mǎŋ   sʊ́r-ɔ̀   ná   gán-ì

       Dakoraa   PST   HAB   read-IPFV   FOC   book-SG

       'Dakoraa was always reading a book'

With polarity, the negation particle *bá* occurs preverbally while the focus/affirmative particle *ná* occurs post verbally. As shown in the following structure (54), this therefore suggests that the two polarity particles do not reside in the same position structurally. Thus, NegP is high up in the tree dominating vP while the FocP is under the maximal projection of the vP. Note that both negation and focus particle never occur together in a simple sentence because they are in complementary distribution semantically. Moreover, given that aspect marker is morphologically attached on the verbal root as a suffix, I consider it to be under the maximal projection of the verb. This is shown in the proposed structure below. As can be seen the tree contains various functional projections. These projections include tense [T], Negation Phrase [NegP], Modality Phrase [ModP] where habitual and repetitive features reside and the Focus Phrase [FocP] which contains the focus or affirmative marker.

(54)   Dagaare V-SPINE

```
                    TP
          ┌──────────┴──────────┐
        SPEC                     T
                        ┌────────┴────────┐
                        T                 NegP
                     [PST/FUT]      ┌──────┴──────┐
                                   Neg           ModP
                                          ┌───────┴───────┐
                                         Mod             vP
                                      [HAB/REP]     ┌─────┴─────┐
                                                    v          FocP
                                                  ┌─┴─┐      ┌──┴──┐
                                                  v  Asp   [FOC]  DP
```
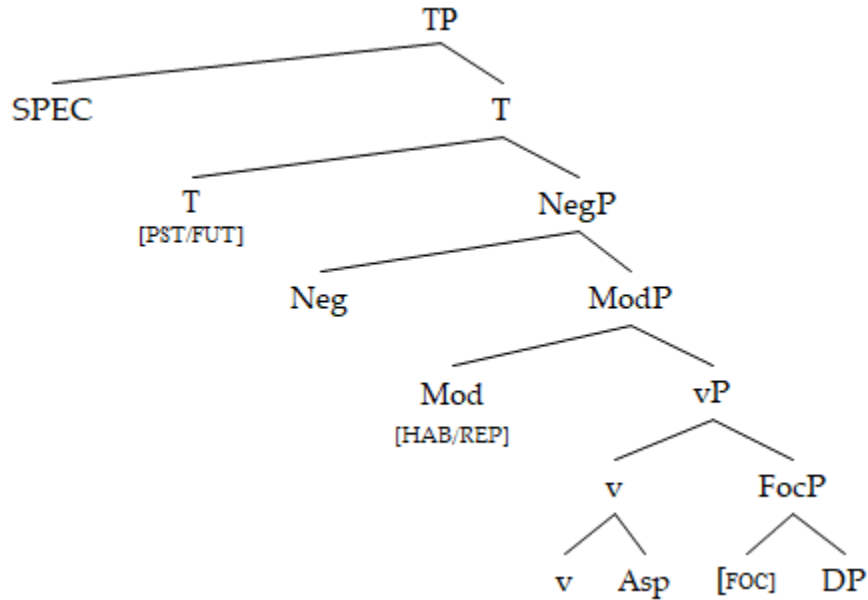
Following the proposed structure in (54), the sentence in (52a) is structurally represented in (55a) while the sentence in (53a) is translated structurally in (55b).

(55)   a.

```
                TP
        ┌────────┴────────┐
      SPEC                 T
        │          ┌───────┴───────┐
    Dakoraa        T              NegP
                   │        ┌───────┴───────┐
                   dà      Neg             ModP
                            │       ┌───────┴───────┐
                           bá      Mod             vP
                                    │        ┌──────┴──────┐
                                   là        v           FocP
                                          ┌──┴──┐      ┌───┴───┐
                                          v   Asp     FOC     DP
                                          │    │               │
                                          dì  -Ø             sáú
```

b.

```
                TP
        ┌────────┴────────┐
      SPEC                 T
        │          ┌───────┴───────┐
    Dakoraa        T              NegP
                   │        ┌───────┴───────┐
                   dà      Neg             ModP
                                    ┌───────┴───────┐
                                   Mod             vP
                                    │        ┌──────┴──────┐
                                   mǎŋ        v           FocP
                                          ┌──┴──┐      ┌───┴───┐
                                          v   Asp     Foc     DP
                                          │           │        │
                                         sórí        ná      gán-ì
```
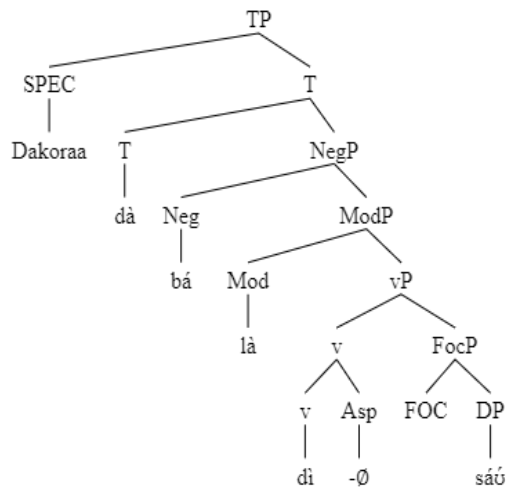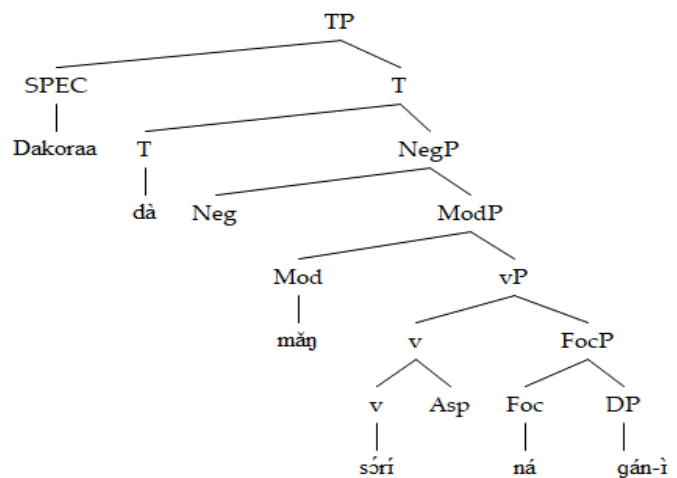
In both (55a), we see that tense, negative polarity and modality particles occur pre-verbally and are all higher on the tree dominating vP. The default aspectual suffix (Ø) occurs to the right of the verb root and the postverbal element is empty because negative and positive polarity items do not co-occur in the same sentence in Dagaare. The structure in (55b) contain the postverbal particle *ná* and this means the absence of negation.

In summary, along the verbal spine in Dagaare, there are five functional categories, namely tense, negative polarity, modality which all occur before the verb head, aspect which is morphologically (overt or covert) attached to the verb and occurs to the right of the verbal root. Then the positive polarity particle is coded by the postverbal particle *ná*. In the next section, I present a syntactic discussion of how number interacts with nominal modifiers illustrating all categories that occur with the noun head. Before presenting how number is signaled in various nominal modifiers in Dagaare, I give an overview of the nominal spine as it will inform the discussion of various nominal elements in the subsequent sections.

3.3.1.2 Nominal spine

As with case in verbs, the nominal spine contains elements that occur with nouns. In the sense of Déchaine et al (2014) and Wiltschko (2014), the nominal spine has four universal divisions, namely nP, ClassP, DP and K (=case)P which respectively correspond to classification, outer typing, anchoring and inner typing. Though all four domains are universal, individual languages may be distinct in terms of how prolific each domain is. This is schematized below.

(56)　　　N-SPINE

a. Core

[$_{KP}$ Kase　　　　[$_{DP}$ Det　　　[$_{ClassP}$ CLASS　　　　　　[$_{nP}$ n　]]]]

b.

KP
… DP
　… ClassP
　　… nP
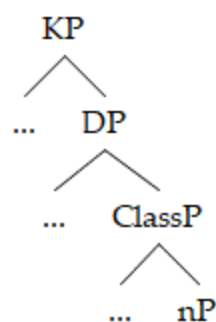
c. Prolific Domain

[$_{KFORCE}$ [$_{KFINITE}$ [$_{DDEF}$ [$_{DSPEC}$　[OuterNAsp Sg/Pl [$_{InnerNAsp}$ Sort [nP n　]]]]]]]

Nouns classify entities and kinds in the same way as verbs classify events/actions. Nominal inflection – number and/or gender – are used to classify entities as partitioned/individuated,

groups, mass, etc. Classification is done at the nP level; ClassP contains the inflectional features such as number or gender; DP is for entity anchoring and KP has the function to connect the whole DP to the wider context. In Dagaare, N-spine consists of the determiner, adjective/degree marker, number, demonstrative, quantifier and cardinal numeral. With these domains, I propose the following as the structure of the nominal spine in Dagaare. Except for the determiner, which is pre-nominal, all other categories are post-nominal.

(57) Dagaare N-spine

[D   [MODIFIERS [classS NUM   [DEM   ([Q   [Numeral)]]

[DDEF [DINDF [MODADJ/DEG [classS sg/pl   [DEMPROX/DIST

These domains are further split into sub-domains. For instance, determiner is further split into overtly marked definite and null indefinite; number is split into singular, and plural based on the noun class; demonstratives sub-divide into proximal and distal. These domains within the spine will translate in the analysis of the nominal phrase.

3.3.1.3 Syntactic analysis of number in Dagaare noun phrase

As illustrated earlier a simple noun in Dagaare is made up of the root and a number suffix – singular/plural. A recap of the structure of the Dagaare noun is illustrated below.

(58)   [[ROOT] – [(SG/PL)] SUFFIX]NOUN

[[pɔ́g]ROOT – [ɔ́]SUFFIX] NOUN

(59)   Structure of a noun

115
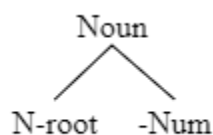
Examples
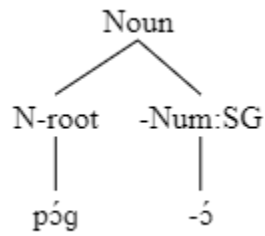
a. Singular   b.   plural
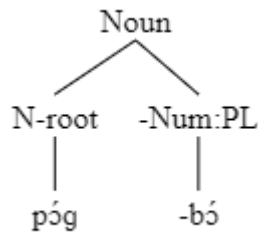
A noun phrase in Dagaare consists of the noun (as lexical head of the phrase) and optionally, one or more modifiers or a possessor (Angkaaraba, 1980; Bodomo, 1997; Bodomo & Van Oostendorp, 1994). This is illustrated below. In (60a), there is just a bare noun in square brackets *pɔ́gɔ́*, which functions as the NP without any modifier. In (60b) the noun phrase is made up of the determiner *à* and the demonstrative *ná* while in (60c) the phrase consists of the determiner, the noun head, an adjective and a demonstrative. All modifying elements are optional in a noun phrase.

(60)   a.   Dàkɔ́ráá   dí   ná   [pɔ́g-ɔ́]

              Dakoraa   take.V   FOC   woman-SG

              'Dakoraa has taken/married a wife/woman'

        b.   Dàkɔ́ráá   dí   ná   [à   pɔ́g-ɔ́   ná]

              Dakoraa   take.V   FOC   DET   woman-SG   DEM

              'Dakoraa has married that woman'

        c.   Dàkɔ́ráá   dí   ná   [à   pɔ̀g-vìèl-áá   ná]

              Dakoraa   take.V   FOC   DET   woman-nice-SG   DEM

              'Dakoraa has married that beautiful woman'

Noun phrases are described and analyzed as phrases headed by nouns. Before Abney (1987), the noun phrase under the NP-hypothesis was assumed to be the projection of the noun with a determiner residing in the specifier position, as in the following examples in English and Dagaare in (61a) and (61b) respectively:

116
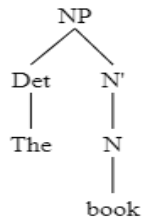
(61)   a. The book   b. à   gán-ì
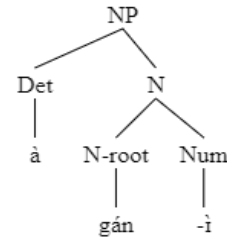
Abney however proposes that the determiner is actually the head of the noun phrase – the determiner being the head and the NP being its complement. There has not been much argumentation for or against either NP or DP, however. Within Lexical Functional Grammar (LFG) Bresnan et al., (2015) for instance remain skeptical as to which structure is preferrable. In the introduction to Tree-Adjoining Grammar (TAG), Frank (2004) considers the DP-hypothesis without arguing for it. Sag et al. (1999) assume the NP-hypothesis while Müller (2013) argues in favour of the NP structure. Within Minimalist syntax, Adger (2003) adopts the DP-hypothesis but does not provide arguments in its favour. The current study does not seek to establish which structure is the better option. The focus is to attempt to formalize how Dagaare noun phrases are examined in terms of the DP-hypothesis. Languages without overt articles are said to lack a D-layer and therefore noun phrases are NPs and languages with articles have DPs because there is a D-layer (Bošković, 2009). Salzmann (2020) suggests two possible ways of interpreting and evaluating the DP-hypothesis. One way is by focusing on the category D and showing that it is or it is not the head. Another way is to determine if N is the head or some functional head within the noun phrase. Two fundamental diagnostics can be employed to determine what the head of a noun phrase is:

- the head and the complement are in an asymmetric relationship: the head selects the complement and can determine its features
- the features of the head are present on the maximal projection

The head-complement asymmetry is manifested in two areas; heads select their complements rather than vice versa and heads determine properties of their complements. The D-elements, 'the' for English and *à* for Dagaare require the presence of a noun. The reverse does not seem to hold as there are nouns which occur without a determiner as in bare plurals such as *pɔ́g-bɔ́* 'women'.

The assumption here is that the noun does not contain a D-element. However, there is a debate on whether bare nouns contain a D-layer or at least a silent functional structure. Two analytical possibilities for bare nouns have been proposed (see Jenks, 2018; Salzmann, 2020). Bare nouns have silent head/material or bare nouns have no silent head. Therefore, under the DP-hypothesis, the noun phrase is a DP with silent D or just an NP and under the NP-hypothesis, the bare noun phrase will be an NP in both cases, either with a silent D or without it in its specifier position. In Mandarin for instance, Jenks (2018) claims that definite bare nouns are NPs and definite noun phrases headed by demonstratives are DPs. In light of the foregoing, I treat the noun phrase (with or without overt D) in Dagaare as DP. The assumption is that a bare noun in Dagaare is headed by a determiner (D) which may be the definite determiner *à* or a possessive. A proposed structure of a noun phrase is given below.

(62)   DP structure in Dagaare
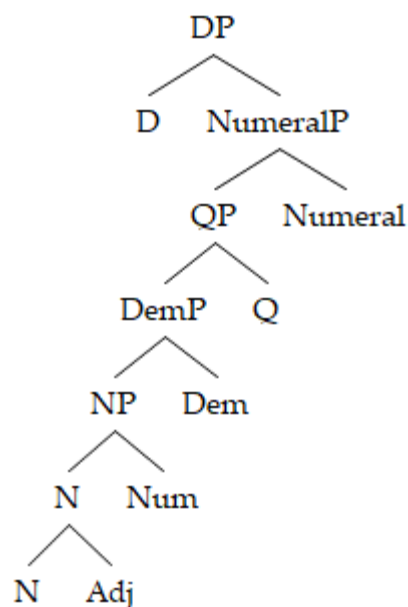
The determiner is the head with other modifiers as complements. NumeralP which is always high in the tree contains cardinal numbers, Q contains quantifiers like *zàá* 'all' and *mìné* 'some' and DemP contains demonstratives. In this section, I present a discussion of nominal modifiers and how they interact with number inflection within the Dagaare noun phrase. Number marker is a functional head in the structure of nominal phrase (Carstens, 2001; Cinque, 1994; Hiraiwa et al., 2017; Ritter, 1991; Vicki, 2000). In Dagaare, number marking is not inflected only on nouns. It

also inflects on other elements of the phrase such as adjectives, demonstratives, and cardinal numerals. The projection Num is above the noun and below the DP (determiner phrase). Therefore, number in Dagaare occupies a syntactic head position and occurs below NP and DemP (demonstrative phrase) in the structure of a nominal phrase. In the sections that follow, each modifier and its role in number is examined in terms of syntactic structures.

3.3.1.3.1   Number on adjectives

In a noun phrase, Angkaaraba (1980) claims that a noun root takes a maximum of four adjectives while Bodomo (1993) and Bodomo & Oostendorp (1993) adds that a maximum of five adjectives may follow a noun root. I argue however that there is no restriction on the number of adjectives that can occur after a noun. A noun head can be stacked with as many adjectives as naturally possible in a phrase. A proposed structure of noun-adjective phrase is illustrated in (63).

(63)   Noun-adjective nominal phrase
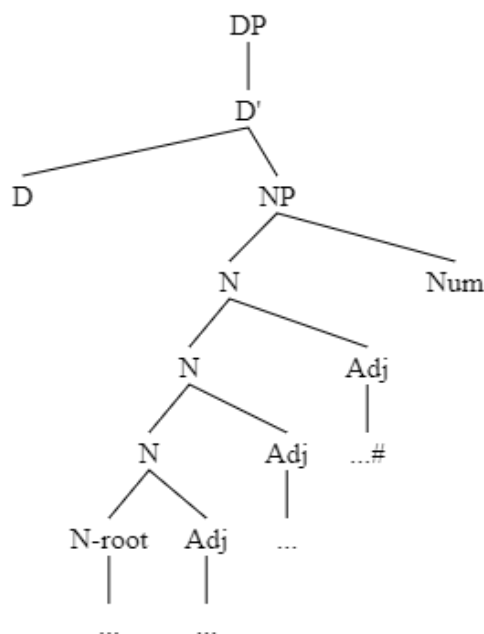
Let us now consider some examples which pattern with the above structure. The phrases in (64-69) show the number of adjectives a noun head can take, ranging from one to six adjectives.

(64)   a.   pɔ̀g-bíl-é

                     woman-small-SG

                     'a young woman'

b. pɔ̀g-bìl-íì

woman-small-PL

'young women'

(65) a. pɔ̀g-bìl-wɛ́g-ì

woman-small-tall-SG

'a young tall woman'

b. pɔ̀g-bìl-wɛ́g-rì

woman-small-tall-PL

'young tall women'

(66) a. pɔ̀g-bìl-wɛ́g-zì-ɛ́

woman-small-tall-red-SG

'a young tall fair woman'

b pɔ̀g-bìl-wɛ́g-zìì-rí

woman-small-tall-red-PL

'young tall fair women'

(67) a. pɔ̀g-bìl-wɛ́g-zì-vìɛl-áá

woman-small-tall-red-nice-SG

'a young tall fair beautiful woman'

b pɔ̀g-bìl-wɛ́g-zì-vìɛl-í

woman-small-tall-red-nice-PL

'young tall fair beautiful women'

(68) a. pɔ̀g-bìl-wɛ́g-zì-vìɛl-bààl-áá

woman-small-tall-red-nice-slim-SG

'a young tall fair beautiful slim woman'

b.   pɔ̀g-bìl-wɛ́g-zì-vìɛ̀l-bààl-í

woman-small-tall-red-nice-slim-PL

'young tall fair beautiful slim women'

(69)   a.   pɔ̀g-bìl-wɛ́g-zì-vìɛ̀l-bààl-sǒŋ

woman-small-tall-red-nice-slim-good.SG

'a young tall fair beautiful slim good woman'

b   pɔ̀g-bìl-wɛ́g-zì-vìɛ̀l-bààl-sɔ̀n-ní

woman-small-tall-red-beautiful-slim good-PL

'young tall fair beautiful slim good women'

Number does not always attach to only nouns in Dagaare. For instance, observe that the rightmost adjective in the phrase is always inflected for number. That is when the adjective is added to the noun head, the number marker appears on the adjective. So, if the noun head has more than one adjective, the number appears on the last one. From the examples above, it can be assumed that the nominal root conditions number marking. Then when an adjective or a string of adjectives modifies the noun, the form of the adjective determines the phonological shape of the number suffix – the adjective enforces the surface realization of the number suffix. The number marking on the adjectives corresponds to what is observed with nouns. Similar to nouns, l-final adjectival roots always take a vowel to mark both singular and plural; g-final adjectival root assumes a vowel for singular and -ri/-rɪ for plural while nasal final root takes -ni/-nɪ for plural.

The above examples provide a clue that number is marked via head movement. Particularly, based on lexical feature system hypothesis and the universal hierarchy hypothesis (Chomsky, 1968; Cinque, 1994; Miyagawa, 1987), adjectives have [+N] feature and are higher than nouns in noun phrases. Therefore, following these hypotheses, it is plausible to claim that the occurrence of number on adjectives in noun phrases as in (64-69) is associated with lexical features. Given that adjectives have a number feature and higher in the tree than nouns, they become possible candidates for head movement to NUM – the functional head which attracts the nearest head with a nominal feature. So, in Dagaare, when an adjective co-occurs with a noun in a phrase, the

adjective phrase which has [+N] feature moves to Num for number checking. Consider the following syntactic structures.
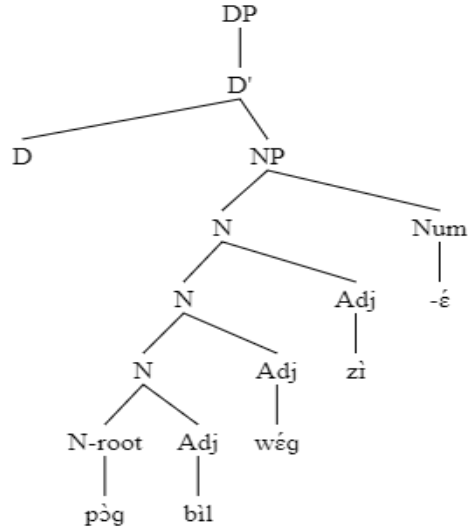
(70) a. b.
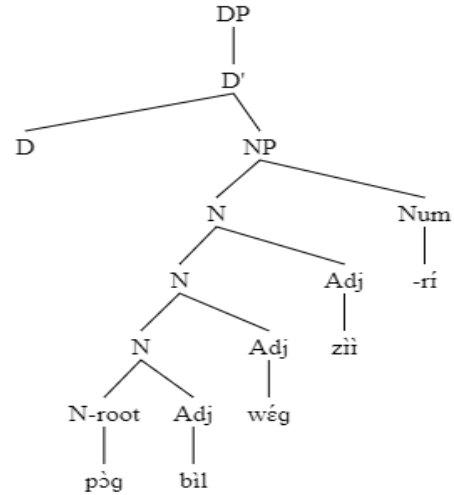
The structures in (70) above show that adjectives block number on nouns i.e., in the presence of an adjective in a noun phrase, a noun does not take number in Dagaare – a noun cannot move to NUM in the presence of an adjective. Thus, phrases like those in (71) are ruled out because of the co-occurrence of number-marked noun and a number-marked adjective.

(71) a. *pɔ̀g-ɔ̀-bíl-é
           woman-SG-small-SG
      b. *pɔ̀g-bɔ̀-bìl-íì
           woman-PL-small-PL

The ill-formedness in the above phrases therefore suggests that the entity that moves in a Dagaare noun phrase to select the number marker is the entity that attracts the nearest head with a nominal feature. This is because number is not just a feature on nouns and adjectives but a functional head that attracts nearest head with number feature.

More support to the claim that number in Dagaare is marked through head movement arises from the coordination of adjectives in the language. Nouns can be coordinated; adjectives cannot be coordinated. The following sentences are illustrations.

(72) a. Dàkóráá   dǎ   ná   [gám-à   nî   kpǎr-ì]
       Dakoraa   buy.V   FOC   book-PL   CNJ   shirt-PL
       'Dakoraa has bought books and shirts'

     b *Dakoraa   dǎ   ná   [kpǎr   zì-ɛ́   nǐ   bíl-é]
        Dakoraa   buy.V   FOC   shirt   red-SG CNJ   small-SG

     c Dàkóráá   dǎ   ná   [kpǎr-zì-bíl-é]
        Dakoraa   buy.V   FOC   shirt-red-small-SG
        'Dakoraa has bought a small red shirt'

     d. *Dàkóráá   dǎ   ná   [kpǎr-zìì-rí-bìl]
        Dakoraa   buy.V   FOC   shirt-red-PL-small

The sentences in (72a and c) are grammatical but (72b & d) are not. In (72a), *gám-à nǐ kpǎr-ì* shows coordination of two noun phrases. The sentence in (72b) is ungrammatical because of the coordination of the two adjectives *zìé* 'red' and *bílé* 'small'. I argue that (72b) is ruled out by the Coordinate Structure Constraint (Ross, 1967). That is, the ungrammaticality suggests that the adjective *bíl-* moves out of the coordinate structure to select the number suffix *-e* and that is a violation of the coordinate Structure Constraint. In (72c), the conjunction is dropped with the two adjectives modifying the noun, hence the phrase is well-formed as the adjectives are not coordinated. For (72d), the conjunction and the number suffix of the second adjective are omitted but the sentence still remains ungrammatical because the last adjective which is closer to Num lacks a number suffix. Rather the number is realized on the first adjective.

3.3.1.3.2   Number on ideophones

As cited in Bodomo (2006), the term ideophone, often credited to Doke (1935), is a vivid representation or depiction of an idea or a sensory experience in sound or in marked forms. Ideophones represent ideas through onomatopoeia. In Dagaare ideophones have specific morphophonological, syntactic and semantic properties which are not present in other word classes. Below are some ideophones in Dagaare.

(73) vàrkpàrà   'in a messy way'

      bìlfìlìì   'extremely huge/fat'

      bòŋgòlóŋ   'unwieldly huge and round'

      fàràtà   'very tall and straight'

      bìlbàlàà   'extremely huge (lying down)'

      yólyól   'of finer quality (e.g., extremely beautiful)'

      pètèŋ   'wide and flat'

      vèlvèl   'long and straight'

As Bodomo (2006) notes ideophones do not lend themselves to morphosyntactic modifications. That is, though it is possible for ideophones to be part of structures like noun phrases, they do not overtly exhibit inflection of any sort. Therefore, in order to express the plurality of a particular concept such as extremely tall persons or huge and round logs/sticks, speakers will normally repeat or reduplicate the ideophone to express more than one entity/concept while leaving its internal morphology unchanged. The repeated or reduplicated ideophone is always directly opposite to the preceding ideophone in terms of tone. That is, if the initial ideophone is L toned, the one following it is always H toned. Here are some examples in which ideophones modify the nouns: *dɔ́ɔ́* 'man' and *tì-ɛ́* 'tree'

(74)   a.   dɔ̀ɔ̀-fàràtà

              man-IDEO

              'an extremely tall and straight man'

        b   dɔ̀ɔ̀-fàràtà   fárátá

              man-IDEO   IDEO

              'extremely tall and straight men'

(75)   a.   tì-bòŋgòlòŋ

              tree-IDEO

              'an extremely huge and rounded tree'

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b	tì-bɔ̀ŋgɔ̀lɔ̀ŋ	bɔ́ŋgɔ́lɔ́ŋ
	tree-IDEO	IDEO

'extremely huge and rounded trees'

Though there is no overt marker of inflection on the ideophones, it can be assumed that they are inherently marked with number when they occur with a noun. This is because when the ideophone is attached to the noun, the number suffix of the noun is dropped as in *tì-ɛ́* 'tree' which reduces to *tì-* when the ideophone is added. Therefore, following the behaviour of adjectives in a noun phrase, it can be argued that number on ideophones is morphologically covert when they modify nouns.

3.3.1.3.3   Number on demonstratives

In terms of number marking, demonstratives agree with the nouns with which they co-occur. There is agreement between demonstratives and all noun classes. In the plural form, the proximal demonstrative follows human vs. non-human nouns; the singular does not exhibit human/non-human contrast. The distal demonstrative follows a neutral pattern – it has no human/non-human contrast and no singular/plural contrast. These distinctions are shown as follows: (i) *ŋá* occurs with any singular noun (human or non-human) as shown in (76a & 77a); (ii) *bá-mà* is a plural form of *ŋá* and it occurs with only plural human nouns as in (76b); (iii) *à-mà* is another plural form of *ŋá* but for non-human plural nouns as illustrated in (77b) and finally (iv) *ná* is number-neutral which co-occurs with both singular and plural nouns as in (78-79). An instance in which a human noun occurs with a non-human demonstrative, or a non-human noun occurs with a human demonstrative result in semantically anomalous phrases as in (80a-b). The (non)human markers behave like prefixes to the demonstratives thereby suggesting that number on nominal expressions may not be entirely suffixal.

(76)	a.	à	bí-é	ŋá
		DET	child-SG	DEM.PXL.SG
			'This child'	

	b	à	bíí-rí	bá-mà
		DET	child-PL	HUM.PL-DEM.PXL.PL
			'These children'	

(77) a. à   bʊ́-ɔ́   ŋá
          DET   goat- SG   DEM.PXL.SG
          'This goat'

      b. à   bʊ́ʊ́-rí   á-mà
          DET   goat-PL   NONHUM.PL-DEM.PXL.PL
          'These goats'

(78) a. à   bí-é   ná
          DET   child-SG   DEM.DIST
          'That child'

      b   à   bíí-rí   ná
          DET   child-PL   DEM.DIST
          'Those children'

(79) a. à   bʊ́-ɔ́   ná
          DET   goat-SG   DEM.DIST
          'That goat'

      b   à   bʊ́ʊ́-rí   ná
          DET   goat-PL   DEM.DIST
          'Those goats'

(80) a. *à   bíí-rí   á-mà
          DET   child-PL   NONHUM.PL-DEM.PXL.PL

      b. *à   bʊ́ʊ́-rí   bá-mà
          DET   goat-PL   HUM.PL-DEM.PXL.PL

Unlike adjectives in NPs which assume the number marker, with demonstratives, both the noun
head and the demonstrative are marked for number – they agree in number. Thus, demonstratives
are different from adjectives in the sense that they do not take the number marker in place of the

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noun. Therefore, omitting the number suffix on the noun in the presence of a demonstrative leads to ungrammatical phrase as in (81a-b).

(81)   a.   *à   bí   ŋá
              DET   child   DEM.PXL.SG

        b   *à   bí   bá-mà
              DET   child   HUM.PL-DEM.PXL.PL

The structure of a noun phrase involving demonstratives is given in (82) which patterns with the examples above.

(82)   a.   b.
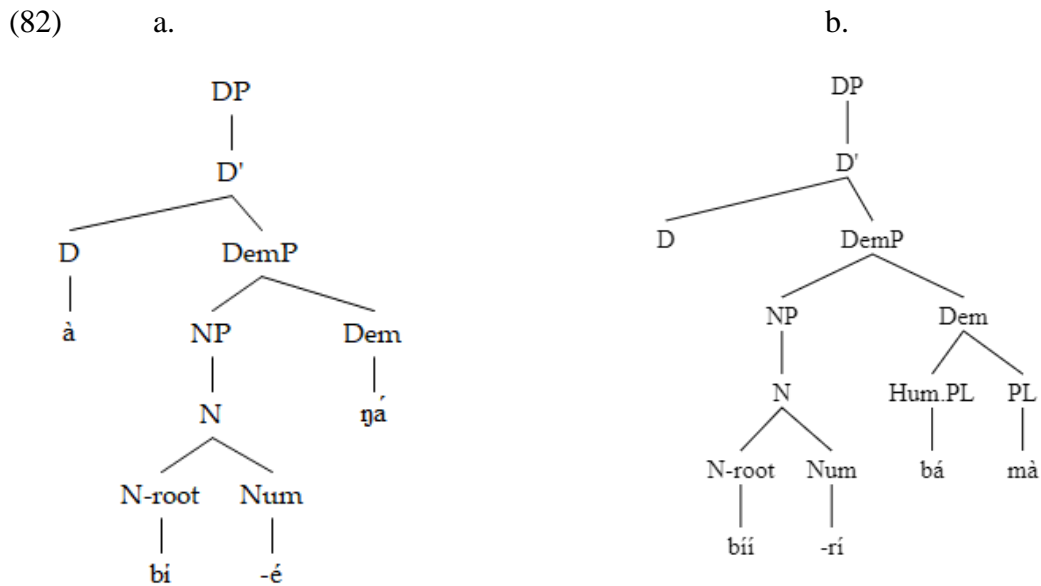
As can be seen on the trees, both the noun and the demonstrative mark number separately, illustrating that the demonstrative is separate from the noun phrase. It should be mentioned also that when an adjective and a demonstrative co-occur in a Dagaare noun phrase, the adjective assumes the number marker which agrees with that of the demonstrative. See the following examples.

(83)   a.   pɔ̀g-wɛ́g-ì   ŋá
              woman-SG   DEM.PXL.SG
              'That tall woman'

b   pɔ̀g-wɛ́g-rì   bá-mà

woman-tall-PL   HUM.PL-DEM.PXL.PL

'Those tall women'

Overall, with all these examples and the structures, it easy to conclude that there is an interaction between number and [±human] features in Dagaare and this interaction manifests on demonstratives. In the next section I present cardinal numerals and how they mark number when they occur with nouns.

3.3.1.3.4   Number on cardinal numerals

Cardinal numerals in Dagaare agree in number inflection with the nouns with which they occur. That is, cardinal numbers are number sensitive. For instance, the singular cardinal number (one) occurs with singular nouns while all cardinals ranging from two occur with plural nouns. Similar to demonstratives, cardinal numbers exhibit a two-way distinction with regards to occurring with human and non-human nouns. The particles that mark the human vs non-human distinction occur before the number thereby suggesting they are prefixes or roots. The following examples illustrate the preceding description with the nouns *bíé – bíírí* 'child' and *báá – báárí* 'dog'.

(84)   a.   bì-jên

child-one

'one child'

b   bíí-rí   bá-jì

child-PL   HUM.PL-two

'two children'

(85)   a.   bà-jên

dog-one

'one dog'

b.   báá-rí   á-jì

dog-PL   NONHUM.PL-two

'two dogs'

In (84a & 85a), when a singular cardinal number occurs after a singular noun, the suffix for the noun is always dropped, with the cardinal numeral presumably taking up the position of the singular marker. In other words, when a singular noun is modified by a numeral that is cardinality of one, the singularity of the noun is coded by the numeral (one). With a cardinality of two, there is number on both the noun and the numeral as shown in (84b & 85b). This suggests that the cardinal number is distinct from the noun phrase. These examples are structurally translated below.
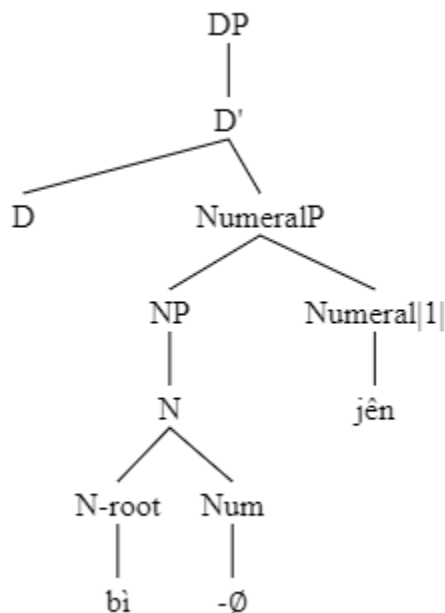
(86)   a.   b
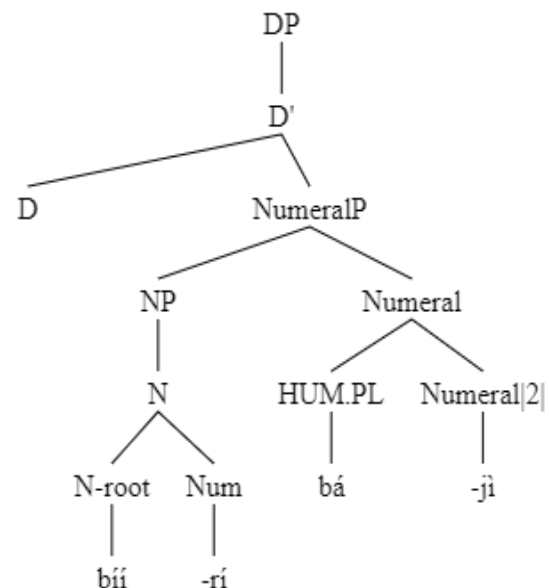
The structures are the same as those of the demonstratives. There however exist some differences. In a noun phrase containing a demonstrative, both the noun and the demonstrative must mark number either for singular or plural such that dropping a number suffix leads to ungrammaticality. With numerals however, a singular suffix becomes null whenever the noun occurs with the numeral with the cardinality of one. For example, sentences like the one (87) are ungrammatical because the noun is number with a singular suffix.

(87)   *bí-é   jên

                        child-SG   one

The singular suffix must not be present in order to have a grammatical phrase. The numeral therefore plays the role of the singular suffix.

3.3.1.3.5 Number and quantifiers

Finally, quantifiers may be part of the noun phrase in Dagaare. A quantifier is a word which indicates the scope of a term to which it attached; it is a determiner to a noun head indicative of quantity. In Dagaare, the particles that denote quantification are *kàŋá* 'some/one', *mìné* 'some' and *zàá* 'all'. When the noun in a phrase is plural, it may occur with either *zàá* or *mìné* but never *kàŋá* and when the noun is singular the particle is always *kàŋá*. Quantifiers are illustrated with these phrases in (89a-c) followed by the phrase representations in (90a-b)

(88)   a.   póg-ó   kàŋá

               woman-SG   INDF

               'some/one woman'

    b.   póg-bó   mìné

               woman-PL   some

               'some women'

    c.   póg-bó   zàá

               woman-PL   all

               'all women'

(89)   a.   b.
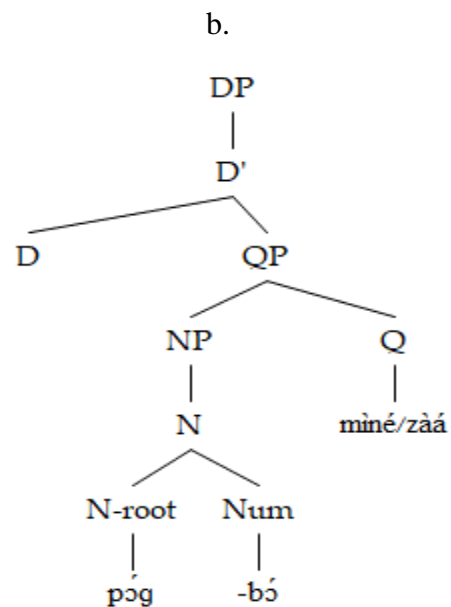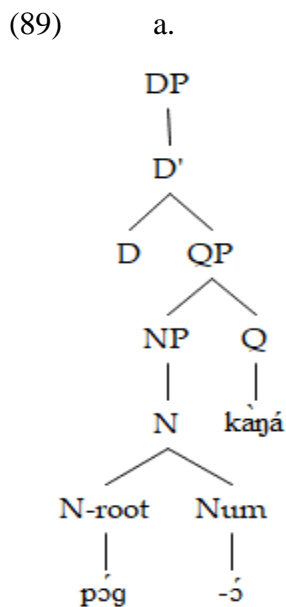
Number always shows up on the noun corresponding to a particular quantifier. When the noun is singular, it occurs with *kàŋá* and when the noun is plural, it occurs with either *mine* 'some' or *zaa* 'all'. The absence of a number suffix on the noun will lead to ungrammaticality. All possible modifiers that form the spine of noun phrase have been discussed. When they all occur in a single phrase, the adjective always inflects for number, the numeral always inflects for number and if not number-neutral, the demonstrative always inflects for number. The following phrase in (91) has the direct structural representation below.

(90) à   pɔ̀g-wɛ́g-rì   ná   zàá   bá-tà

      DET   woman-tall-PL   DEM.DIST   all   HUM.PL-three

      'all those three tall women'
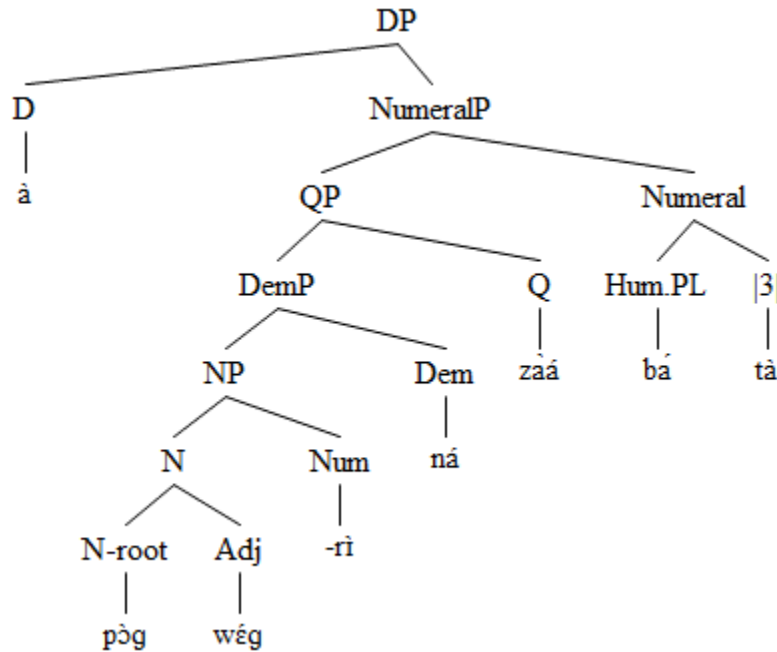
In summary, nominal inflection involves nouns, and various nominal modifiers. At the word-level, number occurs once in both simple and compound forms. When nouns occur on their own, number occurs as a suffix attaching to the root; when a noun is modified by an adjective or a string of adjectives, the last adjective takes the number in lieu of the noun. With ideophonic degree words, there is no morphologically overt number when they occur after a noun head, but it is assumed that number is covertly marked. To express plural with ideophones, a repetition or reduplication is required. For demonstratives and numerals, number is marked on both the noun and the modifier.

3.4 Conclusion

In this chapter, I have discussed the inflectional morphology involving aspectual marking or verbs and number marking on nouns. Inflection in both verbs and nouns has suffixal morphology. Previous studies described verbs as involving a perfective vs imperfective contrast. In this study I have provided evidence that points to the conclusion that verbs in Dagaare mainly consist of a default form and an imperfective form. The previously termed perfective, which always has a high front vowel as the suffix, is the default form. Moreover, there is no evidence of perfective interpretation whenever it occurs with particles such as tense markers. The high vowel does not play any particular role apart from fulfilling some phonotactic requirement such as epenthesis. It agrees in tongue root harmony with the verbal root, but its shape remains unchanged irrespective of the shape of the vowel in the root. The behaviour of this high vowel for default verbs in Dagaare seems to be similar in other Mabia languages but further investigation is required in these languages to assess this claim. For the imperfective form, inflection involves a suffix whose vowel quality always depends on the vowel of the root but is consistently a non-high vowel. This suffix has a dedicated progressive meaning regardless of whether it occurs with past or future tense or if it occurs in imperative context. Given the nature of the default and imperfective forms, I propose that verbal inflection is associated with an interplay of morphology with phonology as well as syntax. That is, morphological structures such as roots determine the phonological forms of the suffixes. With morphosyntax, the default form can occur in different syntactic environments without a particular fixed or dedicated meaning whereas the imperfective always has a progressive reading irrespective of the syntactic frame in which it occurs.

Inflection on nouns presents a more complex situation involving morphophonology, morphosyntax and morphosemantics. Nouns in Dagaare are categorized into classes based on the choice of singular and plural suffixes. This involves ten distinct classes which I classify into three broad groups: phonological, phono-semantic, and semantic classes. Number inflection is effected by various phonological processes such as harmony, vowel lengthening; morphosyntactic processes such as derivation and semantic factors like individuation.

The traditional domain of investigating number in Dagaare has mainly been on the morphophonology of nouns. However, number is not limited to just nouns. Rather it inflects on adjectives, ideophonic degree words, demonstratives and cardinal numerals. Following the

syntactic spine and the DP-hypothesis, I have examined the noun phrase structure in Dagaare showing the elements that can occur with the noun head and how number is inflected on these elements in the Dagaare noun phrase. I have shown that the noun can be followed by adjectives, demonstratives, numerals, quantifiers etc. When an adjective or string of adjectives occurs after a noun head, number is marked on the rightmost adjective (in case there are more than one adjective) and not on the noun. This is because the adjective has a number feature and then when it occurs with a noun in a phrase, it takes on the number suffix in place of the noun. The noun conditions number marking while the adjectives determine the phonological shape of the suffix. In related fashion, degree words such as ideophones also participate in number marking when they occur as nominal modifiers. Ideophones do not undergo any morphological modifications as they do not lend themselves to inflection but when an ideophone occurs with a noun, the number suffix of the noun is elided, thereby suggesting that the number on a noun-ideophone phrase occurs covertly on the ideophone for the singular. With regards to plural, the ideophone on the noun is reduplicated to denote more than one concept.

With demonstratives, the number on a given noun must agree with a given demonstrative. In the plural form, the proximal demonstrative follows human vs. non-human nouns; the singular does not exhibit human/non-human contrast. The distal demonstrative follows a neutral pattern – it has no human/non-human contrast and no singular/plural contrast. Unlike with adjectives, both the noun and the demonstrative inflect for number. Similarly cardinal numerals behave just like demonstratives. A numeral that has cardinality of one always occurs with singular nouns, in which case the numeral always assumes the position of the singular suffix on the noun. Any numeral with cardinality of two and beyond always occurs with plural nouns and in this case both the noun and the numeral inflect for number. Overall, the behaviour of verbs in aspectual inflection and that of nouns in number inflection triggers some curiosity about how inflection works in related dialects of Dagaare and other Mabia languages.

Chapter 4: Harmony patterns

4.1 Introduction

Vowel harmony is a cross-linguistically common phenomenon which differs from language to language in terms of phonological properties and degree of productivity, ranging from robustly productive, less productive to diachronically decayed systems. It is a pervasive phonological pattern which is well attested in African languages of the Niger-Congo (Casali, 2003, 2008), Chadic (Pearce and Lovestrand 2022), Nilo-Saharan family (Rose, 2018). A considerable number of non-African languages from various geographic regions and language families also exhibit various vowel harmony systems. For more discussion of harmony systems outside African languages, see Casali (2008, 2022), Archangeli & Yip (2019), Rose & Walker 2011, Van der Hulst, (2018)

In harmony, neighbouring vowels in some domain agree with each other in terms of some distinctive feature (Bakovic, 2000, 2003). These features are referred to as harmonic features (Pulleyblank 2002; Walker 2012). In terms of phonological dimensions within which harmony operates, the commonest vowel harmony types which have been identified and reported include harmony involving advancement and retraction of tongue root (ATR/RTR harmony), front/back dimension (palatal harmony), rounding (labial harmony) and height. The greatest concentration of languages unquestionably considered as having ATR harmony occurs within the Niger-Congo and Nilo-Saharan language phyla (Casali 2003, 2008). Other harmony types such as rounding/labial, though not as productive and pervasive as tongue root harmony, are also reported in some African languages. For instance rounding is reported in the Fante dialect of Akan (Dolphyne, 1988; O'Keefe, 2004), Nawuri (Casali, 1995), Tafi (Bobuafor, 2013) and a number of Mbam languages of Niger-Congo (Boyd, 2015) while the majority of Chadic languages are reported to exhibit height harmony and/or fronting and rounding harmony (Pearce & Lovestrand 2022).

Discussion on vowel harmony in Dagaare has been severely limited with only a brief description of ATR and rounding harmony in (Bodomo, 1997). (Kuubezelle & Akanlig-Pare, 2017) also provided an analysis of tongue root [TR] harmony in Northern Dagaare (Dagara). Moreover, there is an ongoing study (Akinbo et al. in prep) which focuses specifically on the phonetics of Dagaare ATR harmony. The objective of this chapter therefore is to give a comprehensive description and analysis of both ATR and rounding/backness harmony in Dagaare. The chapter presents an account

for the harmony patterns that manifest in Dagaare based on theoretical models as Optimality Theory – OT (Mccarthy, 2011; McCarthy & Prince, 1993b; Prince & Smolensky, 2004a). The chapter proceeds as follows: Section 4.2 presents the vowel inventory structure, ATR harmony in nouns, verbs, possessive phrases and compounds as well as the status of low vowels. In section 4.3, rounding and other harmonies involving the imperfective are described. This section also discusses the status of the low vowels in rounding/backness harmony. Sections 4.4-4.5 present an overview of various OT approaches to vowel harmony analysis. The formal account of tongue root harmony in terms of OT in 4.6 while rounding is presented in section 4.7. Section 4.8 provides a conclusion of the chapter.

4.2 Tongue root harmony: vowel inventory structure

An issue of recurrent interest in descriptive, theoretical and typological considerations of tongue harmony systems is the topic of value asymmetries. It has long been known by linguists that there exist languages in which [RTR] vowels regularly assimilate to [ATR] vowels (Archangeli & Pulleyblank, 1994; Bakovic, 2000; Casali, 2003, 2008, 2022). Typical examples include Degema and Diola-Fogny, a Maasai language. Conversely there are equally widely attested cases in which tongue root harmony languages such as Yoruba (Archangeli & Pulleyblank, 1989) are analysed in terms of spreading [RTR] feature.

The dominant tongue root value in a language correlates strongly with the vowel inventory structure of the language (Casali 2016, 2022). There are languages that show tongue root contrast in high vowels and languages in which tongue root position is contrastive only in non-high vowels. Languages that show high-vowel contrast are termed /2IU/ languages and those that exhibit contrast in mid vowels are referred to as /1IU/ (Casali, 2008, 2022).

In terms of /2IU/ systems, some languages involve fully-balanced (symmetric) systems with equal numbers of [ATR] and [RTR] vowels – each [ATR] vowel phonemically contrasts and often alternates harmonically with a [RTR] vowel with which it varies only in tongue root position. /2IU/ systems involve languages which show contrast in high vowels. A balanced /2IU/ system is a ten-vowel system as found in Degema (Fulop et al., 1998; Kari, 2007; Casali 2022). Moreover, there are asymmetric /2IU/ cases involving seven- and nine-vowel systems such as Kinande and Akan respectively. The attested inventories are shown below for Akan and Kinande.

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(1) Nine-vowel /2IU/ inventory (e.g., Akan, Maasai)

/i/   /u/

/ɪ/   /ʊ/

/e/   /o/

/ɛ/   /ɔ/

    /a/

(2) Seven-vowel /2IU/ inventory (e.g., Kinande, Lugungu)

/i/   /u/

/ɪ/   /ʊ/

/ɛ/   /ɔ

    /a/

Languages under /1IU/ systems exhibit contrast only in mid vowels. A typical example is Yoruba (Casali 2008, 2022). This is illustrated below.

(3) Seven-vowel /1IU/ inventory

/i/   /u/

/e/   /o/

/ɛ/   /ɔ/

    /a/

Dagaare, previously reported as a nine-vowel system (Bodomo, 1997) is a /2IU/ system given the contrast in high vowels. Based on Bodomo's claim, Dagaare can be considered as an asymmetric system involving four pairs of contrastive non-low vowels and a non-contrastive [RTR] low vowel [a]. Recent studies (Angsongna & Akinbo, 2022; Ozburn et al., 2018) show that Dagaare has ten contrastive vowels, representing a fully-symmetric balanced system involving equal numbers [ATR] and [RTR] vowels. The low vowel [a] in these studies has been found to have an advanced counterpart [ə]. Therefore, there are five [ATR] vowels and five [RTR] vowels. Below is the ten-vowel inventory of Dagaare.

(4) Ten-vowel /2IU/ inventory of Dagaare

/i/   /u/

/ɪ/   /ʊ/

/e/   /o/

/ɛ/   /ɔ/

       /ə/

       /a/

With this system, harmony is typically manifested in two ways: (i) within a root morpheme, all vowels must generally come from the same tongue root [TR] set of vowels – [ATR] and [RTR] vowels do not occur together root-internally and (ii) affix vowels alternate harmonically in their surface tongue root quality in agreement with vowels of the root to which they are adjoined.

(5) Root-internal and root– to – suffix tongue root harmony

ATR	Gloss	RTR	Gloss
tù-ó	'baobab-SG'	bʊ́-ɔ́	'goat-SG'
bí-é	'child-SG'	pɪ́-ɛ́	'roof-SG'
bùg-ó	'silo-SG'	bʊ̀ŋ-ɔ́	'donkey-SG'
nə̀ɲìg-é	'thief-SG'	zɔ̀mìŋ-ɛ́	'friend-SG'

The suffix vowels in these examples harmonize with the vowels of the roots. This kind of assimilation has been commonly discussed under the term root-control (Bakovic, 2000, 2003; Clements, 1985). Such symmetric patterns, according to (Casali, 2003) correlate with the general assumption that /2IU/ languages have the tendency of showing [ATR] dominance – a case in which an [RTR] suffix shows up as [ATR] by virtue of an [ATR] root.

However, by themselves these symmetric patterns do not always provide explicit evidence for considering either tongue root value as the dominant, spreading feature. Therefore, if such patterns are what a particular language has, then it is plausible to assume that both [ATR] and [RTR] features pattern symmetrically in all relevant environments, thereby suggesting that harmony is totally a matter of root-control. So that, if the root contains vowels of ATR value, the suffix assimilates that feature and if the root is has RTR vowels, the suffix takes on the RTR feature.

Languages in which [ATR] features pattern symmetrically are reported to be uncommon, but it is possible to find cases where [ATR] is the spreading feature in some /2IU/ languages. Following Casali (2002, 2003; 2022), the most straightforward kind of evidence of [ATR] spreading in /2IU/ languages involves cases in which [ATR] affixes spread their ATR property onto adjacent [RTR] roots. Leftward spreading of [ATR] quality from an [ATR] suffix onto preceding root vowels is a typical case in Maasai as illustrated with the following examples in (Casali 2008: 514)

(6)   a.   ɛ́-sój   's/he will follow'
                  3sg-follow

         b.   e-suj-ie   's/he will follow using it (e.g. a car)
                  3sg-follow-INSTR

Casali (2022) identifies several other patterns that are possibly representative of [ATR] dominance which are found in /2IU/ languages. These include (i) spreading (mostly leftward) of [ATR] across word boundaries and/or between adjacent roots in compounds (ii) systematic preservation of [ATR] in coalescence of adjacent vowels of opposite [RTR] values (e.g. /ɛ+i/ → [e]), (iii) a pattern termed allophonic [ATR] dominance in which a phonemically unpaired [RTR] vowels (mostly /a/) has a predictable [ATR] allophone that occurs only in contexts where its tongue root value is simply attributable to spreading from neighbouring [ATR] vowels and (iv) a pattern (termed weak assimilatory [ATR] dominance). This pattern according to Casali (2003) involves cases in which some suffix in a word harmonises for [ATR] with root morphemes in some contexts but not others or it does not harmonise but surfaces invariably in [RTR] form. Whether Dagaare aligns with one or some of these patterns is not immediately known. In the upcoming sections, we will examine these issues.

4.2.1   Tongue root harmony in nouns: alternations in number suffixes

A simple noun in Dagaare consists of a noun root or the root and a suffix. The suffixes that occur with nouns are number suffixes, singular and plural. These suffixes vary depending on the class of the noun. Refer to chapter 3 for discussion of the noun class system of Dagaare. See also (Bodomo, 1997; Bodomo & Marfo, 2006) for a list of the noun class suffixes. If the noun is made up of only the root, all vowels are always within the domains of a particular tongue root feature as in the following.

(7) Root internal harmony

ATR   RTR

túú   'forest.SG'   kɔ̀lóŋ   'well. SG'

də̀júú   'rat. SG'   tònzûŋ   'headpad. SG'

Then if there are number suffixes, they alternate harmonically with the roots. That is, the vowels in the suffix agree in tongue root specifications with the vowels in the root. Consider the examples below (8a-b). The vowel of the suffix is [ATR] when the preceding root contains an [ATR] vowel; the suffix vowel is [RTR] when vowel in the preceding root is [RTR].

(8) Nominal suffixes

   a. -V suffixes

ATR   RTR

zí-é   'place-SG'   tì-ɛ́   'tree-SG'

dù-ó   'warthog-SG'   dʊ̀-ɔ́   'dawadawa-SG'

tíŋ-é   'feast-PL'   tíŋ-ɛ́   'ground-SG

bùg-ó   'silo-SG'   bʊ̀ŋ-ɔ́   'donkey-SG

kóg-ò   'mahogany-SG'   lɔ́ŋ-ɔ́   'frog-SG'

lǒŋ-ò   'hourglass drum-SG'   sɔ́ŋ-ɔ̀   'basket-SG'

   b. -CV suffixes

ATR   RTR

jí-rì   'house-SG'   pɪ́ɪ́-rì   'sheep-PL'

bíí-rí   'child-PL'   sɪ́ɪ́-rí   'waist-PL'

kùù-rí   'hoe-SG'   bʊ̌ʊ̀-rí   'goat-PL'

tò-bó   'ear-PL'   kɔ́-bɔ́   'bone-PL'

tíg-rí   'feast-SG'   síg-rí   'hut-PL'

lín-ní   'lid-PL'   sìn-ní   'deep water pot-PL'

In the next section, I give examples demonstrating that the domain of harmony in Dagaare also includes verbal morphology, triggering alternations in aspectual suffixes.

4.2.2 Tongue root harmony in verbs: alternations in aspectual suffixes

The basic verbal inflectional morphology in Dagaare consists of the verb root and an aspectual suffix. The selection of the verb form is determined by the aspectual context, which has been described in terms of a perfective vs. imperfective contrast (Bodomo, 1997; Saanchi, 2003). As discussed in chapter 3, I refer to the so-called perfective form as a default verb form which is composed of just the verb root and a suffix, or it may just be the root with no overt suffix. The suffix, if present always contains the front high vowel [i/ɪ] whose tongue root value is dependent on the value of the vowel in the root. The suffix vowel never changes regardless of the environment in which it occurs. In terms of the imperfective, there are always two overt morphemes: root followed by either a -V suffix or a -CV suffix. Unlike the default case, this suffix marks imperfective and nothing else. Descriptively, the imperfective suffix is either a vowel, [rV] or [nV] with the vowel quality determined by the phonology. That is, the tongue root quality of the vowel in the suffix is determined by the tongue root value of the vowels in the verbal root. (Refer to chapter 3 for discussion of inflectional morphology). Now, consider the following verbs and the harmonic alternation between roots and suffixes.

(9) Verbal suffixes

    a.   -V suffixes

           i. Default

ATR		RTR	
wùlì	'show.V'	bòrì	'sow.V'
pùòrì	'greet.V'	kòòrì	'sell.V'
hə́ə́rì	'yawn.V'	háárì	'shoo.V'

          ii. Imperfective

ATR		RTR	
wùl-ó	'show-IPFV'	bòr-ɔ́	'sow- IPFV'
pùòr-ó	'greet- IPFV'	kòòr-ɔ́	'sell-IPFV'
hə́ə́r-!ə	'yawn- IPFV'	háár-!á	'shoo- IPFV'

b. -CV suffixes

    i. Default

ATR		RTR	
kpìnnì	'extinguish.V'	pènnì	'rest.V'
ɲùnnì	'smell.V'	zànnì	'learn.V'
lònnì	'hurry.V'	mánnì	'describe.V'

    ii. imperfective

ATR		RTR	
dì-ré	'eat- IPFV'	dí-!rɛ́	'take- IPFV'
túú-rò	'dig- IPFV'	tʋ́ʋ́-rɔ̀	'insult- IPFV'
dúó-rò	'climb- IPFV'	dʋ́ɔ́-rɔ̀	'weed-IPFV'
síg-rè	'descend- IPFV'	sɛ́g-rɛ̀	'write-IPFV'
pùg-ró	'praise- IPFV'	dʋ́g-rɔ̀	'boil/cook- IPFV'

As in the case of the nominal suffixes, the vowel of the aspectual marker is either ATR or RTR depending on the verbal root. Observe also that aside from the agreement in tongue root quality between the suffix and verbal root, there is also agreement in rounding/backness and low feature between the imperfective suffix and the verbal root. This is further discussed in section 4.3 below.

4.2.3 Alternations in possessive CV pronouns

The domain of tongue root harmony in Dagaare is not limited to only nominal and verbal suffixes. There are proclitics/prefixes which also undergo tongue root harmony. Until recently (Archangeli and Pulleyblank 2022; Akinbo et al. in prep) where proclitics have been mentioned in tongue root harmony, they were rarely mentioned in previous studies. In the examples that follow, non-low prefix vowels alternate between advanced and retracted vowels based on the tongue root quality of the following root vowel. In (10a), the second person singular possessive is [fù] when the following nominal root vowel is [ATR], but [fʋ̀] when the following vowel is [RTR]. Similarly, in (10b), the first-person possessive plural is [tì] when following an [ATR] root vowel and it is [tɪ̀] when the following root vowel is [RTR]

(10)   Harmonic proclitics

a. 2SG possessive pronoun

ATR   RTR

fù=bíí-rí   'your children'   fò=píí-rì   'your sheep'
2SG=child-PL   2SG =sheep- PL

fù=kóg-ó   'your chair'   fò=pɔ́g-ɔ́   'your woman/wife'
2SG =chair-SG   2SG =woman- SG

fù-wì-rí   'your horse'   fò-dʊ́g-ì   'your pot'
2SG =horse- SG   2SG =pot- SG

fù=dè-rí   'your houses'   fò=wɛ́g-rì   'your logs'
2SG =house- PL   2SG =log- PL

b. 1PL possessive pronoun

ATR   RTR

tì=bíí-rí   'our children'   tì=píí-rì   'our sheep'
1PL=child- PL   1PL =sheep- PL

tì=kóg-ó   'our chair'   tì=pɔ́g-ɔ́   'our woman'
1PL =chair- SG   1PL =woman- SG

tì=wì-rí   'our horse'   tì=dʊ́g-ì   'our pot'
1PL =horse- PL   1PL -pot- SG

tì=dè-rí   'our houses'   tì=wɛ́g-rì   'our pot'
1PL =house- PL   1PL =log- PL

The harmonic feature of the proclitic and the suffix vowels is triggered by the root vowel. This shows bidirectionality – a case in which a harmonic feature spreads rightward to a suffix and leftward to a prefix or proclitic. This is a case typically described as affixal harmony. Furthermore,

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the patterns are indicative of [ATR] root dominance in which an [ATR] root spreads its harmonic feature to the proclitic and the suffix. Following the preceding presentation of data, tongue root harmony is morphologically conditioned. Thus, it operates in two levels: root/word-level and phrase level, both root-controlled. At the word-level harmony spreads rightward from the root and at the phrase-level, the harmonic feature operates bidirectionally, from the root to the proclitic/prefix and the suffix. A look at the harmony pattern in both nouns and verbs shows a clear invariance of root vowels. In this case, harmonic property of the root vowels remains unchanged regardless of what form the proclitics and suffixes take. This invariance is described as phonological asymmetry which is common in languages with root-controlled harmony.

4.2.4   Tongue root harmony in compounds

Compounding is a productive morphological process in Dagaare. Compounds are words that contain more than one root. They may consist of a combination of two or more roots. The roots in a compound word may be harmonic or disharmonic in terms of tongue root. That is, there are harmonic compounds with the roots agreeing in same tongue root value or there are compounds that are disharmonic in which the roots have distinct tongue root values. The possibilities are as follows: [ATR]-[ATR], [ATR]-[RTR], [RTR]-[RTR], [RTR]-[ATR]. The most productive compounds in compounds in Dagaare are noun-noun (N-N) and noun-adjective (N-A) compounds. Noun-verb (N-V) and verb-verb (V-V) compounds are less common. Harmony, when observed in compounds is generally accidental because there is no alternation in tongue root value in the roots that form the compounds. I give illustrative examples of compounds which are made up of roots of identical tongue root feature in section 4.2.4.1 and compounds involving roots of different tongue root features in 4.2.4.2.

4.2.4.1 Compounds with roots of same [TR] feature

In harmonic compounds, the tongue root value of the roots is the same. The compounds in (11a) illustrate harmonic N-N compounds while those in (11b) show harmonic N-A compounds.

(11)   Compounds

a. Noun-Noun compounds

ATR

Noun	Gloss	Noun	Gloss	Compound	Gloss
dìó	'room'	bíé	'child'	dìó-bíé	'cat'
kòró	'food storage'	dìó	'room'	kòró-dìó	'kitchen'
zû	'head'	pílí	'cove/mat'	zú-!pílí	'hat/cap'

RTR

Noun	Gloss	Noun	Gloss	Compound	Gloss
tìèní	'chin'	kɔ́mɔ́	'hair'	tìèŋ-kɔ́mɔ́	'beard'
gbɛ́rì	'leg'	púɔ́	'inside'	gbɛ́-!púɔ́	'sole (of foot)'
mɔ́ɔ́	'bush/grass'	náá!bʊ́	'cow'	mɔ̀-náá!bʊ́	'buffalo'

b. Noun-adjective compounds

ATR

Noun	Gloss	Adjective	Gloss	Compound	Gloss
bùgó	'silo'	bílé	'small'	bùg-bílé	'small silo'
vǐgì	'owl'	bílé	'small'	vǐg-bílé	'small owl'
bìrìjùó	'duck'	bílé	'small'	bìrìjù-bílé	'small duck'

RTR

Noun	Gloss	Adjective	Gloss	Compound	Gloss
dáǎ̀	'alcohol'	zìɛ́	'red'	dáǎ́-zìɛ́	'pito (local beer)'
púɔ́	'stomach'	pɛ́lí	'white'	pò-pɛ̀lì	'happiness'
gbɛ́rì	'leg'	kpêŋ	'big'	gbɛ́-kpêŋ	'thigh (lit: big leg)'
zɔ̀mìŋɛ́	'friend'	fáá	'bad'	zɔ̀mìɱ-fáá	'bad friend'

4.2.4.2 Compounds with roots of different [TR] feature

The data below are illustrations of compounds involving noun-noun roots in (8a) and noun-adjective roots in (8). The roots disagree in tongue root feature.

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(12)   Compounds

a. Noun-noun compounds

Noun	Gloss	Noun	Gloss	Compound	Gloss
bí-é	'child-SG'	dɔ́ɔ́	'man.SG'	bì-dɔ́ɔ́	'boy.SG'
bí-é	'child-SG'	pɔ́g-ɔ́	'woman- SG'	bì-pɔ́g-ɔ́	'girl-SG'
zû	'head.SG'	kɔ́m-ɔ́	'hair-PL'	zú-!kɔ́mɔ́	'hair (on head)'

b. Noun-adjective compounds

Noun	Gloss	Adjective	Gloss	Compound	Gloss
bí-é	'child- SG'	lɛ̀ɛ́	'small'	bì-lɛ̀ɛ́	'baby. SG'
bí-é	'child- SG'	fáá	'bad'	bì-fáá	'bad child. SG'
síg-í	'hut- SG'	bílé	'small'	sìg-bíl-é	'small hut. SG'
kɔ̀lɔ́ŋ	'well. SG'	zùlúŋ	'deep'	kɔ̀lɔ́ŋ-zùlúŋ	'deep well. SG'

As stated already, this harmony in compounds is a result of accidental combination of roots that share same tongue root feature. They do not involve alternation in harmonic feature. Disharmony in compounds is a common phenomenon in related Mabia languages such as Buli (Akanlig-Pare, 1994, 2002), Birifor (Dundaa, 2013), Waali (Abdul-Aziz 2015) and Dagara (Kuubezelle & Akanlig-Pare, 2017). The failure to have harmony across the roots in compounds is result of an opacity effect triggered by the adjacency of word boundaries, one at the right edge of the first root and the other on the left edge of the second root.

4.2.4.3 Harmonic compounds

Given the disharmonic cases above, it is easy to argue that [ATR] roots do not influence the ATR feature of the [RTR] roots in a compound. However, there are cases in which [ATR] roots change the quality of [RTR] roots. There are cases in which cross-word harmony applies between roots regressively – spreading harmonic feature from right to left. The following data are illustrations.

(13)   Harmonic compounds

RTR root	Gloss	ATR root	Gloss	Compound	Gloss
gbɛ́-rì	'leg-SG'	mún-í	'bottom- SG'	gbé!mún-í	'heel- SG'
gbɛ́-rì	'leg- SG'	bì-rí	'seed- SG'	gbébì-rí	'toe- SG'

nʊ́-ɔ̀	'hen- SG'	bílé	'small'	nóbíl-é	'chick- SG'
bʊ́-ɔ́	'goat- SG'	léé	'small'	bùléé	'kid. SG''
báá	'dog. SG'	léé	'small'	bɛ̀léé	'puppy, SG''

In short, it is not always the case that combinations of disharmonic roots surface as a disharmonic compound. Rather, some [ATR] roots, when combined with [RTR] roots result in harmonic [ATR] compounds. Similar to what is seen with possessive pronouns, these are cases where leftward spreading of [ATR] occurs across adjacent roots in compounds. In all cases, the dominant feature is [ATR] and it forces an otherwise [RTR] root to emerge as [ATR].

4.2.5   Status of the low vowel /a/ in tongue root harmony

A topic of recurrent research interest in many tongue root harmony languages within Niger-Congo is the status of the low vowel /a/. In some /1IU/ languages the generalization is that harmonising affixes consistently appear in their [RTR] allomorphs when they occur with the low /a/ as the only root vowel, e.g. Yoruba (Archangeli & Pulleyblank, 1989). This same generalisation holds true of some /2IU/ languages. It is reported (Boyd 2022) that in tongue root-languages with seven or nine vowels, the inherently [RTR] low vowel /a/ may occur in [ATR] environment. This involves three main harmony-resolution processes: (i) the vowel /a/ has a predictable non-contrastive [ATR] quality. That is in [ATR] contexts /a/ may be realised as [ATR] as in Kinande which has seven contrastive vowels and three predictable [ATR] variants including the advanced low [a̹] (ii) the low vowel /a/ is realised as [a] as disharmonic and transparent as it does not undergo any phonetic change and allows [ATR] spread through it. Manila, a Bantu M language is analysed as having a disharmonic and transparent /a/– it is underlyingly [RTR] but is transparent and surfaces in [ATR] contexts without a change in quality (Kutsch Lojenga, 2008). Some examples in Boyd (2022) are given below for Manila.

(14)   Manila (M24)

ATR		RTR	
in-ta-**líi**-**mil**-a 'I will not drink'		ɪn-ta-lí-sɔgɔl-a	'I will not leave'
u-ta-**líi**-**mil**-a 'you will not drink'		ʊ-ta-lí-sɔgɔl-a	'you will not leave'

The vowel /a/ is also realised as disharmonic and opaque because it does not undergo any phonetic change and it blocks the spreading of [ATR] feature. Kwamba, a Bantu D language of Western

Uganda is shown to have cases involving opaque /a/. Harmony in this language operates from right to left. But in the examples (Boyd 2022) below any vowel that occurs to the left of /a/ is obligatorily [RTR].

(15)   Kwamba (D22)
         mʊ-lwan-i   'fighter'
         ɓʊ-yamb-i   'help'

There are also cases like Kikuyu where the vowel /a/ blocks [RTR] feature from spreading (Leitch 1996) as in tɛt-an-er-a 'indulge in mutual recrimination'. It may also be transparent, allowing [RTR] feature pass through. Finally, Leitch (1996) gives examples from Babole a Bantu C language in which the low vowel /a/ in verbal suffix assimilates to the vowel preceding it. The vowel assimilates to either of the mid vowels /ɛ/ and /ɔ/.

In Dagaare which is a /2IU/ language, the status of the low /a/ in ATR has raised some interesting debates among researchers. As cited in Bodomo (1997), Kennedy (1966) argues that /a/ occurs with vowels showing open harmony and excludes vowels that exhibit close harmony. Hall (1973) suggests that /a/ occurs with [ATR] vowels to the exclusion of [RTR] vowels. According to Bodomo (1997), /a/ occurs with [ATR] and [RTR] vowels within the same domain, thereby suggesting that /a/ is neutral to tongue root harmony. There is, however, phonetic and phonological evidence supporting the existence of phonologically contrastive low vowels in Dagaare. More recent studies (Angsongna & Akinbo, 2020; Ozburn et al., 2018), show that the low vowel /a/ is not neutral to tongue root harmony, but surfaces as ATR vowel when in the target position of ATR harmony. The advanced counterpart of /a/ is transcribed here as [ə]. The following examples show how low vowels in the third person plural (3PL) possessive alternate between advanced and retracted low vowels.

(16)   3PL possessive pronoun
         ATR   RTR
         bə̀=bíí-rí   'their children'   bà=tìì-rí   'their trees'
         3PL=child-PL   3PL =tree- PL

         bə̀=kóg-ó   'their chair'   bà=pɔ́g-ɔ́   'their woman'
         3PL =chair- SG'   3PL =woman- SG'

| bὲ=dὲ-rí | 'their houses' | bà=wέg-ὲ | 'their log' |
| 3PL =house- PL | | 3PL =log- SG' | |

| bὲ=lúg-ó | 'their pillar' | bà=dɔ́g-ì | 'their pot' |
| 3PL =pillar- SG' | | 3PL =pot- SG' | |

As shown in (16), the vowel in the possessive pronoun is [ə] when the following root is [ATR] and it is realised as [a] when the root is [RTR]. Moreover, preverbal particles containing low vowels undergo [ATR] harmony in the contexts of neighbouring ATR vowels. Evidence of this is based on acoustic analysis of the following examples in Angsongna & Akinbo (2022) Ozburn et al. (2018). As shown in (17a) below, the imperative negation marker is realised as [tá] when it precedes a vowel with [RTR] quality and then it is surfaces as [tə́] when preceding an [ATR] vowel. In (17b), the past tense particle is [dà] when the vowel in the following verb is [RTR] and it becomes [dὲ] when the vowel in the following verb is [ATR]. Moreover, in (17c) the future tense marker is realised as [nà] when the vowel in the following verb is [RTR] and it becomes [nὲ] when the following vowel is [ATR]. Finally, the negation in (17d) is [bá] when preceding a verb with an [RTR] vowel, but as [bə́] when the following verb contains an [ATR] vowel.

(17)   Alternations in preverbal particles

a.   bə́júó, tá=dí dííbú   'Bạyuo, don't take food
      bájɔ̀ɔ́, tə́=dí dííbú   'Bayɔɔ, don't eat food'

b.   bájɔ́ɔ̀   dà=dí là bέŋὲ   'Bayɔɔ took beans'
      bə́júó   dὲ=dí là dííbú   'Bạyuo ate food'

c.   bájɔ́ɔ̀   nà=dí là bέŋὲ   'Bayɔɔ will take beans'
      bə́júó   nὲ=dí là dííbú   'Bạyuo will eat food'

d.   bájɔ̀ɔ́   bá=dògí bέŋὲ   'Bayɔɔ hasn't cooked beans'
      bə́júó   bə́=dí dííbú   'Bạyuo hasn't eaten food'

These examples show that tongue harmony applies regressively outward from the verb root to the preverbal particle, right to left – root-controlled harmony.

The advanced low vowel [ə] is not restricted to only pronominal clitics and preverbal particles and does not only arise in [ATR] contexts, but there are some verbal roots which contain advanced low vowel [ə]. These examples are based on Saanchi's (1997) claim that Dagaare indeed has ten vowels which include two contrastive low vowels.

(18)　　　　Minimal pairs with low vowels

ATR		RTR	
və́	'scorch.v'	vá	'hit.v'
hə́ə́rì	'yawn.v'	háárì	'shoo.v'
hə́lí	'widen.v'	hálí	'stink.v'
sə́ə́rì	'gather.v' (in bulk)'	sáá-rì	'broom-SG'
bə̀ə̀r-ə́	'smart-IPFV'	bàà-rá	'grow-IPFV'
wə́ə́lì	'bruise.v'	wáálì	'steam.v'

The vowels of the suffixes are [ATR] when attached to a verbal root with advanced [ə] and [RTR] when attached to a verb root with [a]. This is an indication that the low vowels [ə, a] are not only targets but they also condition tongue root harmony.

Crucially, although it is reported in Northern Dagaare – Dagara (Kuubezelle 2013) and in Western Dagaare – Bɪrɪfɔ (Dundaa 2013) that /a/ co-occurs with both [ATR] and [RTR] vowels, it has also been reported that Southern Dagaare (Waale) (Abdul Moomin, 2015) has ten vowels with the advanced low vowel being transcribed as [ạ]. The claim in Southern Dagaare further confirms that there is an advanced low vowel in at least some varieties of Dagaare. This then invites some further investigation of the vowel inventory of the other varieties.

In general, the data shows that tongue root harmony in Dagaare is limited to vowels and intervocalic consonants in the sense that within a harmonic domain, vowels act as triggers and targets while intervocalic consonants are non-harmonic but transparent.

4.2.6   Summary

Tongue root harmony is productive in Dagaare with the alternation occurring between nominal roots and number suffixes, verbal roots and aspectual suffixes. It is a symmetric balanced system involving equal number of ATR and RTR vowels. The domain of harmony is not restricted only to nominals and verbal suffixes; nominal proclitics in possessive phrases and preverbal particles also undergo tongue root harmony in Dagaare. It is also observed that compound nouns can be (dis)harmonic with sequences such as [ATR]-[ATR], [ATR]-[RTR], [RTR]-[RTR] and [RTR]-[ATR]. This (dis)harmony in compounds is seemingly accidental in that there is no alternation in tongue root value in the roots that form the compounds. However, there are cases involving compounds which truly exhibit regressive tongue root harmony in which the [ATR] feature of the rightmost root spreads leftward to the other root. The examples in the preceding sections show that both [ATR] and [RTR] features pattern symmetrically particularly in simple words, suggesting that harmony is completely a matter of root-control, given that all elements/affixes (e.g. proclitics, preverbal particles and suffixes) immediately surrounding a root consistently assimilate to the tongue root value of the root vowels. Finally, the low vowel [a] which has previously been reported as neutral is in fact not neutral. Recent research has shown that there is an advanced low vowel [ə] which is realised in pronominal and verbal clitics and occurs in verbal roots and suffixes as well. There also verbal and nominal roots with advanced low vowels which trigger harmony of suffixes. Though the presence of an advanced low vowel is not known in other varieties like Dagara and Birifor, there is evidence that it exists in others such as Central and Southern.

4.3 Rounding harmony

Rounding harmony (also referred to as labial harmony) is a phenomenon in which vowels within a certain domain agree in lip rounding – all vowels are either round or all vowels are unround (Kaun, 1995, 2004). Rounding harmony is a phenomenon found in languages around the world but is predominantly found in the languages of Central Asia, Siberia and Mongolia (Kaun 1995, 2004; Kaun & McCollum 2022). It has also been reported in North American languages such as Yowlumne (Archangeli, 1984) and in African languages of the Niger-Congo family such as Chumburung, Dagaare and Igbo (Bodomo, 1997; Krämer, 2008; Van der Hulst & Van de Weijer, 1995), Fante, a dialect of Akan (Dolphyne 1988; O'Keefe 2004) and Nawuri (Casali 1995). Languages that exhibit rounding harmony often show harmony for another feature (Rose &

Walker, 2011). That is, there are certain themes that characterise the patterns observed in rounding harmony. For instance, a number of languages show both rounding and backness harmony e.g., Ewe (Odden 1991). There are languages in which rounding applies only when the target is high as in Nawuri (Casali, 1995) or when both trigger and target are high vowels. Rounding harmony also applies in some languages so long as the trigger and target agree in height as in Sibe (Li, 1996). There are also instances of rounding and tongue root harmony occurring together in a language such as Fante (Dolphyne 1988; O'Keefe 2004). Therefore, rounding harmony as a whole is often described as parasitic (Steriade, 1981; Kaun & McCollum 2022) given that it is usually conditioned by other vowel features such as height and backness.

Rounding harmony in Dagaare is mainly restricted to the imperfective form of the verb (Bodomo 1997) and cases of agentive reduplication. As will be shown in section 4.3.2, there are also few cases of rounding in nouns, which is not regular as compared to the verbs. True to the claim by Rose and Walker (2011), Dagaare is an example of a language which exhibits rounding in addition to harmony in other features. Rounding harmony in Dagaare operates in tandem with backness and tongue root harmony. That is since Dagaare has no front round vowels, all non-low vowels within a domain are round and back or all are unround and front. Moreover, there is tongue root agreement in the vowels within a domain, whether round or unround.

While rounding harmony is sensitive to height in some languages, in Dagaare, rounding harmony does not necessarily apply based on the height of vowels within a word. For instance, while the verbal root may contain a high or mid vowel or both, the following imperfective suffix is always a non-high vowel. With respect to the low vowels, when the root has a low vowel, the vowel of the imperfective suffix is always low. When rounding occurs in a language that exhibits other harmony systems, it often tends to be a more restricted harmony pattern (Kaun, 1995; Van der Hulst, 2018; van der Hulst & Moskal, 2013) as compared to other harmonies such as tongue root harmony. This correlates with the observation that rounding harmony in Dagaare is associated with only imperfective form of verbs as compared to tongue root harmony which is present across the whole language.

It is important to note that aside from the Central variety of Dagaare, rounding harmony is reported in Birifor particularly in reduplication (Dundaa 2013). It is however absent in Dagara (Kuubezelle,

2013) and in Waali (Abdul Moomin, 2015). In the follow section, I provide a description of the rounding pattern in verbs with illustrative examples.

4.3.1 Rounding in verbs: alternations in aspectual suffixes

As noted in section 4.2.2, a Dagaare verb is made up of the verb root and an aspectual suffix, marking either default aspect (so-called perfective aspect) or imperfective aspect. The default form is made up of the root and the high front vowel [i/ɪ] or it is unmarked if the root is vowel final while imperfective form always has a root and an overt suffix, -V or -CV. A description of how verb roots interact with the aspectual suffixes is given in the sections that follow.

4.3.1.1 Default verb forms

The suffix of default verb if any, always has a high front vowel regardless of what shape the root vowel takes. This means that the high vowel is never sensitive to rounding and backness even if it harmonises with the root in terms of tongue root feature.

(19)   Default verb forms

ATR   RTR

wùlì   'show/teach.v'   bòrì   'sow.v'

tùùrì   'pick.v'   kòòrì   'snore.v'

kpérí   'slice.v'   kpɛ́rí   'spill.v'

hɔ́ɔ́rì   'yawn.v'   háárì   'shoo.v'

kpìnnì 'extinguish.v'   zànnì   'learn.v'

The examples in (19) show that rounding harmony does not happen with default verb forms in Dagaare. Next is the imperfective verbs.

4.3.1.2 Imperfective verbs

Similar to the default forms, the vowel quality of the imperfective is completely predictable. The imperfective suffix always has a non-high vowel which always harmonises with the preceding root in terms of rounding, backness, tongue root and [±low] feature. In effect, whenever the verb root contains a round and back vowel, the imperfective suffix is also round and back as illustrated in (20a) and when the root vowel is unround and front, the vowel in the imperfective suffix is unround

and front as shown in (20b). Finally, when the vowel in the verb root is low, the imperfective suffix is also low as shown in (20c).

(20)   Imperfective suffixes

a.   ATR   RTR

bùr-ó   'soak-IPFV'   bòr-ɔ́   'sow-IPFV'

wùl-ó   'show/teach- IPFV'   sɔ́r-ɔ̀   'count/read- IPFV'

túú-rò   'dig- IPFV'   tʊ́ʊ́-rɔ̀ 'insult- IPFV'

dúó-rò 'climb- IPFV'   dʊ́ɔ́-rɔ̀ 'weed- IPFV'

b.   ATR   RTR

jíél-!é   'sing- IPFV'   jíɛ́l-!ɛ́   'winnow- IPFV'

dì-ré   'eat- IPFV'   dí-!rɛ́   'take- IPFV'

síg-rè   'descend- IPFV'   sɛ́g-rɛ̀ 'write- IPFV'

lé-rè   'tie- IPFV'   síɛ́-rɛ̀   'roast- IPFV'

c.   ATR   RTR

hɔ́ɔ́r-!ɔ́ 'yawn- IPFV'   háár-!á 'shoo- IPFV'

sɔ́ɔ́r-!ɔ́ 'gather- IPFV' (in bulk)'záá-rà 'throw-IPFV'

bɔ̀ɔ̀r-ɔ́ 'smart- IPFV'   bàà-rá 'grow-IPFV'

gɔ́ɔ́r-!ɔ́ 'belch- IPFV'   dáá-!rá 'push- IPFV'

The patterns exhibited by the default verb form and imperfective form simply suggests that rounding harmony is morphologically restricted to the imperfective suffix whose rounding is based on vowel height – non-high vowels. Thus, rounding/backness/[±low] harmony targets only non-high vowels and that explains why the high vowel in the default suffix is never a target, hence the absence of rounding in the default verb form. Moreover, apart from the harmonic patterns that manifest in the imperfective, when we compare the default and the imperfective, it is observed that the tone pattern exhibited by the default is systematically different from the tone pattern exhibited by the imperfective. Thus, when the default verb has low tone (L), the imperfective has low-high (L-H); when the default verb is high (H), the imperfective is high-low (H-L) and when the default verb is high-low (HL), the imperfective is high-downstepped high (H-!H). Since the focus of this

chapter is on harmony, tonal alternations are not further discussed. Refer to chapter 5 for detailed description and analysis of tone. Also, aside from the tonal alternation, we see that the verb root has either a long vowel or a diphthong when the imperfective suffix is attached. Length and diphthong alternation is briefly discussed in chapter 6 (the conclusion) as an area for future research but will not be analysed in this dissertation.

4.3.1.3 Rounding harmony: Agentive nominalisation

When verbs undergo nominalisation, the root of the verb is reduplicated either partially or fully. The reduplicant occurs immediately after the root and then followed by the suffix, which is either a -V or a -rV for singular just as the imperfective and always a -bV for the plural. Both reduplicant and suffix always agrees in terms of rounding/backness, [±low] and tongue root feature with the root. The meaning invoked by the reduplicant is 'one who X' or 'X-er'. Here are some examples illustrating the pattern.

(21)   Agentive nominalisations

b. ATR

Root	Root-RED-suffix	Root- RED -suffix	Gloss
zú-	zú-zúú-rò	zú-zúúr-!bó	'one who steals'
dó-	dó-dúó-rò	dó-dúór-bó	'one who climbs'
dì-	dì-dí-ré	dì-dír-bé	'one who eats'
lè-	lè-lé-ré	lè-lér-bé	'one who falls
və́-	və́-və́ə́-rə̀	və́-və́ə́r-!bə́	'one who scorches'

c. RTR

Root	Root- RED -suffix	Root- RED -suffix	Gloss
kʊ́-	kʊ́-kʊ́ʊ́-rɔ̀	kʊ́-kʊ́ʊ́r-!bɔ́	'one who kills'
zɔ̀-	zɔ̀-zɔ́-rɔ̀	zɔ̀-zɔ́r-!bɔ́	'one who runs'
sì-	sì-síí-rɛ́	sì-síír-bɛ́	'one who skins'
mɛ̀-	mɛ̀-míɛ́-rɛ́	mɛ̀-míɛ́r-bɛ́	'one who builds'
vá-	vá-váá-rà	vá-váár-!bá	'one who hits'

In rounding there is a strict restriction with respect to the vowels that occur in a domain – all vowels must either be low, or all must be non-low as shown in both imperfective and reduplicated cases. Now let's turn our attention to what happens in nouns.

4.3.2   Rounding in nouns: alternations in number suffixes

In Dagaare nouns, rounding harmony is not as productively attested as in the case of the imperfective form of the verb. Unlike in the imperfectives where rounding is completely predictable, in nouns rounding is irregular and completely unpredictable. This therefore gives the impression that rounding in nouns is exceptional or irregular. There are a few cases in which both singular and plural suffixes agree in rounding as illustrated in (22a). In other cases, there is agreement in rounding between singular suffixes and the noun roots while the plural suffixes are insensitive to rounding as shown in (22b). There are also cases in which the vowel in singular suffixes is disharmonic with respect to the nominal root but there is agreement in rounding between the plural suffix and the nominal root as shown in (22c).

(22)   Nominal suffixes

a. Singular   Plural

pɔ́g-ɔ́   'woman-SG'   pɔ́g-bɔ́   'woman- PL'

dɔ́ɔ   'man. SG'   dɔ́-bɔ́   'man- PL'

b. Singular   Plural

bùg-ó   'silo- SG'   bùg-rí   'silo- PL'

gòŋ-ó   'silk cotton- SG'   gòn-ní   'silk cotton- PL'

bòŋ-ɔ́   'donkey- SG'   bòn-ní   'donkey- PL'

sɔ́ŋ-ɔ́   'basket- SG'   sɔ́n-ní   'basket- PL'

c. Singular   Plural

lúg-rí   'pillar- SG'   lúg-ó   'pillar- PL'

tòò-rí   'ear- SG'   tò-bó   'ear- PL'

kɔ́ɔ́-rí   'bone- SG'   kɔ́-bɔ́   'bone- PL'

sɔ́ɔ́-rí   'liver- SG'   sɔ́-bɔ́   'liver-PL'

ɲɔ́ɔ́-rí   'intestine- SG'   ɲɔ́-bɔ́   'intestine- PL'

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Suffixes containing back/round vowels such as -o/-ɔ, -bo/-bɔ never occur with unrounded roots. In a related situation to the default cases, rounding is restricted in nouns because rounding feature in nominal roots does not target high vowels. Anttila & Bodomo (2009) however argue that the pattern in nouns is entirely regular in that the [-ri/-rɪ] suffix is [+high, -round] and blocks the spreading of height and rounding by the Elsewhere Principle which requires that lexical items take precedence over rules (Kiparsky, 1982, 1984).

4.3.3 Status of low vowels in rounding harmony

The low vowels /a/ ~ /ə/ have special status in rounding harmony similar to the case with tongue root harmony. When the verbal root has a low vowel, the imperfective suffix is necessarily a low vowel. The suffix alternates between ATR and RTR depending on the tongue position of the root. In (23a-b), while agreeing in tongue root feature, the suffix vowel is low when the preceding vowel in the root is low.

(23)　　Low vowels

a.　　Verb root　　　　　Imperfective form

və́-　'scorch'　　və́ə́-rə̀ 'scorch- IPFV'

hə́l-　'widen'　　hə́l-ə̀ 'widen- IPFV'

mə́l-　'scald'　　mə́l-ə̀ 'scald- IPFV'

hə́ə́r-　'yawn'　　hə́ə́r-ə̀ 'yawn- IPFV'

b.　　Verb root　　　　　Imperfective form

vá-　'hit'　　váá-rà 'hit- IPFV'

hál-　'stink'　　hál-à 'stink- IPFV'

màl-　'punish'　　màl-á 'punish- IPFV'

háár-　'shoo'　　háár-!á 'shoo- IPFV'

This data show what can be described as total harmony. This is however not always the case in all Dagaare varieties. For instance, in Southern Dagaare (Waale), it is common for the low /a/ to occur as the suffix of the imperfective to a root that is nonlow. Compare the following data between Central Dagaare and Southern Dagaare.

(24)

	Central	Southern	
Root	imperfective	imperfective	Gloss
dî-	dí-!rɛ́	dí-!rá	'take- IPFV'
sɛ́-	síɛ́-rɛ̀	síɛ́-rá	'roast- IPFV'
dʊ́g-	dʊ́g-rɔ̀	dʊ́g-rà	'boil/cook- IPFV'
dɔ̀ɔ̀-	dɔ̀ɔ̀-rɔ́	dɔ̀ɔ̀-rá	'squat- IPFV'
ʔɔ̀ɔ̀-	ʔɔ̀ɔ̀-rɔ́	ʔɔ̀ɔ̀-rá	'chew/eat- IPFV'

Interestingly, in the southern dialect, only non-low [RTR] roots seem to occur with the low vowel. There are no known cases involving non-low [ATR] roots occurring with the advanced [ə]. That is, the advanced low [ə] never occurs as suffix when the root is non-low. Depending on the vowel quality, [ATR] roots always occur with [-re/ro].

4.3.4 Summary

In summary rounding harmony is productive in Dagaare but mainly limited to the imperfective and agentive reduplicated forms in Central Dagaare and reduplication in Western Dagaare (Birifor). Rounding is not apparent in underived nouns. The absence of rounding in the default verb form and nouns seems to be attributed to the fact that rounding harmony targets only non-high vowels. Alternatively, it could be due to the claim that the high front vowel [i/ɪ] is epenthetic inserted at the word level because words have to be bimoraic and given that rounding is a root-level process, the high vowel is not a target for rounding. The form and status of the low vowel is also predictable in that roots with low vowels take low vowels in the suffixes, though this is not the case in other varieties such as Waale.

4.4 Formal approaches to vowel harmony: Optimality Theory

The central basis of Optimality Theory (Mccarthy, 2011; McCarthy & Prince, 1993; Prince & Smolensky, 1993, 2004) is the interaction of universal ranked violable constraints that are evaluated side-by-side to define the grammar of a language. Thus, the notion is that cross-linguistic regularities in phonological phenomena are to be found in output configurations and not input configurations. OT specifically seeks to give an account of how representational well-formedness determines the grammatical structure of a given language. In light of this, proponents of this model

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are interested in developing a set of theoretical devices referred to as constraints which drive phonological phenomena such as harmony. These optimality-theoretic constraints are of two main kinds; faithfulness constraints which prohibit differences between a given input or underlying representation and an output and markedness constraints which ensure the well-formedness of output forms (McCarthy, 2011). These constraints are not necessarily mutually consistent. That is, in response to a particular input representation, it is possible for constraints to generate conflicting outcomes. So, this means that constraints can be violated, given that a particular form can satisfy one set of constraints and violate others.

Moreover, OT maintains that constraints on output well-formedness are the basis of universal grammar (McCarthy, 2011). Thus, individual grammars consist of a particular ranking of this set of constraints. In this ranking there is a property of dominance in which a given constraint is considered more important than others. For a given underlying representation or input, a range of potential surface representations or outputs are assessed. The grammar then plays the role of identifying which output best satisfies the constraint hierarchy. The constraint hierarchy therefore functions to identify the most harmonic surface representation for a particular input. Based on Prince and Smolensky (1993) and McCarthy (2011), the grammar is made up of two components: GEN (for Generator) and EVAL (for evaluation). GEN operates on input representations, generating a set of output representations which are referred to as candidates. These candidates are then evaluated with respect to one another by EVAL, which rates each output in terms of its harmony. The candidate with the highest level of harmony is the candidate that emerges optimal or as the surface form.

In the OT framework, a number of approaches have been proposed to formally account for the different patterns of vowel harmony that are present across languages. In the following sections (4.4.1 – 4.4.6), I present overview of various approaches within the OT framework, namely Feature Alignment, Positional Faithfulness, Feature Spreading, Local Agreement, Span Theory and Agreement – By – Correspondence (ABC). Then section 4.5 gives an overview of Emergent Phonology and Tier-Based Strictly Local (TSL).

4.4.1   Feature Alignment

Feature Alignment (Kirchner, 1993 Akinlabi 1996; Pulleyblank 1996; Archangeli & Pulleyblank 2002) is a theory that may require phonological features to be aligned with right or left edge of a

morphologically or phonologically defined domain. With this approach, alignment constraints are invoked to enforce the spread of the harmonic feature from a trigger to a target within a domain. That is, alignment constraints are used to align harmonic features to relevant prosodic or morphological domains. Below is the general definition of alignment constraint (Kirchner, 1993)

(25)   Feature Alignment

         ALIGN (F) – R/L; P$_{CAT}$/M$_{CAT}$

         The right/left edge of a harmonic feature F is aligned with the right/left edge of phonological/morphological category

A theory that is closely related to feature alignment is Optimal Domains Theory (Cole & Kisseberth 1994) which creates abstract harmonic domains and output correspondents of input segments that belong to domains which bear the relevant feature. The next section discusses positional faithfulness.

4.4.2   Positional faithfulness and markedness

Positional Faithfulness is a theory proposed in the analysis of height harmony in Shona (Beckman, 1997, 1998). This theory establishes that psychologically and prosodically privileged positions bear the heaviest burden of lexical storage, lexical access and retrieval and processing. Privileged positions are those positions which enjoy some perceptual advantage in the processing system through psycholinguistic and phonetic prominence over the complement of non-privileged positions. These privileged positions include root-initial syllables, roots and to some extent final syllables. By contrast, medial syllables, and functional elements such as inflectional affixes, clitics, and closed-class items, though vital, play a lesser role in the structure of the lexicon. Positional faithfulness is manifested in three distinct, but closely related patterns of phonological asymmetry as shown illustrated.

(26)   Phonological asymmetries diagnostic of positional faithfulness

        -   Positional maintenance of contrasts which are neutralised elsewhere

        -   Positional triggering phonological processes

        -   Positional resistance to processes which apply elsewhere

Beckman contends that height harmony and positional height neutralisation in Shona result from higher-ranked faithfulness constraints to the height features of root-initial syllables, and

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markedness constraints that prohibit the manifestation of feature specification in other positions. Constraints of positional faithfulness derive harmony via interaction with feature-driven markedness constraints. In this case markedness constraints evaluate candidates by the number of featural autosegments they contain, not by the number of segments that bear the feature. It is however noted that positional faithfulness approach is not enough to analyse some patterns and therefore faces a problem of deriving harmony in languages in which non-privileged positions behave differently.

4.4.3   Feature Spreading

Feature spreading as proposed in (Padgett, 1995, 2002; Walker, 1998) requires a rightward or leftward spread or (multiple) linking of the harmonic feature within a domain. SPREAD constraints are usually in the form of SPREAD – L/R (F, D), where F stands for the harmonic feature and D for the domain of the spread with L/R denoting directionality – left or right. The formal definition of spread constraints is proposed by Padgett (1997) is given below

(27)   SPREAD [αF] (Padgett, 1997)
          If a feature [αF] is linked to a segment, the same feature is linked to every
          segment
          (Spread (x): ∀xy, x(y): x= feature, y=segment).

Spread requires multiple linking of the harmonic feature and the above constraint is satisfied when the same feature is shared by all the vowels in a particular domain. It enforces total spread of the feature to all segments in a domain. With spread, every output representation with non-harmonic segment within a given prosodic word incurs a violation of the constraint for each such segment the word contains. In the following, an example is shown with the phrase /ba-bii-ri/ 'their children' to demonstrate how SPREAD constraints derive harmony.

(28)   SPREAD [ATR]

/ba-bii-rɪ/	SPREAD [ATR]
a. [ba-bii-rɪ]	*!
b. [ba-bii-ri]	*!
c. [bə-bii-ri] ☞	
d. [bə-bii-rɪ]	*!

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The output form in (c) is the only one that satisfies SPREAD [ATR] given that the ATR vowels spread the to the other vowels in the domain. Candidates (a), (b) and (d) are ruled out because the [ATR] feature fails to spread to the vowels in the harmony domain.

4.4.4 Local Agreement

Another approach to vowel harmony is Local Agreement which has been used in a variety of harmony analyses (Bakovic, 2000, 2001, 2003; Bakovic & Wilson 2000; McPherson & Hayes 2016). As a counter approach to directional SPREAD constraint in vowel harmony, Bakovic (2000) claims that directionality in vowel harmony is based on morphological structure and positional faithfulness (Beckman 1997, 1998). For instance, spreading from the stem outward might receive a rightward analysis with directional constraints like ALIGN, but in terms of AGREE, directionality is derived from the morphological domain. He argues that only two vowel harmony processes exist in human language in terms of directionality, namely stem-controlled and dominant-recessive harmony. With stem-control, the harmonic feature of the stem determines the feature of the other morphemes in the domain. In dominant-recessive process, a particular feature, the dominant one determines the feature of the entire domain irrespective of the morpheme in which it occurs – a morpheme with the non-dominant (recessive) features undergoes harmony. In order to account for both cases, what is needed is an agreement constraint that is directionless, AGREE [αF] as defined below.

(29)   AGREE [αF] (Bakovic 2000)

Adjacent segments (vowels) agree in the feature [αF]

This constraints demands that adjacent segments within a domain have the same specification for the harmonic feature (see also Pulleyblank, 2002; Lombardi 2001). Some important differences exist between agreement and other harmony constraints such as ALIGN and SPREAD. Unlike in SPREAD which defines a given segment as the point from which the harmonic feature originates onto target segments within a domain, AGREE basically requires that adjacent segments have the same value for the feature – the domain of evaluation is local and AGREE performs pairwise comparison of adjacent vowels.

As Finley (2022) points out, one of the research questions driven by AGREE constraint is whether vowel harmony truly has directionality or whether directionality in vowel harmony can be derived through constraints. Bakovic (2000) shows that directional effects can be derived without directional constraints, but there are also cases which may require reference to directionality (Harvey & Baker, 2005; Ribeiro, 2002; Mahanta 2022)

Also as mentioned in Mahanta (2022), AGREE constraints make unwanted typological predictions. For instance, the non-directional nature of AGREE predicts 'pathological' Majority Rules harmony patterns, where the direction of spreading is determined by the number of faithfulness violations. In addition, AGREE predicts a 'pathological' spreading pattern termed 'Sour Grapes' in which harmony fails to apply to otherwise harmonic vowels in the presence of a blocker (Wilson 2003). This has been argued to be unattested in natural language though there are some suggested cases of sour grapes also known as non-myopic harmony such as in Tutrugbu (McCollum & Essegbey 2022).

In addition to the approaches discussed in the preceding sections, there have been some new approaches proposed to account for vowel harmony. These include the Span Theory of harmony (McCarthy 2004, Smolensky & Legendre 2006) and Agreement By Correspondence – ABC (Hansson 2001; Rose & Walker 2004; Walker 2000). An overview of these approaches is presented in the next sections, starting with the Span Theory in section 4.4.5 and in section 4.4.6, ABC is discussed. Other more recent approaches to the analysis of vowel harmony include: Emergent Phonology (Archangeli & Pulleyblank, 2017, 2022; Cohn, 2011; Mielke, 2008)and Tier-based Strictly Local (TSL) (Heinz, 2011, 2018; Heinz et al., 2011; Aksenova et al 2022). In section 4.4.8, I give an overview of Emergent Phonology and in section 4.4.7 I discuss TSL.

4.4.5   Span Theory

The Span Theory (ST) of harmony or theory of Headed Spans (McCarthy 2004, Smolensky & Legendre 2006) is a theory based on autosegmental feature spreading using Optimality Theory. In Span Theory, the segments of a word are exhaustively parsed into spans for each distinctive feature. It accounts for harmony by putting harmonic domains into spans for each feature. A span, according to McCarthy (2004: 3) is defined as a constituent whose terminal nodes are segments in a contiguous string. Each span is assumed to contain a head and the head determines the actual production of the segments in that span. In ST, a segment cannot be part of the string of segments

that constitute a span if it is not part of that span. Thus, in a string of segments like ABC, if A and C are part of the same span of a feature, then B must also belong to that span. Therefore, there cannot be a case of gapped representation where A and C belong to same span while skipping B. This then means there is a locality condition which requires spreading to be strictly local (Gafos, 1999; Ní Chiosáin & Padgett, 2001; Walker, 2014).

In Span Theory, feature sharing is done by some representational assumptions based on GEN (McCarthy, 2003). Similar to the tiers in autosegmental phonology (Clements & Ford, 1979; Goldsmith, 1976), there are different spans for each distinctive feature. Every segment belongs exactly to one span for each feature – an assumption closely related to the association conventions of early autosegmental phonology (Clements & Ford, 1979; Goldsmith, 1976) such as 'every tone bearing unit is associated with a tone'. Just like the prohibition against crossing association lines, spans are non-overlapping. In OT the mechanism by which heads are designated in autosegmental representation has been developed in (Smolensky, 1995, 2006) and in Optimal Domains Theory (Cassimjee & Kisseberth, 1998, 1989).

One segment of a span is assigned to be the head of the span and all of the segments in a span of the feature [F] are pronounced with the value of the head segment. It is possible for a segment to head a span for some features but not others. There is no particular number of segments a span can consist of. It can be made up of just a single segment which necessarily acts as the head of the span; it can also consist of up to every segment in the domain and in this case only one segment functions as the head.

In a well-studied phenomenon of nasal harmony, Walker (2014) demonstrates how the Span Theory works. Consider the word *mawar* 'to spread' in the Malayo-Polynesian language Sundanese, which exhibits nasal harmony. In this language vowels undergo nasal assimilation when they occur in the neighbourhood of a nasal consonant, while all glides and less sonorous segments are blockers of nasal spread. Therefore, the surface representation of this word would be [mãwar]. This then means that the word involves two spans, (mã) (war); a nasal span headed by the initial [m] which is also the trigger and an oral span headed by the glide [w], the blocker or the opaque consonant. By contrast in Johore Malay glides and vowels are undergoers of nasal harmony, but liquids and all less sonorous segments are opaque to nasal harmony as in *pəŋãw̃ãsan* 'to cause', *m̃ratappi* 'to cry'. In Kolokuma Ijo, liquids and glides can undergo nasal assimilation,

but non-sonorous segments cannot, as illustrated in *ɟ̃ãr̃ĩ* 'shake' and in Applecross Gaelic fricatives can nasalize though stops never nasalize as in *s̃ŋãnʲdʲan* 'thread'. As noted by Walker (2014), blockers of nasal harmony follow a hierarchy that approximates the sonority scale except for the nasal consonants themselves. In terms of the representational claims, McCarthy (2003) proposes four main constraints:

(30)　Constraints in Span Theory

(i)　A markedness constraint that rules out more than one adjacent span of the same feature [F]. This constraint replaces the AGREE or ALIGN constraints in other theories of spreading.

(ii)　Faithfulness constraints which require input [αF] to head [αF] spans in the output. These faithfulness constraints are the alternative to IDENT constraints in Span Theory

(iii)　Markedness constraints which require certain types of segments to head spans with a particular [F] value. They are feature co-occurrence restrictions

(iv)　Markedness constraints requiring the head segment to be in a particular position relative to other members of the span. These constraints enforce directionality effects like ALIGN.

4.4.6　Agreement-By-Correspondence (ABC)

Originally proposed for consonant harmony, Agreement-By-Correspondence (ABC) (Hansson, 2001; Rose & Walker, 2004; Walker, 2000) has been adopted for the analysis of vowel harmony. It is an approach which uses correspondence constraints to determine agreement. Correspondence constraints as a core part of Optimality Theory have been used to govern relationships between the input and the output (McCarthy & Prince, 1994), and between surface forms – output-output faithfulness.

In the ABC framework, two main constraint types are required: CORR-VV constraints which govern the segments that must be in correspondence and IDENT-VV constraints which regulate featural agreement in corresponding segments. As a rule, correspondence is required for segments that already agree in some other feature. The constraints are formalized as follows based on Rose & Walker (2004).

(31)   CORR-VV

Let S be an output string of segments and let V_i, V_j be segments that share a specified set of features F. If V_i and V_j are in S, then V_i is in a relation with V_j: V_i and V_j are correspondents of one another.

(32)   IDENT-VV [F]

Let V_i be a segment in the output and V_j be any correspondent of V_i in the output. If V_i is [αF] then V_j is [αF].

I apply these correspondence constraints to ATR harmony in Dagaare, in which vowels agree in the feature [ATR]. The tableau below in (33) shows how these constraints works. Correspondences are indicated via subscripts where identical subscripts indicate correspondence.

(33)   ATR harmony in ABC

/bugɔ/ → [bugo] 'silo.SG'

	/bugɔ/	CORR-VV	IDENT-RT [ATR]	IDENT-VV [ATR]	ID-IO [ATR]
a.	bù$_x$gɔ́$_x$			*!	
b.	bù$_x$gó$_y$	*!			*
c.	bʊ̀$_x$gɔ́$_x$		*!		*
d.	bù$_x$gó$_x$ ☞				*

Candidate (a) violates IDENT-RT [ATR] because the corresponding vowels do not share the same tongue root feature. Candidate (b) is ruled out by the Agreement-By-Correspondence constraint, CORR-VV because the two vowels are not in correspondence. Both (c) and (d) satisfied by CORR-VV but (d) is preferred because (c) is ruled out by the IDENT-RT [ATR] constraint due to root unfaithfulness between the output and the input. In the next tableau the ABC constraints are illustrated with rounding harmony.

(34)   Rounding harmony in ABC

/ko-rV/ → [kò-ró] 'dry-IPFV'

	/ko-rV/	CORR-VV	IDENT-RT [RD]	IDENT-VV [RD]	ID-IO [RD]
a.	ko$_x$-ró$_x$			*!	*
b.	ko$_x$-ró$_y$	*!			*
c.	kɔ$_x$-rɔ$_x$		*!		*
d.	ko$_x$-ró$_x$ ☞				*

The IDENT-VV [RD] rules out candidate (a) because the vowels in correspondence do not share the same [RD] feature. In (b) both vowels share the same feature [RD], but they are not in correspondence hence violation of CORR-VV. Moreover ID-IO [RD] is violated because the output suffix vowel is not identical to the input. In (c), there is correspondence between the vowels, but it is ruled out by IDENT-RT [RD] due to the unfaithfulness between the root of the input and that of the output. Finally, candidate (d) is the optimal choice having satisfied all constraints except the low-ranked IDENT-RT [RD].

Given that correspondence constraints generally require shared features, parasitic harmony – where harmony applies only to vowels that already share a feature value – appears to be a natural use for ABC constraints (Rhodes, 2012; Walker, 2018). Unlike AGREE constraints, in ABC, two segments can be in correspondence even if they are non-adjacent (see McCollum & Essegbey, 2020; Rhodes, 2012; Sasa, 2009; Walker, 2014). That is, an ABC approach may be suited to handle non-local effects such as transparent vowels.

4.4.7 Emergent Phonology

In Emergent Phonology (Archangeli & Pulleyblank, 2017, 2022), the recognition of a sound sequence and its paired meaning results in identifying *morph M* – a string of sounds associated with meaning and or grammatical function {[sound string]}MEANING/FUNCTION. More than one sound string can correspond to a given meaning, resulting in morph sets. For instance, in set like {pæt, pæɾ}PAT in English, selecting the relevant morph is determined by phonological sequences. There

are other cases where selection of morphs is based on semantic and syntactic rather than phonological requirements.

With the morphs and morph sets, the learner can select the appropriate surface representation. There is no evidence which requires the learner to assume a single abstract form for the lexical representation. Thus, the generative phonological notion of underlying representation (UR) with possible surface forms does not play a part in Emergent Phonology. Underlying representation is used in reference to the hypothesis that there is a single mental representation for each morpheme whether it is the UR of generative phonology or the input of Optimality Theory. Therefore Archangeli & Pulleyblank (2022) propose that sets of morphs are the formal instantiations of the phonological forms corresponding to a particular set of morphosyntactic features, instead of invoking the more common unique underlying representation. As a result, there is no conceptual necessity for underlying representations. The focus in emergent phonology is on minimal morph sets with a particular semantic label. These morph sets may have single or multiple members.

When morphs are phonologically related to each other as in the case of [t]-final and [ɾ]-final morph in English, the assumption is that learners can make generalizations about the membership of morph sets. These are called morph set relations (MSRs), which can relate in productive and unproductive ways. Then there are morph set conditions (MSCs) which formalize productive morph set relations by penalizing sets that lack expected members. Another core component in emergence is well-formedness conditions which regulate the combination of meaningful strings of sounds in words and morphs (the domain D). Therefore, when multiple morphs are identified with the same morphosyntactic feature, the learner is challenged with the task of choosing among the morphs to build words – these conditions rely on morpho-phonotactic properties. The well-formedness conditions make up three categories; type conditions which prohibit a particular single element; paradigmatic conditions which ban the combination of two elements and syntagmatic conditions which prohibit the sequence of two elements. With vowel harmony patterns, the class of elements that are the focus F of a condition are vowels.

These ideas are relevant in the interaction between phonological harmony patterns and morphological systems. Archangeli & Pulleyblank (2022) introduce the role of the different components of the emergence model in understanding harmony systems with three languages, namely well-formedness in Kɔda; moph sets with Dagaare and morph set relations with Fula. Here,

I give an overview of how morphs and morph sets work only in Dagaare. Refer to Archangeli & Pulleyblank (2022) for discussion of the other languages.

In Dagaare within roots, all vowels agree in tongue root position, advanced or retracted. In compounds, ATR value of the first root may or may not be the same as the second member of the compound.

(35) Dagaare root-internal

  root + affix   compound: root + root

  a. [bìrìjù-ó] 'duck-SG' [bìrìjù-bílé] 'small duck'

    [kpòŋkpó-bú] 'cassava-SG' [kpòŋkpò-fáá] 'bad cassava'

  b. [kòlóŋ]   'well.SG' [kòlòŋ-zùlúŋ] 'deep well'

    [zòmìŋ-ɛ́] 'friend-SG' [zòmìŋ-fáá] 'bad friend'

The harmonic pattern also occurs with proclitics/prefixes and suffixes. Non-low affix vowels alternate between advanced and retracted based on tongue root position of the root vowel

(36) Dagaare affix harmony

  a. 2SG possessive pronoun

    [ATR]   [RTR]

    [fù-bíí-rí] '2SG-child-PL'   [fò-tìì-rí] '2SG-tree-PL'

    [fù-dè-rí] '2SG-house-PL'   [fò-wèg-ɛ́] '2SG-log-SG'

    [fù-kóg-ó] '2SG-chair-SG'   [fò-póg-ó] '2SG-woman-SG'

  b. 1PL possessive pronoun

    [ATR]   [RTR]

    [tì-bíí-rí] '1PL-child-PL'   [tì-tìì-rí] '1PL-tree-PL'

    [tì-lúg-ó] '1PL-log-PL'   [tì-dóg-ì] '1PL-pot-SG'

    [tì-kóg-ó] '1PL-chair-SG'   [tì-póg-ó] '1PL-woman-SG'

These patterns motivate the syntagmatic conditions in (37) below. The morph domain is motivated by roots in (35) while the word domain is motivated by affixed forms in (36).

(37)   Dagaare root vowel syntagmatic well-formedness condition

    *[ATR] [RTR]   With respect to vowels within a morph or word, assign a

    *[RTR] [ATR]   violation for each sequence where the tongue root

    F: vowels   features differ

    D: morph, word

The words in (36) motivate prefixes/proclitics with two forms: {fù} and {fʊ̀} which contribute to the meaning 2SG.POSS, resulting in the morph set {fù, fʊ̀}₂SG.POSS. Then there are the forms {tì} and {tɪ̀} which contribute to the meaning 1PL.POSS. They result in the morph sets, {tì, tɪ̀}₁PL.POSS. When the prefix {fù, fʊ̀}₂SG.POSS is combined with {dè-rí}HOUSE-PL, both [fù-dè-rí] and *[fʊ̀-dè-rí] could result. Therefore, the phonotactics in (37) identifies the morph combination whose vowels satisfies the well-formedness condition. This is demonstrated with the Assessment tables below.

    (38)   Dagaare Assessments

        a. [fù-dè-rí] 'your houses'

        Morph sets: {fù, fʊ̀}₂SG.POSS; {dè-rí}HOUSE

YOUR HOUSE	*ATR-RTR	*RTR-ATR
a. [fùdèrí] ☞		
b. [fʊ̀dèrí]		*!

        b. [tì-dʊ́g-ì] 'our pot'

        Morph sets: {tì, tɪ̀}₁PL.POSS; {dʊ́gɪ̀}POT

YOUR HOUSE	*ATR-RTR	*RTR-ATR
a. [tìdʊ́gɪ̀]	*!	
b. [tɪ̀dʊ́gɪ̀] ☞		

Dagaare has harmonic patterns formally characterised by the syntagmatic well-formedness condition which prohibits some vowel sequences, thereby resulting in vowel harmony. Vowel harmony hold at both morph and word level in Dagaare. A property of Dagaare is that morph sets have multiple members with harmonic counterparts and thus the learner can encounter all relevant forms. There are other cases where it is impossible to encounter all possible surface forms. In such cases it is the grammar that provides a mechanism for producing forms that have not been encountered. Such is the case with root alternations in Fula. See Archangeli and Pulleyblank

(2022) for more discussion of this pattern and how the relations among members of a morph set are represented.

4.4.8   Tier-Based Strictly Local

Tier-based Strictly Local – TSL grammars (Heinz, 2011, 2018; Heinz et al., 2011; Aksenova et al 2022) capture non-local dependencies by projecting relevant input elements of a certain type onto a tier in order to achieve locality among remote segments and forbidden strings. Forbidden substrings of segments can be ruled out over the tier. A TSL grammar consists of the tier alphabet T and the set of k-grams G_{TSL} that must not be found on a tier representation of a well-formed string. Consider the following examples showing well-formed and ill-formed surface forms in Lokaa; Niger-Congo (Akinlabi, 2009). The agreeing segments in these forms are not adjacent to each other. A non-high vowel agrees with the preceding non-high vowel in ATR value. All high vowels and consonants are transparent for harmony

(39)   Lokaa harmony

  a. èsìsòn 'smoke'   *èsìsɔ̀n

  b. ɛ̀sísɔ̀n 'housefly'   *ɛ̀sísòn

  c. lèjìmə̀ 'matriclan'   *lèjìmà

  d. ɛ́kílìkà 'kind of plant' *ékílìkà

The data shown in (40) illustrates a harmony pattern that affects non-high vowels that are apart. It is impossible to construct a Strictly Local – SL grammar for this pattern because there is no bound to the amount of material which separate the two non-high vowels. In TSL grammar however, it is possible to project (remote) dependent items on a tier and block ill-formed combinations over the tier.

(40)   TSL grammar for Lokaa harmony

	Tier of non-high vowels T = {ɛ, e, o, ə, ɔ, a}
1.	*[α tense] [- α tense]
	H_{ATR} = {*ɛe, *eɛ, *oɛ, *oɛ, *ɛə, *əɛ, *ɔe, *eɔ, *ɔo, *oɔ, **aə, *ao, *ae, *ea}

In the above table, the tier alphabet includes all non-high vowels in the language. The ATR pattern in the surface forms is obtained by blocking the combinations of non-high vowels that do not agree in [ATR] specifications.

Multiple feature agreement is commonly observed in many languages. For instance, in Turkish, vowels agree in rounding and backness; in Imdlawn Tashlhiyt sibilants agree in voicing and anteriority and in Bukusu one agreement pattern involves vowels and another involves liquids (Aksenova et al. 2022) and in Dagaare verbs, the imperfective suffix agrees in tongue root position, rounding/backness and height. These are the cases often described as double or multiple harmonies. These patterns often raise questions as to whether more than one tier is required to account for double harmonies or whether there is a restriction on the tier alphabets for patterns that exhibit double or multiple harmonies.

Aksenova et al. (2022) propose four logically possible relations between distinct tier alphabets T_1 and T_2: (i) T_1 can be the same as T_2 and in that case the set of blockers and undergoers is the same for both harmonic patterns – same tier (ii) T_1 may share no common elements with T_2. This a typical case of disjoint tiers involving independent vowel and consonant harmonies in one system (iii) T_1 can be a subset of T_2 (embedded tiers). This is common with consonant harmony and (iv)T_1 overlaps with T_2 (overlapping tiers). This case is said to be typologically unattested.

TSL approach is used to capture different harmonic patterns. According to Aksenova et al. (2022), a study of double vowel harmony patterns show they require a single tier, although more than one feature is involved. For sibilant harmonies however, two tiers are needed. Languages with both vowel and consonant harmonies also require two tiers though the two tiers do not share any common element. That is, they are disjoint. I give an overview of how TSL captures double vowel harmony with data in Kirghiz.

In Kirghiz, the rule of double harmony is to spread the features frontness and rounding simultaneously. All vowels within a word must agree in these two features. In the data below from (Nanaev 1950), a locative affix with a non-high vowel (-de, -do, -da, -to, -dö) and a genitive affix with a high vowel (-nin, -din, -dün, -tun) are used in the examples.

(41)   a.   kɨz-da   'girl-LOC'   b.   kɨz-nɨn   'girl-GEN'

		ot-to	'fire- LOC'		ot-tun	'fire- GEN'
		kim-de	'who- LOC'		kim-din	'who- GEN'
		üj-dö	'house- LOC'		üj-dün	'house- GEN'

The examples show two harmonizing features which can either be plus or minus. The table in (42) shows the feature configurations which must be avoided in well-formed vowel sequence in Kirghiz. A case in which two vowels disagree in fronting or rounding is ruled out.

(42)   TBSL grammar for Kirghiz harmony

	Vowel tier T = {a, ɨ, e, i, o, o, ö, u, ü}
1.	$*[\alpha \text{ front}] [\beta \text{ front}]$
	H_{front} = { *ai, *ae, *aö, *aü, *oi, *oe, *oö, *oü, * ɨi, *ɨe, *ɨo, *ɨü, *ui, **ue, *uü, *ia, *io, *iɨ, *iu, *ea, *eo, *eɨ, *eu, *öa, *öo, *öi, *öu, **üa, *üo, *üɨ, *üu }
2.	$*[\alpha \text{ round}] [\beta \text{ round}]$
	H_{round} = { *oa, *oɨ,, *ua, *uɨ,, *öi, *öe, *üi, *üe, *ao, *au, *iö, *iü, **ɨo, **ɨu, *eö, *eü, *oe, *oi, *öa, *öɨ, *ue, *ui, *üa, *üɨ, *eo, *io, **aö, *ɨö, *eu, *iu, *aü, * ɨü}

Both harmonies operate over the same set of vowels, and this means that the tier alphabet T consists of all vowels. To realise frontness harmony, sequence of vowels that do not agree in the [front] feature must be blocked by $H_{front.}$ Substrings with vowels of different [round] are also prohibited by $H_{round.}$ Kirghiz vowel harmony is a clear example of a case that requires just a single tier to account for the two dependencies. In summary, Kirghiz has single tier – only one TSL grammar is required. Discussions of other double harmony patterns can be found in (Aksenova et al 2022). In the next sections, I give an account of Dagaare harmony within the frameworks of Optimality Theory

4.5 Account of Dagaare harmony patterns

This section presents a formal account of tongue root harmony and rounding harmony patterns in Dagaare using Optimality Theory (Mccarthy, 2011; Prince & Smolensky, 2004a). In Dagaare, a root vowel that contains a particular harmonic feature determines the harmonic feature of the suffix vowels. Suffixes are therefore undergoers within the harmony domain. In the imperfective forms of the verb, in addition to the tongue root harmony that occurs between the root and the imperfective suffix, a root that contains vowels with rounding/backness feature triggers rounding/backness on the imperfective suffix. This suggests that rounding and tongue root harmony in Dagaare are controlled by the root. Harmony on other parts such as affixes is dependent on the feature of the root. In many African languages with harmony systems, [ATR] is the dominant feature and this pattern requires harmony-driving constraints in order for harmony to surface between vowels of roots and affixes. While majority of vowel harmony systems are root/stem controlled, there are cases where harmony is controlled by the affix as in Turkana (Noske, 2000) and in Fula (Archangeli, 2000; Krämer, 2002, 2003).

4.5.1   Domain of harmony

The domain of harmony is the phonological or prosodic word (PWd). Dakubu (1997) observes that the phonological word in Central Gur/Mabia languages is typically composed of at least a CV syllable with a full range of articulatory contrast, and a suffixal syllable with restricted vowels and consonants. The form of the suffix vowels tends to be partly conditioned by the vowel features of the root syllable. There may be asymmetry between roots and affixes in terms of vowel distribution. This asymmetry is reported in Dagbani (Fusheini 2010) and Kɔnni (Cahill 1999, 2007). For instance, in Dagaare, the high round vowels [u, ʊ] do not occur in the suffix of the imperfective nor in the default form even if the root is round.

Aside from the root and the suffix, the harmonic domain in Dagaare also includes pronominal and preverbal clitics as illustrated in section 4.2.5. The obligatory constituent in the domain is the root. Then there are suffixes which inflect for number or aspect and derivational suffixes which derive nouns from verbs and adjectives (nominalisations). With nouns, a root and a number suffix are the minimal requirement for tongue root harmony to occur. The other constituents are pronominal clitics. For verbs, the constituents that form part of the harmonic domain for tongue root harmony are the root, aspectual suffixes, and preverbal clitics. In terms of rounding, the domain of harmony

is made up of the root and the suffix. Preverbal and pronominal particles do not form part of the domain of rounding harmony. The structure of the harmonic domains are schematized below for tongue root and rounding harmony.

(43)　　a.　　Domain of tongue root harmony

[pronouns, preverbal] clitic [[root] number, aspect, derivation] suffix

　　　　b.　　Domain of rounding harmony

[[root] aspect] imperfective suffix

Crucially the domain of harmony in Dagaare is restricted only to vowels and intervocalic consonants. This means that word-initial and final consonants are not part of the harmonic domain. The vowels operate as triggers and targets while the intervocalic consonants are non-harmonic segments which do not block harmony.

4.5.2　Directionality in Dagaare harmony

Vowel harmony is a phonological process where harmonic properties of a vowel may proliferate in one direction or the other or both. The direction of harmonic spreading has been argued by phonologists of various persuasions as an epiphenomenon – harmonic spreading is dependent on the correlation between the direction of spreading and morphological structure(Aoki, 1968; Archangeli & Pulleyblank, 2007; Bakovic, 2000, 2003). Thus, due to the predominance of languages that demonstrate root/stem outward harmony, harmonic direction came to be understood as part of morphological structure where root/stem spread their harmonic features to affixes. However, according to Mahanta (2022) an extensive survey of previously not well studied languages show that directionality is much more independent than has been assumed. Directionality in vowel harmony is traditionally considered as progressive or perseveratory (rightwards) or else regressive or anticipatory (leftwards).

The idea that direction of harmony is mainly connected to the direction of affixation can be traced to prefix-suffix asymmetries in root-controlled harmony systems (Mahanta 2022). Therefore, if there are no prefixes, then harmony is more likely progressive as in Turkish and if both prefixes and suffixes are attested, then the harmonic alternation will be bidirectional (e.g. Akan). If prefixes are the only affixes attested, as in Yoruba, then harmony is regressive.

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The most well-known cases involve Assamese (Mahanta, 2007, 2008), Karaja (Ribeiro 2002), Mayogo (McCord, 1989) which have patterns that operate from both roots and suffixes. There are also regressive cases where harmony operates only from suffixes particularly in languages with no prefixes such as Pulaar (Paradis, 1986, 1992). In such cases, harmony is triggered by the affix and thus christened affix-controlled harmony (Kramer 2002, 2003). With progressive system, harmony is triggered by prefixes and roots. For example, in Tutrugbu, a Kwa language (McCollum & Essegbey, 2020) in which suffixation is very restricted, rounding harmony in roots is triggered by initial prefixes which contain round vowels. Similarly, in Kibudu (Bantu), under the influence of an [ATR] numeral prefix, the vowel of the numeral root becomes [ATR] (Mahanta 2022; Lojenga, 1994). Overall, according to Mahanta (2022), the majority of languages appear to show either regressive or stem-controlled directionality.

In Dagaare, the harmonic feature can be bidirectional in tongue root harmony but only progressive with rounding harmony. Given that Dagaare mainly has suffixing morphology, progressive harmony is well attested with roots and suffixes as schematized: [root] → [**number**, **aspect, derivation**]suffix. However, in phrasal contexts, it is possible for bidirectional ATR harmony to occur as follows: [**proclitic/preverbal**]clitic←[root]→[**number, aspect, derivation**]suffix. For instance, proclitics and preverbal particles assimilate to the tongue root feature of the roots they precede. Some of the earlier examples are repeated below illustrating progressive root-controlled harmony in (44).

(44)   Nominal suffixes

a. -V suffixes

ATR   RTR

zí-é   'place-SG'   tì-ɛ́   'tree- SG'

lŏŋ-ò   'hourglass drum- SG' sɔ́ŋ-ɔ́ 'basket- SG'

b. -CV suffixes

ATR   RTR

jí-rì   'house- SG'   píí-rì 'sheep- PL'

bíí-rí   'child-PL'   síí-rí 'waist- PL'

In the next examples below, bidirectional harmony is shown with pronouns in possessive nominal phrases (45) and with preverbal particles in verb phrases in (46).

(45)   Harmonic proclitics

a. 2SG possessive pronoun

ATR   RTR

fù=bíí-rí   'your children'   fʋ̀=píí-rì   'your sheep'

2SG=child- PL   2SG =sheep- PL

fù=dè-rí   'your houses'   fʋ̀=wɛ́g-rì   'your logs'

2SG =house- PL   2SG =log- PL

b. 1PL possessive pronoun

ATR   RTR

tì=bíí-rí   'our children'   tì=píí-rì   'our sheep'

1PL=child- PL   1PL =sheep- PL

tì=dè-rí   'our houses'   tì=wɛ́g-rì   'our logs'

1PL =house- PL   1PL =log- PL

(46)   Alternations in preverbal particles

a. bə́júó   bá=dʊ́g-í   bɛ́ŋɛ̀   'Bayuo hasn't cooked beans'

    bə́júó   bə́=búrì   kʊ̀ʊ́̃   'Bayuo hasn't fetched water'

b. bájɔ̀ɔ́, tá=tʊ́ʊ́-rɔ̀   má   'Bayɔɔ, don't be insulting me'

    bájɔ̀ɔ́, tə́=tùù-ró   mà   'Bayɔɔ, don't be following me'

As the examples illustrate above, tongue root harmony in Dagaare can be bidirectional with the ATR value of the nominal/verbal root determining the harmonic features of the pronominal and preverbal clitics that precede the root and the suffixes that follow the root. In rounding harmony, however, the direction of the harmonic feature is only progressive – rounding propagates outward from the verbal root to the imperfective suffix. A preverbal particle that contains an unround vowel remains unround even if the following verbal root is round as can be seen in the examples in (46b). This is because at the root-level, there are only suffixes and as such there is no place for regressive

rounding harmony to show up. The data show that the trigger of vowel harmony in Dagaare is the vowel in the root which then targets the vowels in all other constituents of the harmonic domain. In a nutshell, Dagaare can be considered a two-way directionality, a progressive system operating from the root rightward to the suffix and a bidirectional system in which harmony emerges from the root and spreads leftward to a pronominal or preverbal clitic and rightward to the suffix. Alternatively, it can be argued that both tongue root and rounding harmony are bidirectional in principle, but then rounding operates in a limited or a smaller domain than tongue root harmony does. For instance, if there is a structure as follows: [pfx [[root]$_A$ sfx]$_B$]$_C$, then rounding harmony is limited to the intermediate domain or constituent (B) rather than the larger domain (c).

4.5.3   Optimality Theoretic analysis of tongue root harmony

4.5.3.1 Analysis of simple non-compound forms

The basic question is with regards to what motivates vowels to harmonize. Within OT, the devices that drive harmony are constraints. These constraints have been proposed in a number approaches within the broader OT framework such as feature alignment, local agreement, feature spreading, Span Theory and ABC. (See section 4.4 which presents the groundwork for the various OT models). It is important to mention that any of the above approaches and others such as Emergent Phonology can be used to account for the vowel harmony patterns in Dagaare. In this study however, I propose that vowel harmony in Dagaare can be analysed with the assumption of constraints that enforce harmony within domains which includes both roots and affixes. This can be accounted for with SPREAD [F] constraint (Padgett 1997). SPREAD [F], as in (47) is a pro-spreading analysis of (non)-local assimilation. This constraint requires a feature [F] that is linked to a vowel be shared by all vowels in a specified domain. The constraint assigns one violation mark if a feature is linked to a vowel in a domain, but not shared by every vowel in that domain. That is, harmony is fulfilled only through feature spreading.

(47)   SPREAD [αF] (Padgett, 1997)

            If a feature [αF] is linked to a segment, the same feature is linked to every

             segment

The tongue root specific formulation of SPREAD [αF] is given in (48) which requires the feature [αATR] to be linked to all vowels in a phonological word. This constraint is violated when

[αATR] feature that is linked to a vowel is not shared by other vowels with phonological word. Recall that the prosodic or phonological word is the domain of harmony in Dagaare.

(48)   SPREAD [αATR]_{PWd} (Padgett, 1997)

        If a feature [αATR] is associated with a vowel, the same [αATR] feature is linked to every vowel in PWd.

The structures in (49a-b) demonstrate how SPREAD constraint works. In (49a) the structure violates SPREAD [αATR] because only one of the vowels in the word is [αATR]. The structure in (49b) satisfies SPREAD [αATR] it contains vowels which agree in tongue root feature.

(49)   a. violates   b. satisfies

        SPREAD [ATR]   SPREAD [ATR]

        [V   V]   [V V   V]

        [ATR]   [ATR]

As mentioned before there is invariance in root vowels. The invariance also known as phonological asymmetry has been extensively discussed within positional faithfulness theory (Selkirk 1995; Beckman 1998). In the case of Dagaare, the asymmetry between the roots and affixes appears to be more morphological than phonological. In this account, invariance in vowels in terms of harmonic feature is a result of them occurring in roots which is the core and most informative part of the word. Since Dagaare root vowels maintain contrast, which is then neutralised for the suffix, I will adopt positional faithfulness theory to account for this invariance of the root vowels. The positional faithfulness constraint in (50) is therefore assumed. This constraint is violated when there is a change in [αATR] feature of a root vowel. Moreover, the alternation between vowels suggests a certain violation of a constraint that preserves identical features between input and output forms in every environment. To this end the constraint in (51) is proposed.

(50)   IDENT-RT[αATR] (Beckman, 1998)

        Let α be an input vowel contained in a root, and β the output correspondent of α. If α is [λATR], then β must be [λATR].

(51)   ID-IO [αATR] (McCarthy & Prince, 1999)

          Let α be an input vowel, and β the output correspondent of α.

          If α is [λATR], then β must be [λATR].

In tableaux (52) and (53), I assume that the underlying tongue root feature of the suffix vowel is opposite in value to the feature of the root vowel. The choice of the underlying suffix is arbitrary and note that the underlying suffix vowel could be of the same TR feature as that of the root vowel. The numeric indices in the output forms indicate whether the vowels share the same tongue root feature or not. If an index in the input is different from that in the output, it shows that there is an epenthetic feature.

(52)   /kog-ɔ/ → [kóg-ó] 'chair-SG'

	INPUT /kog$_1$ -ɔ$_{2/}$	IDENT-RT [αATR]	SPREAD [αATR]$_{PWd}$	ID-IO [αATR]
a.	kó$_1$gɔ́$_2$		*!*	
b.	kó$_1$gó$_3$		*!*	*
c.	kɔ$_2$gɔ́$_2$	*!		*
d. ☞	kó$_1$gó$_1$			*

(53)   /pɔg-o/ → [pɔ́g-ɔ́] 'woman'

	INPUT /pɔg$_1$ -o$_{2/}$	IDENT-RT [αATR]	SPREAD [αATR]$_{PWd}$	ID-IO [αATR]
a.	pɔ̀$_1$gò$_2$		*!*	
b.	pɔ̀$_1$gɔ̀$_3$		*!*	*
c.	pò$_2$gò$_2$	*!		*
d. ☞	pɔ̀$_1$gɔ̀$_1$			*

The forms above show that constraints on harmony force adjacent vowels to share the same tongue root feature value. The output forms in (52a) and (53a) are ruled out for violating SPREAD [αATR]$_{PWd.}$ Candidates (52b) and (53b) both are faithful to the harmonic feature of the root but are ruled out by SPREAD [αATR]. This is because SPREAD wants [αATR] elements to be linked to every

vowel in the domain. However, in (52b) and (53b) each [αATR] element has one vowel that it is linked to, hence the two violations. With (52c) and (53c) SPREAD [αATR] is fulfilled given that the harmonic feature of the root is shared with the suffix but crucially ruled out by IDENT-RT [αATR]. Harmony is preferred over the violation of faithfulness to ATR feature in the suffix. This is illustrated with the winning candidates in (52d) and (53d) in which the suffix vowel surfaces with a tongue root feature which is identical to the one in the root. The next sections present an analysis of the interaction between proclitics and roots. In these analyses, IDENT-RT [αATR] must rank above ID-IO [αATR] to ensure the optimal form is derived.

4.5.3.2 Analysis of tongue root harmony in proclitics

We see that pronominal clitics assume the harmonic feature of the root they precede, suggesting that the harmonic quality of the pronominal vowel is influenced by the harmonic feature of the root. This then raises questions as to what motivates the harmony of the proclitics with the prosodic word, given that they are separate words. In other words, why do proclitics not surface differently in terms of harmonic features with the prosodic word? My claim is that proclitic constitutes part of the prosodic domain. But in order to understand what triggers this harmonic integration, it is important to note that the prosodic word in Dagaare is minimally bimoraic (Anttila & Bodomo 2009).

Therefore, if a proclitic and a root occurs separately as different prosodic words, it will violate minimality and hence there will be no harmony. However, if the proclitic and the nominal root occur as a single domain, then it will satisfy minimality. This harmony between proclitic and root vowel is described as prosodic integration. Given that the proclitic is assumed as part of the PWd, it is expected that the harmonic feature in the root spreads leftward to the clitic. To account for the bimoracity of PWds, the minimality constraint that is formulated below in (54) will require that a prosodic word is minimally bimoraic. In addition, to ensure that each syllable is parsed by the PWd, I assume exhaustive parsing of strict layering (Inkelas, 1993; McCarthy & Prince, 1993b). This constraint is also formalized in (55)

(54)   Minimality (Anttila & Bodomo, 2009; Downing, 1999)
         PWd must be at least bimoraic.

(55)   Parse-σ-PWd (McCarthy & Prince, 1993)

Every σ must be parsed by PWd.

Now consider the following prosodic structures in (56). In (50a), the root morpheme and the proclitic act as separate prosodic words and that violates minimality. In (56b), the proclitic is a separate syllable and not part of the prosodic word while the noun constitutes a separate PWd and that rules it out. In (56c), both the proclitic and the root are integrated, yielding a single prosodic domain and therefore satisfying minimality.

(56)   Minimality fulfilment for the input: /fʊ=nû/ 'your hand'

a.   b   c
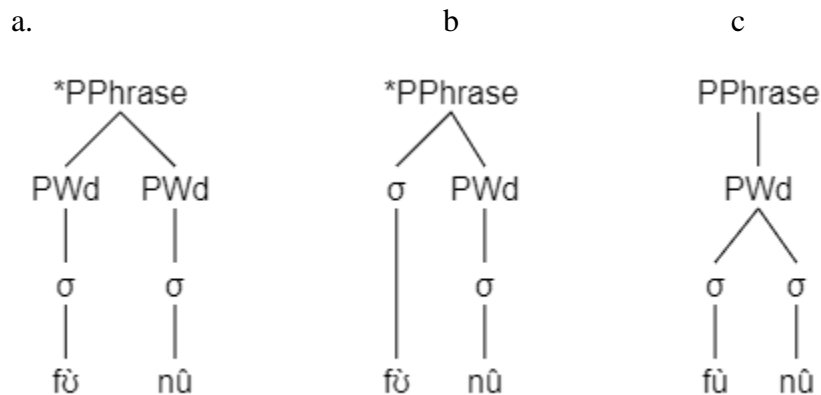
Moreover, the prosodic structure of Dagaare nouns gives more evidence that minimality triggers prosodic integration. A monomoraic[3] nominal root occurs with a -V or -CV suffix. This is shown in (57). The root /ji-/ 'house' never occurs as bare root; it either takes a –(C)V suffix or CV proclitic.

(57)   Prosodic integration in CV noun

a. Suffix integration

    i. jí-rì   'house-SG

    ii. jíè   'house.PL

---

[3] There are a few exceptions however with regards to bimoracity requirement. That is, there are some five words which violate the minimality condition in that they are monomoraic and do not necessarily require a suffix to be complete. These nouns include: zû 'head', nû 'hand', gbô 'heart', bâ 'father' and má 'mother'. The general fact is that the majority of nouns are minimally bimoraic. Note also that the bimoracity is not true of verbs as they are minimally monomoraic. Perhaps these subminimal verbs are roots which are made words by inflection.

b. proclitic integration

    i. tì= jí-rì   'our house'

        1PL.POSS=house- SG

    ii. bə̀= jí-rì   'their house'

        3PL.POSS=house- SG

Note also that there are a few bimoraic roots which are free and can therefore occur without suffixes or proclitics. These include: *túú* 'forest', *ʧúù* 'month/moon', *wɔ́ɔ̀* 'elephant', *láá* 'bowl'. This therefore suggests that the restrictions on the prosodic word in Dagaare is phonological. The analysis of affixation and cliticization as prosodic integration in Dagaare is in line with Booij's (1996) analysis of cliticization and Peperkamp's (1997) analysis of affixation. With the previous constraints and those in (54-55), I give an account of the integration of proclitics into a prosodic word. The parenthesis ( ) here is used for PWd boundaries not feet and also not spans. The root in the structure /ba=ji-ri/ is *ji-* and that of /tɪ=kog-o/ is *kog-*.

(58)   / bà= jí-rì / > [bə̀jírì] 'their house/home'

	INPUT /bà₁- jí₂ -rì₃/	IDENT-RT [αATR]	Parse-σ-PWd	Min	SPREAD [αATR]$_{pwd}$	ID-IO [αATR]
a.	(bà₁) (jí₂) (rì₃)			*!**		
b.	(bà₁) (jí₂rì₃)			*!		*
c.	(bà₁ jí₂ rì₃)				*!*	
d.	(bə̀₂jí₂)(rì₃)			*!		*
e. ☞	(bə̀₂jí₂rì₂)					**
f.	(bà₃jí₃rì₃)	*!				*
g.	bà₁(jí₂rì₂)		*!			*

Minimality rules out monomoraic PWds. For instance, (58a) is ruled out for having three separate monomoraic prosodic words though it satisfies the constraints on harmony. Candidate (58b) is also banned by minimality and ID-IO while (58c), although it fulfils minimality, is checked against SPREAD given that each syllable in the prosodic domain assumes a different tongue root feature. Even when the stem is bimoraic, as in (58d), minimality rules out the suffix from forming a PWd on its own. The forms also show prosodic integration results in harmony. However, the winning

candidate in (58e) fulfils both minimality constraint and the constraint on harmony. Crucially, candidate (58f) is ruled out by IDENT-RT since the root vowel in the output fails to identically correspond to the one in the input. Finally, in (58g), as result of failure of the proclitic to be parsed into a PWd, it is ruled out by parse-σ-pwd. The analysis in (58) is exactly the same as the one in (59) below. In these analyses, it is crucial to maintain root identity between the input and output and also ensure that every syllable is parsed by a PWd, hence IDENT-RT outranks both Parse-σ-PWd and ID-IO [αATR] to derive the correct output.

(59)   / tì= kóg-ɔ́ / > [tì=kóg-ó] 'our chair'

	INPUT /tɪ₁- kóg₂ -ɔ₃/	IDENT-RT [αATR]	parse-σ-PWd	Min	SPREAD [αATR]$_{pwd}$	ID-IO [αATR]
a.	(tì₁) (kóg₂) (ɔ₃)			**		
b.	(tì₁) (kóg₂ɔ₃)			*!	**	*
c.	(tì₁kóg₂ɔ₃)				*!*	
d.	(tì₁kó₂g)(ó₂)			*!		*
e. ☞	(tì₂kó₂gó₂)					**
f.	(tɪ₂kó₂gɔ₃)	*!				*
g.	tì₁(kó₂gó₂)		*!			*

Overall, Minimality triggers the prosodic integration of clitic and suffixes into the domain of harmony in Dagaare. As a result of the prosodic integration, the vowels of the clitics and suffixes harmonize with the root vowel in tongue root feature value.

4.5.4 Summary

In summary, tongue root harmony in Dagaare simple words operates between roots and affixes. Within roots, all vowels must agree in tongue root feature while affix vowels alternate harmonically in their surface tongue root quality in agreement with vowels of the root to which they are attached. This suggests that harmony in Dagaare is root controlled. The harmony is driven by optimality theoretic constraints which enforce spreading of harmonic feature from the root to the suffix. When the root and suffix of a word fail to share the same harmonic feature, then the word is regarded as ill-formed and ruled out by the grammar. The data also shows that tongue root

harmony is possible across word boundaries. For instance, in some compounds, [ATR] as the dominant feature forces harmony across roots while proclitics and preverbal particles assume the tongue root feature of the roots they precede. This then shows that tongue root harmony in Dagaare operates at both root/word and phrase-levels and in both cases, it involves root-controlled directionality.

I argue that minimality constraint triggers the integration of harmonic targets into the domain of harmony. In the analysis, I assume the domain of harmony is PWd which is minimally bimoraic. Using OT framework, bimoraicity is accounted for with Minimality constraint. Since all the targets of harmony are monomoraic, they violate Minimality and cannot form PWd on their own. So, in order to satisfy Minimality, proclitics and suffixes are integrated into the PWd. The vowel of the proclitics and suffixes harmonizing with the root vowel is a diagnosis for prosodic integration. In summary, the analysis supports the hypothesis that prosodic minimality triggers the integration of harmonic targets into the domain of harmony. As root-controlled harmony targets clitics and affixes which are prosodically ill-formed (i.e monosyllabic, monomoraic), minimality constraint should be incorporated into the analysis of languages with PWd as the domain of harmony. The harmonic pattern in Dagaare has been analysed in terms of the traditional OT framework which has provided information on how constraints sanction the derivation of harmony from single underlying representations. In the upcoming section, rounding harmony is discussed in terms of OT.

4.6 Account of Dagaare rounding harmony

This section gives a formal account of rounding/backness harmony in Dagaare based on OT. Rounding harmony is not as productive as tongue root harmony as it is attested mainly with the imperfective suffix and that of agentive nominalisations. The shape of the vowel of the suffix is determined by the shape of the vowel in the vowel root. Similar to tongue root harmony, rounding harmony is root-controlled. Recall that vowels in the rounding also agree in tongue root as well as backness and low features.

4.6.1   Rounding in Optimality Theory

In this section, I present an optimality theoretic analysis of the rounding harmony pattern that is laid out in section 4.3. As stated already, rounding is productively attested only with imperfective

verbs. The vowel of the imperfective suffix is always a mid vowel when the root contains non-low vowel, or the suffix is a low vowel when the root vowel is low. The fact that only imperfectives exhibit rounding raises questions as to why that is the case. My proposal is that the vowel of the imperfective suffix is unspecified for rounding and it needs the missing rounding feature from a donor to be realized as round. That is, given that the vowel of the imperfective suffix is always either mid or low, I assume that it is an underlying -V which is specified as [-high] not specified for the feature [round]. Then when realised on the surface, it must agree with all harmonic features associated with the root vowel. Therefore, if the root vowel is round (either high or mid round), the underlying [-high] vowel surfaces as a mid round vowel; if the root contains high or mid non-round vowel, the suffix vowel is realised as a mid non-round vowel and if the root vowel is low and unrounded, the suffix vowel is always low. Here is a schematised rounding/backness process below.

(60)   Rounding harmony

     kò   rV$_{[-hi]}$ $\rightarrow$ [kò-rɔ́]   'run-IPFV'

     [+rd] $\leftarrow$ [ ]

What happens is that the -V in the suffix has a [-high] feature and is then realized as round after getting the rounding feature from the root and this results in kò-rɔ́ 'give- IPFV'.

To provide an account for the how rounding is derived, I adopt a set of constraints and show how they interact to yield the surface forms. These constraints are discussed in more detail in section 4.4. Rounding can be accounted for by assuming constraints that trigger the spread of the feature [round] across a domain. Similar to the tongue root harmony, a constraint that drives rounding harmony is SPREAD [αF] (Padgett, 1995). The feature of focus is [round]; so, the relevant instantiation of SPREAD [αF] will be labelled SPREAD [αRD] as in (61). This constraint dictates that within a domain, any instance of the feature [αround] must be linked to all adjacent vocalic positions.

(61)   SPREAD [αRD] (Padgett, 1995)

     If a feature [αRD] is associated with a vowel, the same [αRD] feature is

     linked to every vowel in the PWd.

Since roots in Dagaare maintain their contrast, a positional faithfulness constraint as defined in (62a) will be required to ensure there is no change in [αround] feature of the root vowel. A constraint that also keeps identical features between input and out forms in every context is required to account for rounding. This is also defined in (62b). Moreover, given that the vowel of the imperfective suffix is always non-high, a constraint that forces faithfulness in height is assumed in (62c).

(62)   a.   IDENT-RT[αRD] (Beckman, 1998)

             Let α be an input vowel contained in a root, and β the output

             correspondent of α. If α is [λRD], then β must be [λRD].

    b.   ID-IO[αRD] (McCarthy & Prince, 1999)

             Let α be an input vowel, and β the output correspondent of α.

             If α is [λRD], then β must be [λRD].

    c.   ID-IO [αhigh] (McCarthy & Prince, 1999)

             Let α be an input vowel, and β the output correspondent of α.

             If α is [λhigh], then β must be [λhigh].

As already established, aside from rounding, the imperfective suffix agrees with the tongue root feature of the root, it is crucial that a constraint that enforces tongue root agreement is adopted. This leads to the following constraint as stated in (63). This constraint rules out forms which have vowels that disagree in tongue root feature, even if the vowels agree in rounding.

(63)   SPREAD [αATR]

         If a feature [αATR] is associated with a vowel, the same [αATR] feature is

         linked to every vowel in the PWd.

The following tableaux demonstrates how the constraints interact to derive the optimal form.

(64)   /kʊ-rV[-hi]/ → [kʊ̀-rɔ́] 'give-IPFV'

	INPUT /kʊ̀-rV[-hi]/	IDENT-RT [αRD]	ID-IO [αhigh]	ID-IO [αRD]	SPREAD [αRD]PWd	SPREAD [αATR]
a.	kʊ̀-ró					*!
b.	kʊ̀-rɛ́				*!	
c.	kʊ̀-rʊ́		*!			
d. ☞	kʊ̀-rɔ́					
e.	kù-rɔ́					*!
f.	kù-rú		*!			
g.	kò-ró		*!			

In the above tableau, the output in (64a) is crucially ruled out. Though the adjacent vowels agree in round feature, there is a violation of SPREAD [αATR] because the vowels do not share same tongue root value. In (64b), we see that it satisfies SPREAD [αATR] but is ruled out by SPREAD [αRD] since the vowels do not share the same rounding feature that prevents it from emerging optimal. As high vowels are prohibited in the imperfective suffix, it then means that any output form that has a high vowel in the suffix like (64c) will be banned by ID-IO [αhigh] because the suffix in the output has a high vowel instead of a non-high vowel compared to vowel specification in the input. Candidate (64d) is the winning output which fulfils all constraints. Candidates (64e-g) are all ruled out by the high-ranked ID-IO[αhigh] because of the violation of suffix faithfulness. The analysis in (64) applies exactly to the one below in (65), except for the specific values for [round] involved. Observe that the analyses presented with these two forms in (64-65) involve cases where the winning candidate is harmonically bounded by the other candidates in that candidate (d) will always win under any conceivable ranking. Thus, no particular crucial ranking is established here.

(65) /di-rV[-hi]/ → [dì-ré] 'eat-IPFV'

	INPUT /di-rV[-hi]/	IDENT-RT[αRD]	ID-IO [αhigh]	ID-IO [αRD]	SPREAD [αRD]	SPREAD [αATR]
a.	dì-rɛ́					*!
b.	dì-ró				*!	
c.	dì-rí		*!			
d. ☞	dì-ré					
e.	dɪ-re					*!
f.	dì-rí		*!			
g.	dè-ré		*!			

The OT analysis of rounding shows that the vowel of the imperfective suffix is underlyingly specified for the feature [-high] and whichever mid vowel that is realised on the surface must agree in terms of rounding and backness feature as well as tongue root feature of the root. In short, there is something morphologically special about the imperfective suffix in the sense that it has an underlying -V specified for [-high] whose surface form is determined by the verbal root. With rounding morphologically restricted the imperfective forms, a question arises as to how to account for absence rounding in default verbs and nouns.

I assume that the underlying suffix of the default form is the same as the surface form. That is the suffix is underlyingly specified as high and remains the same on the surface regardless of the shape of the root vowel. This is illustrated in (66). Candidate (a) which satisfies all constraints is crucially ruled out by the faithfulness constraint ID-IO [αRD] for the round suffix vowel. As the default final vowel is assumed to be insensitive to rounding, the round feature in the root vowel fails to spread to the suffix, hence leading to SPREAD [αRD] violation in the optimal output, candidate (b). The final high vowel blocks height and rounding harmony. Candidate (c) has same round and height features as the winner (b) but banned by ID-IO [αATR]. Candidates (d-g) are all ruled out by ID-IO [high]. Candidate (e) which is the optimal imperfective version of the default form is crucially prohibited against ID-IO [high].

(66) /sɔr-ɪ/ → [sɔ́rí] 'count/read.v'

	INPUT /sɔr-ɪ/	IDENT-RT [αRD]	ID-IO [αhigh]	ID-IO [αATR]	ID-IO [αRD]	SPREAD [αRD]
a.	sɔr-ʊ				*!	
b. ☞	sɔr-ɪ					*
c.	sor-i			*!		*
d.	sur-o		*!	*	*	
e.	sɔr-ɔ		*!		*	
f.	sur-u		*!	*	*	
g.	sor-o		*!	*	*	

In the above analysis, ID-IO [αRD] must outrank SPREAD [αRD] for the optimal output to emerge. This ranking does not have any consequences on the underspecified non-high vowels in the imperfective suffix as shown in (64-65) given that all candidates in the imperfectives are tied on ID-IO [αRD], thereby showing the distinction between underspecification for the imperfectives vs. full specification for the default forms.

4.6.2 Summary

Harmonic patterns which are associated with the imperfective and agentive nominal suffix are examined. The suffix involves rounding/backness, height and tongue root harmony. Within OT, the assumption is that the suffix vowel is underlyingly a -V specified for [-high]. Then on the surface, it agrees with all the features namely, [±round], [±ATR] [±back] or [±low] of the root vowel. For the default verb form, the suffix is fully specified as high front [i/ɪ] – it is the same underlyingly and on the surface. It simply fails to agree in the rounding feature of the preceding root vowel because high vowels are insensitive to and block rounding.

4.7 Conclusion

Prior to writing this chapter, only a little was known about harmony systems in the Dagaare in terms of description and analysis. The chapter therefore gives a more detailed description and analysis of Dagaare harmony patterns – tongue root harmony and harmony patterns that are connected to the imperfective and agentive nominalising suffix. These harmony patterns are laid

out in purely descriptive terms and then followed by analysis within the theoretical framework of Optimality theory.

With a symmetric /2IU/ ten-vowel system, all vowels within the harmonic domain – the prosodic word – must share the same harmonic feature. Suffix vowels harmonise with the vowels of the root suggesting that harmony in Dagaare is root-controlled. In this case each harmonic feature, ATR/RTR pattern symmetrically, with none of them being the dominant spreading feature. This happens particularly with simple forms made up of just roots and suffixes. The analysis further showed that the domain of tongue root harmony is not limited to only roots and suffixes because pronominal/verbal clitics also undergo tongue root harmony. This then means that harmony is Dagaare is both bidirectional and progressive. That is, tongue root harmony is analysed as morphologically conditioned – operating on two levels: root-level and phrase-level, both root-controlled. At the root-level harmony spreads rightward from the root to the suffix and at the phrase-level, the harmonic feature operates bidirectionally, from the root to the prefix/proclitic and the suffix. Rounding harmony is analysed as generally morphologically restricted to the imperfective, targeting the imperfective suffix progressively – from the root to the suffix. I proposed that the presence of rounding only in imperfective verbs is due to an underlying vowel which is specified for the feature [-high] while the lack of rounding in the default form is attributed to rounding being opaque to high vowels, probably because high [i/ɪ] is epenthetic introduced at word level.

In formally accounting for these patterns, I first adopt an optimality theoretic analysis arguing that harmony is driven by constraints that enforce spreading of features between roots and affixes. For the cases of pronominal clitics, my claim is that minimality constraint motivates the integration of harmonic targets into the harmonic domain. Since the clitic targets are monomoraic, they violate minimality and cannot form PWd on their own. So, they get integrated into the PWd. This analysis supports the claim that prosodic minimality conditions the integration of harmonic targets into the domain of harmony.

Chapter 5: Tone

5.1 Introduction

Tone as a common phenomenon has been investigated in many African languages. Some of these languages include Margi (Hoffman, 1963; Pulleyblank, 1986), Bambara (Dwyer, 1976), Kishamba (Odden, 1982), Digo (Kisseberth, 1984), Chizigula (Kisseberth 1992) Chichewa (Myers, 1998) and a variety of Bantu languages (Hyman & Kisseberth, 1998). Specific discussion of tone in the Gur/Mabia family exists for languages such as Moore (Peterson, 1971; Kenstowicz et al. 1988), Lama (Ourso, 1989b), Dagbani (Hyman, 1993; Issah 1993; Hyman & Olawsky, 2004), Buli (Akanlig-Pare, 1997; Akanlig-Pare & Kenstowicz, 2002), Dagaare (Anttila & Bodomo, 1996; Bodomo, 1997; Angsongna 2021) and Kɔnni (Cahill, 1998, 1999).

Mabia/Gur languages are either two- or three-tone systems. Consistent with the crosslinguistic observation that two-tone languages are the most common (Cahill 2007; Maddieson 1978), the majority of Mabia languages are two-tone. Tone-bearing consonants such as nasals have been observed in some Mabia languages such as Moore (Kinda, 1997), Dagara (=Northern Dagaare) (Somé, 1998), Waali (=Southern Dagaare) (Abdul Moomin, 2015), Birifor (=Western Dagaare) (Dundaa, 2013). It has been observed in Central Dagaare as well that there is tone on nasal consonants, particularly on the first-person pronoun (Anttila & Bodomo, 1996).

Theoretical analysis of tone in terms of models such as Optimality Theory (Prince & Smolensky 1993; McCarthy & Prince, 1995; Prince & Smolensky, 2004; McCarthy 2011) has been common in African languages, particularly on Bantu languages (Bickmore, 1996; Cassimjee & Kisseberth, 1998; Myers & Carleton, 1996; Odden, 1998; Reynolds, 1997 etc). There are also some analyses of non-Bantu languages which can be found in e.g. Akinlabi (1996); Pulleyblank (2004). Bringing this home to Gur/Mabia, the available OT analysis of tone are of Dagaare (Angsongna, 2021; Anttila & Bodomo, 1996, 2000) and Konni (Cahill, 1998, 1999). In the analysis of Dagaare, much of the focus has been on the nominal system at the expense of other categories in the language. The present research takes a step further by proposing an analysis for the nominal tones, verbal tones, and derived forms like nominalisations. This chapter is therefore a relevant addition to the descriptive and theoretical analysis of tone in Dagaare.

5.2 Dagaare tone

5.2.1   Tone inventory and distribution

Dagaare is a register tone language with two basic levels of tone, high (H) and low (L) (Kennedy, 1966; Anttila & Bodomo 1996; Bodomo 1997; Angsongna 2021). A high tone is represented with the acute accent [á] and a low tone is represented with the grave accent [à]. There are also cases of downstep; a phenomenon in which the second of two high tones is not equally as high as the first one (Hyman, 1985; Selkirk & Tateishi, 1991). Downstep is represented here with an exclamation mark [!á]. In this section, I show examples of simple verbs and simple nouns in Dagaare to illustrate these tones.

5.2.1.1 Distribution of verbal tones

As with vowel harmony, the default and imperfective verb forms exhibit different patterns. That is, there are three tone classes for Dagaare verbs and for each of the classes, the surface pattern it exhibits in the default is systematically different from the pattern it exhibits in the imperfective. Both have three lexical classes corresponding as follows: For the default form which may be mono- or disyllabic, there are three surface patterns, H/H-H, L/-L-L, HL/H-L with their corresponding imperfective forms, which are always disyllabic surfacing as H-L, L-H and H-!H (H!H, respectively analysed as HLH with the L floating; Kenstowicz, 1994; Pulleyblank, 1986). There is no LH or L-H in the default form and there are no H-H and L-L in the imperfectives. It is however possible to see a H-H imperfective arise postlexically in a clause when preceded by some preverbal particles. This will be illustrated in section 5.2.4 below. The tone classes in the default and imperfective forms of the verb are described next.

In the default form there are three tone melodies: L, H, and HL. All these melodies are attested on monosyllabic CV(V)-Ø forms which involve null suffix, where an HL melody is realised as a falling contour. These melodies (L, H, HL) are the same in the disyllabic default forms. In these cases, the suffix is either an overt mora or a CV syllable with the preceding root either being CV or CVV or CVC or CVVC. In the imperfective forms, there are L-H, H-L and HLH (=H-!H).

First, the default of L toned roots are given in (1). They involve cases with CV or CVV or CVC forms which have no suffixes and there are CVC roots which are followed by either –V or –CV suffix while CVVC and CVCC roots are followed by -V.

(1) L-root, default L; imperfective L-H

Verb root	Perfective	Gloss	Imperfective	Gloss
dì-	dì	'eat.v'	dì-ré	'eat-IPFV'
tù-	tù	'follow.v	tùù-ró	'follow- IPFV'
kò-	kò	'give.v	kò-rɔ́	'give- IPFV'
lè-	lè	'fall.v	lè-ré	'fall- IPFV'
jùò-	jùò	'open.v	jùò-ró	'open- IPFV'
tùò-	tùò	'carry.v	tùò-ró	'carry- IPFV'
zɛ̀l-	zɛ̀lì	'lift.v	zɛ̀l-ɛ́	'lift- IPFV'
wùl-	wùlì	'show.v	wùl-ó	'show- IPFV'
sɔ̀r-	sɔ̀rì	'beg.v	sɔ̀r-ɔ́	'beg- IPFV'
sàr-	sàrì	'slip.v	sàr-á	'slip- IPFV'
pɔ̀g-	pɔ̀gì	'close.v	pɔ̀g-rɔ́	'close- IPFV'
kpìn-	kpìnnì	'extinguish.v	kpìn-né	'extinguish- IPFV'
tùùr-	tùùrì	'pick.v	tùùr-ó	'pick- IPFV'
kòɔ̀r-	kòɔ̀rì	'sell.v	kòɔ̀r-ɔ́	'sell- IPFV'
bòɔ̀l-	bòɔ̀lì	'call.v	bòɔ̀l-ɔ́	'call- IPFV'
sòŋ-	sòŋ	'help.v	sòn-nɔ́	'help- IPFV'
bàŋ-	bàŋ	'know.v	bàn-ná	'know- IPFV'
zìgl-	zìglì	'seat.v	zìgl-ɛ́	'seat- IPFV'
tɔ̀gl-	tɔ̀glì	'imitate.v	tɔ̀gl-ɔ́	'imitate- IPFV'
zàgr-	zàgrì	'refuse/reject.v	zàgr-á	'refuse/reject- IPFV'

Both root and suffix are L-toned. For the imperfectives of these L roots, there are CV or CVC or CVV root syllables preceding the high front vowel. The root is L while the suffix is H. Given these cases, I will be treating the root for both default and imperfective as underlyingly L.

The cases involving perfective H in (2) are similar to what is described above in (1). For instance, there are CV, CVV and CVC monosyllabic roots with no suffixes, so we see H tone over a monomoraic or bimoraic but monosyllabic verb, as well as H-H over disyllabic verb.

(2) H-root, default H; imperfective H-L

Verb root	Perfective	Gloss	Imperfective	Gloss
lé-	lé	'tie.v	lé-rè	'tie- IPFV'
tú-	tú	'dig.v'	túú-rò	'dig- IPFV'
kʊ́-	kʊ́	'kill.v'	kʊ́ʊ́-rɔ̀	'kill- IPFV'
kɔ́-	kɔ́	'farm.v	kʊ́ɔ́-rɔ̀	'farm- IPFV'
lɔ̃́ɔ̃́-	lɔ̃́ɔ̃́	'drop/throw.v	lɔ́ɔ́-rɔ̀	'drop/throw- IPFV''
jɔ́ɔ́-	jɔ́ɔ́	'pay.v'	jɔ́ɔ́-rɔ̀	'pay- IPFV'
kpér-	kpérí	'slice.v	kpér-è	'slice- IPFV'
sɔ́r-	sɔ́rí	'count/read. v'	sɔ́r-ɔ̀	'count/read- IPFV'
vɔ́l-	vɔ́lí	'swallow.v'	vɔ́l-ɔ̀	'swallow- IPFV'
síg-	sígí	'descend.v	síg-rè	'descend- IPFV'
dʊ́g-	dʊ́gí	'cook/boil.v	dʊ́g-rɔ̀	'cook/boil- IPFV'
nɔ́ŋ-	nɔ́ŋ	'massage.v	nɔ́n-ɔ̀	'massage- IPFV'

Just like the cases of the L toned default form, there are and CVC roots that are followed by either -V or -CV suffix but unlike the L roots which have cases with CVVC, there are no H toned roots with the shape CVVC. This probably is an accidental gap. The imperfective forms always have either a -V or CV suffix. The root is H and the suffix is L. These patterns lead to the assumption that the root is underlyingly H.

In the HL class as shown in (3) only one CV monomoraic default form is attested in the language and it comes with a contour tone. There are CVV syllables with zero suffixes and in this case, there is HL contour across the bimoraic but monosyllabic CVV form as in examples like *fáà* 'seize'. The V-final roots are followed by a -CV suffix while CVC roots are followed by a –V or a –CV suffix. In these cases, the surface forms have the root syllable being H and the suffix being L.

(3) HL-roots, default H-L; imperfective H-LH = H-!H

Verb root	Perfective	Gloss	Imperfective	Gloss
dî-	dî[4]	'take.v	dí-!rɛ́	'take- IPFV'
díɛ̀-	díɛ̀	'receive.v	díɛ́-!rɛ́	'receive- IPFV'

---

[4] The verb 'take' is quite unusual in Niger-Congo languages and this could be why it is the only monomoraic form with a contour in Dagaare.

vʊ́ɔ̀-	vʊ́ɔ̀	'uproot.v	vʊ́ɔ́-!rɔ́	'uproot- IPFV'
fáà-	fáà	'seize.v	fáá-!rá	'seize- IPFV'
dáà-	dáà	'push.v	dáá-!rá	'push- IPFV'
lôr-	lórì	'untie.v	lór-!ó	'untie- IPFV'
kôr-	kórì	'cough.v	kór-!ɔ́	'cough- IPFV'
ɲûn-	ɲúnnì	'evaporate.v	ɲún-!nó	'evaporate- IPFV'
jíèl-	jíélì	'sing.v	jíél-!é	'sing- IPFV'
dúòr-	dúórì	'urinate.v	dúór-!ó	'urinate- IPFV'
hɔ́ɔ̀r-	hɔ́ɔ̀rì	'yawn.v	hɔ́ɔ́r-!ɔ́	'yawn- IPFV'
háàr-	háárì	'shoo.v	háár-!á	'shoo- IPFV'
sɔ́gl-	sɔ́glì	'hide.v	sɔ́gl-!ɔ́	'hide- IPFV'

CVVC and CVCC H-toned root followed by a L-toned –V suffix. When it comes to the imperfectives, the only CV root has a CV suffix as in *dí-!ré* 'taking'. CVV roots precede CV suffixes; CVC roots are followed by –V or –CV suffixes, where the -CV suffix occurs with only nasal-final roots and CVVC roots come with –V suffixes. In the CVC or CVVC or CVCC imperfective cases, we do not see HL-H (falling + H) surface pattern. Rather a level high tone occurs and then a downstepped high on the suffix. Even if there are three moras available, they do not associate one-to-one mapping. With this in mind, I will consider the root to be underlyingly HL.

The choice of the imperfective suffix is completely predictable based on the phonological shape of the root and the default form. For instance, CV(V)r, CV(V)l, CVgr and CVgl roots take -V suffix. Recall (in chapter 3) that evidence for positing CVgr and CVgl as roots instead of CVg- or CVl- is based on reduplication. CVVN roots take –V suffix while CVN roots take -(C)V suffix. Moreover CV, CVV and CVg roots take –rV suffix. As shown in chapter 4, the imperfective suffix has an underlying -V specified for [-high] feature. The shape of the root then determines the shape the suffix vowel takes on the surface. Refer to chapter 3 for detailed illustrations of the kind of shape the default and imperfective root and suffix takes.

When we compare the default vs the imperfectives, apart from the fact that the tone on the imperfective suffix is opposite to the root-final tone, it is also observed that there are some imperfective forms which involve lengthening and diphthongisation in the root. Moreover, the

vowel quality of both default and imperfective suffixes is completely predictable. The default suffix if any, always has high front unrounded vowel [-i/-ɪ] and the imperfective always has a non-high vowel [-e/-ɛ, -o/-ɔ, -ə/-a]. Unlike the imperfective suffix, the shape of the verbal root does not determine the shape of the default suffix. Both suffixes harmonise in tongue root position with the root, and the imperfective suffix harmonises in backness, rounding and [±low] with the root. Discussion of harmony patterns is found in chapter 4. The next section presents descriptive data for tone distribution in nouns.

5.2.1.2 Distribution of nominal tones

The great majority of simple nouns are categorized into three main tonal classes, namely H-H, H-L and L-H. Recall that nouns are minimally disyllabic as the tone patterns show. L-L pattern is said to be systematically absent (Anttila & Bodomo, 1996, 2000; Bodomo, 1997). The database of 314 simple nouns for this research however shows the presence of three nouns with a L-L pattern. The general tendency is that the singular and the plural forms display the same tonal melody, with a few exceptions. The data in (4-6) shows the three main tone classes in nouns.

(4) ∅ -root; HH – singular vs plural

Root	singular	plural	Gloss	Evidence for root representation	
bi-	bí-é	bíí-rí	'child'	bì-fáá	'bad child'
zi-	zí-é	zíí-rí	'place'	zì-fáá	'bad place'
sɪ-	sí-ɛ́	síí-rí	'waist'	sì-kpɛ̂ŋ	'big waist'
ɲu-	ɲú-ú	ɲúú-rí	'neck'	ɲù-wɛ́gì	'long neck'
bʊ-	bʊ́-ɔ́	bʊ́ʊ́-rí	'goat'	bú-bílé	'small goat'
sɪg-	síg-í	síg-rí	'hut'	sìg-bílé	'small hut'
zɪg-	zíg-ɛ́	zíg-rí	'back'	zìg-bílé	'small back'
pɛg-	pɛ́g-í	pɛ́g-rí	'shell'	pèg-kpɛ̂ŋ	'big shell'
kog-	kóg-ó	kóg-rí	'chair'	kòg-bílé	'small chair'
bag-	bág-á	bág-rí	'shoulder'	bàg-bílé	'small shoulder'
taŋ-	táŋ-á	tán-ní	'mountain'	tàm-bílé	'small mountain'
naŋ-	náŋ-á	nán-ní	'scorpion'	nàn-zìɛ́	'red scorpion'

In (4) above, the noun root is L in a compound. Then both singular and plural take H toned suffix. The underlying form of the nominal root is established by noun-adjective (N-A) combination. The

H~L alternation provides evidence about the underlying tonal content of the root – specifically, of the tonal content of roots that surface as H-H. In the examples, if a H-H noun is modified by an adjective, the number suffix of the noun is dropped while the root bears a L tone. As noted in Kenstowicz et al. (1988), the H is a property of the suffix, so a default L is expected on the nominal root in the N-A compound if the root does not have a tone of its own. Therefore, I will consider these roots as underlyingly toneless.

In the next set of examples in (5) below, the noun root surfaces as L in N-A compound just as the examples in (4). Then in both singular and plural, the suffix takes a H tone. In these cases, both the singular and plural as well as the N-A compound have lexically specified L. Since the root remains L in all these environments, I consider it to be underlyingly L.

(5) L-root; L-H – singular vs plural

Root	singular	plural	Gloss	Evidence for root representation	
pì-	pì-é	pìì-rí	'rock'	pì-bílé	'small rock'
ɲù-	ɲù-ó	ɲùù-rí	'navel'	ɲù-bílé	'small navel'
sù-	sù-ó	sùù-rí	'knife'	sù-zì-ɛ́	'small knife'
dè	dì-é	dè-rí	'room/house'	dè-bílé	'small room/house'
jɔ̀ɔ̀-	jɔ̀ɔ̀-rí	jɔ̀-bɔ́	'termite'	jɔ̀ɔ̀-bílé	'small termite'
tòò-	tòò-rí	tò-bó	'ear'	tòò-wɛ́gì	'long ear'
bìg-	bìg-í	bìg-rí	'law'	bìg-fáá	'bad law'
bùg-	bùg-ó	bùg-rí	'silo'	bùg-kpɛ̂ŋ	'big silo'
bɔ̀g-	bɔ̀g-í	bɔ̀g-rí	'hole'	bɔ̀g-zùlúŋ	'deep hole'
gòŋ-	gòŋ-ó	gòn-ní	'silk cotton'	gòŋ-wɛ́gì	'tall silk cotton'

The next class in (6) below is different as we see that the compounds have a H!H pattern when the adjoining adjective is H-toned. The singular and plural suffixes are L-toned. Following the proposals of Anttila & Bodomo (1996, 2000), I am going to treat these roots as underlyingly H.

(6) H-root; H-L – singular vs plural

Root	singular	plural	Gloss	Evidence for root representation	
jí-	jí-rì	jí-è	'house/home'	jí-!bílé	'small/house/home'
mí-	mí-rì	mí-è	'rope'	mí-!ŋmáá	'short rope'
nɛ́-	níɛ́-rì	nɛ́-ɛ̀	'grinder'	nɛ́-!bílé	'small grinder'

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gbɛ́-	gbɛ́-rì	gbɛ́-ɛ̀	'leg'	gbɛ́-wɛ́gì	'long leg'
jó-	júó-rì	jó-è	'name'	jó-!fáá	'bad name'
só-	só-rì	só-è	'path'	só-!ŋmáá	'short path'
dʊ́g-	dʊ́g-ì	dʊ́g-rì	'pot'	dʊ́g-kpɛ̂ŋ	'big pot'
wɛ́g-	wɛ́g-ɛ̀	wɛ́g-rì	'log'	wɛ́g-!ŋmáá	'short log'
kóg-	kóg-ò	kóg-rì	'mahogany'	kóg-wɛ́gì	'tall mahogany'
fɔ́ŋ-	fɔ́ŋ-ɔ̀	fɔ́n-nì	'section'	fɔ́m-!bílé	'small section'

In summary, the tone pattern in nouns involve cases where the singular/plural suffix contributes a tone that is opposite to the tone of the root, or the suffix tone is the same as the root. That is, in the cases in (4), the H tone on the suffix contributes the H tone on the root. So, on the surface both root and suffix share the same tone. For the cases in (5) and (6), the root bears a tone that is contrastive to the tone of the suffix syllable. This contrast between the root and suffixal tone is what has been referred to as tonal polarity, a dissimilatory process in which a tone-bearing unit, generally an affix, shows a tone value opposite to one immediately adjacent to it (Hoffman, 1963; Pulleyblank 1983, 1986; Kenstowicz et al., 1988). Essentially the L and H roots result in surface polar tones on the suffix.[5]

The tone patterns that are attested for verbs and nouns are given with the following tables. First, here are the verbs. Since verbs are always either monosyllabic or disyllabic, the attested tone patterns they exhibit are the ones already stated above for the default and imperfective forms. Contours are those with different tones without a hyphen.

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[5]It should be mentioned also that although studies (e.g. (Anttila & Bodomo, 1996, 2000) claim that LL forms are systematically absent in Dàgáárè, our current database has the following three LL forms: *ʤùglì - ʤùglò* 'vulture', *gbàgà - gbàgrì* 'agama lizard' and *tɔ̀ɔ̀rì – tɔ̀bɔ̀* 'tobacco'. There are also simple nouns which are LHL like *gʊ̌ɔ̀ - gʊ̀ɔ́-rì* 'thorn', *lǒŋ-ò - lǒn-nì* 'hourglass drum'. Moreover, there is a case where both surface singular and plural forms are H-! H, *sʊ́ʊ́ŋ-!áá – sʊ́ʊ́n-!í* 'rabbit'

Table 5.1: Attested surface tone patterns in verbs

Default					Imperfective				
Size	**Pattern**	**Ex.**	**Gloss**	**No.**	**Size**	**Pattern**	**Ex.**	**Gloss**	**No.**
One-syllable	H	tú	'dig.v'	39	One-syllable				
		jɔ́ɔ́	'pay.v'	4					
	L	tù	'follow.v'	29					
		bàà	'grow.v'	18					
	HL	dî	'take.v'	1					
		dáà	'push.v'	8					
	*LH				Two-syllable	*H-H			
Two-syllable	H-H	sɔ́rí	'count.v'	26		H-L	sɔ́r-ɔ̀	'count-IPFV'	69
	L-L	sɔ̀rì	'beg.v'	110		L-H	sɔ̀r-ɔ́	'beg-IPFV	154
	H-L	kɔ́rì	'cough.v'	60		H-!H	kɔ́r-!ɔ́	'cough-IPFV'	69
	*L-H					*L-L			

Nominal patterns involve syllable counts ranging from one to five are detailed in the following table representing each syllable count. The table below shows the different syllables and the tone patterns they exhibit.

Table 5.2: Attested surface tone patterns in nouns

Size	Pattern	Example	Gloss	No.
One-syllable	H	má	'mother'	1
		báá	'dog'	11
	HL	zû	'head'	5
		ʧúù	'moon'	18
	LH	pìé	'rock'	29
	*L			
Two-syllable	H-H	kó.gó	'chair'	119
	H-L	jí.rì	'house'	55
	L-H	bù.gó	'silo'	73
	L-L	tɔ̀.bɔ̀	'tobacco'	3
	H-!H	ʤɛ́.l!íí	'eggs'	12
	LH-L	gʊ̀ʊ́.rì	'thorns'	17
Three-syllable	H-H-H	sín.sá.gá	'rattle'	14
	H-H-L	sí.kpá.gà	'proverbs'	3
	L-H-H	nà.fí.ríí	'hoof'	20
	L-L-H	zɔ̀.mì.ŋɛ́	'friend'	32
	L-H-L	lì.bí.rì	'money'	12
	H-H-!H	ká.máá.n!íí	'corn'	3
	H-L-H	gbé.bì.rí	'toe'	10
Four-syllable	L-H-L-H	bì.rí.jùù.rí	'ducks'	7
	H-H-L-H	gɔ́.má.tìì.bʊ́	'chameleon'	4
Five-syllable	L-H-H-H-H	sà.kpá.lím.bí.rí	'kidney'	1

The tone possibilities found in the one- and two-syllable words represent simple nouns. I should mention that even though I refer to these one- and two-syllable nouns as simple, they are actually morphologically complex in the sense of containing two morphemes: a root plus an affix, each of which could potentially come with its own tonal content. So, the simple nouns involve tone sequences with monosyllabic noun roots. The more complex patterns (i.e, three- four- and five-

syllable) nouns are mostly compounds. Note that the number of forms for each pattern is not representative of all the forms of the language; it is based on the current database of nouns (see Appendices A & B) . It must also be emphasized that this information is reflective of the variety of Central Dagaare spoken in Sombo and its environs. Other varieties might have varying syllable counts and tone patterns. The above patterns lead us to the following generalizations.

(7) Surface generalizations about Dagaare tone

    i.   There are restricted number of L-L nouns in Dagaare. Only three nouns are attested in the database

    ii.   The imperfective suffix syllable never has the same tone as the preceding root syllable. That is, if the root is L, the suffix is H and if the root is H, the suffix is H or !H, where !H is the result of a floating L in underlying HLH.

    iii.   There are no surface HLH within simple words in Dagaare (both nouns and verbs). What this effectively means is that we never find HL-H (where HL is falling) or H-LH (where LH is rising) and we never find a monosyllabic HLH (falling-rising contour). There is however a H-!H which I believe results from HLH (with the L floating, i.e., H (L)-H).

    iv.   Contours are generally word-final, with a few exceptions in nouns

    v.   A contour in Dagaare has a maximum of two levels of pitch, HL, LH. That is a maximum of two tones associated to a TBU except for LHL on a CVV syllable in the singular of 'thorn' *gŭɔ̀*.

    vi.   Both rising and falling contours are attested in nouns, but only falling contour is attested in verbs (= *LH in verbs)

    vii.   There is no evidence suggesting the presence of a floating H, but L tones can float between high tones, causing downstep.

As the discussion in this chapter progresses, there may be other generalizations. These, in addition with those listed above will inform the basis of a number of OT constraints for the analysis.

In summary, the data above shows the various tone classes attested in simple verbs and nouns. The default form of the verb has the surface tone patterns: L(-L), H(-H) and H(-)L while the corresponding imperfective form has the patterns: L-H, H-L and H-!H. For nouns, the tone patterns are generally similar for both singular and plural in simple nouns. The major classes include H(-

H), H(-)L and L(-)H. Other very marginally attested surface simple forms are L(-L), H-!H and LH(-)L.

5.2.2 Representation of tone

Under autosegmental phonology (Goldsmith, 1976; Leben, 1973), tone is on a separate tier from the segmental and prosodic content. A tone is only realized on the surface if it is linked or associated to some segmental or prosodic material such as the syllable or the mora on which it (the tone) is eventually pronounced. An important aspect of this theory is about how tones are connected to tone bearing units. There have been a number of detailed proposals at representing tones in terms of features (see Yip, 1980; Clement 1980; Pulleyblank, 1986). As phonological segments such as speech sounds are represented as sets of features, tone can also be represented as set of features. Under these proposals tone is specified by a combination of features, such as [upper] and [raised] in which H equals [+upper, +raised]; M is [-upper, +raised], and L is [-upper, -raised] etc. Though relevant to a two-tone system, the tone feature system has been associated with at least a three-tone system. Therefore, it is not common to design a feature system for tone height on the basis of a language with only a two-way contrast such as Dagaare. In such cases, there are two options; either there is a single binary feature for tone, namely [-/+high], or there is unary feature representing high and an unspecified low. In the case of Dagaare, I will assume that the two tones are distinguished by way of the unary features [high] and [low].

As stated in (Zoll, 2003), about three independent parameters play a role in accounting for the distributional asymmetries in tone association patterns cross-linguistically, namely the morphological category of autosegments (e.g. prefix or suffix), the quality of tone (e.g., H or L) and phonological directionality, which in most cases is left to right (Clements & Ford, 1979; Goldsmith, 1976; Leben, 1973; Pulleyblank, 1986; Williams, 1976) depending on the language and generalisations. These associations are shown with lines connecting the tone tiers to the syllables, segments or moras. The illustration below shows lines connecting tones and syllables.

(8)   T T T
 | | |
         σ σ σ
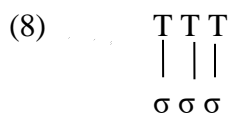
In some languages, associations are underlying. If tones are not associated to a tone-bearing unit (TBU) in the underlying form, then the grammar of the language must supply associations on the
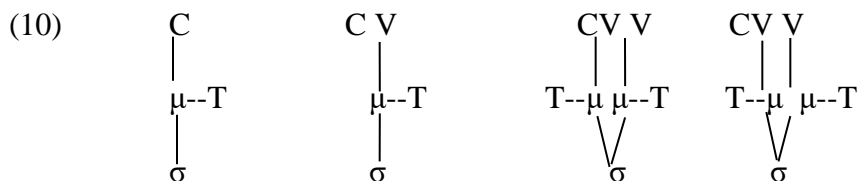
surface, though there can be exceptions such as a case where an L is allowed to be unassociated on the surface and being audible as downstep on the following tone.

5.2.2.1 Tone bearing units

The TBU is the landing site on which tones anchor (Hyman & Leben, 2017; Hyman, 2018). In terms of associating tones to TBUs, it is not always straightforward what the TBU of a language is. Tones may anchor on a segment, syllable, or mora. Odden (Odden, 1995, 2020) draws evidence from various languages which appear to show that the entity to which tone associates is the mora in some languages and the syllable in other languages. He concludes that further research is required to explicitly address the question of what the TBU is. In a similar fashion, Yip (2002) proposes various mechanisms to illustrate that the TBU could be the segment, mora or the syllable depending on the language. To this end, if a language has monomoraic CV syllables where each syllable bears exactly one tone, it is possible that the TBU may be the vowel, mora or the syllable.

(9)   CV--T   CV   CV
           | | |
           μ   μ--T   μ
           | | |
   σ   σ   σ--T
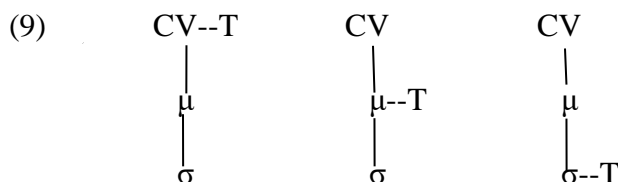
If a language has both light monomoraic and heavy bimoraic syllables such that they differ in the number of tones they can bear, where monomoraic syllables can bear only one tone and bimoraic syllables can bear two, then it has to be a case that the mora and not the syllable is the TBU. An example of a language that fits this assumption is Gurenɛ; Mabia/Gur (Adongo 2018).

(10)   C   C V   CV V   CV V
          | | | | | |
         μ--T   μ--T   T--μ μ--T   T--μ μ--T
          | | \ /   \ /
   σ   σ   σ   σ

Citing Zec (1988) and Steriade (1997), Yip (2002) notes that there are languages where the TBU is not just the mora but vocalic/sonorant moras only.

Finally, if a language has two different syllable weights, light and heavy, and both can bear the same number of tones, the syllable is the TBU.

(11)

```
        CV              C V V
        |               | |
        μ               μ μ
        |                \ /
      σ--T              σ--T
```
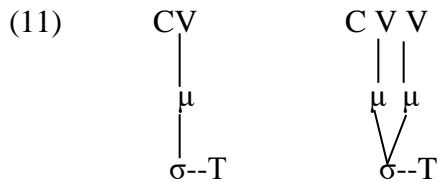
Dagaare has cases involving light and heavy syllables which can both bear same number of tones. The above approach in (12) therefore correctly describes Dagaare, suggesting that the TBU is the syllable as earlier posited in Anttila & Bodomo, (1996) and Kennedy (1966) and not the mora. Dagaare allows a maximum of two pitch levels per syllable. That is, phonologically this corresponds to two associations per syllable which may be HL or LH, and this holds for all syllable weights: CV, CVV, CVC, CVVC. Note that for CV syllables in Dagaare, only HL contour is attested. Let us consider the following examples in which (12a) has the one mora and dominated by two tones and (12b) has two moras with one tone. Then we see (12c) with one mora and two tones while (12d) has two moras and two tones.

(12)   a. H   b. H   c. HL   d. HL
           | \   \ /   \ /
         ma   'mother'   tuu 'forest' zu 'head'   ʧuu 'moon'
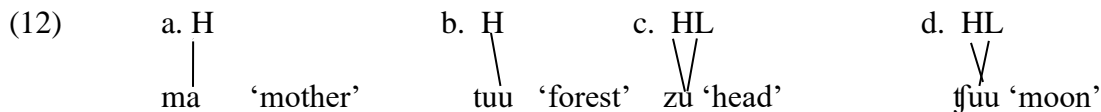
For LH contour to be possible we require two moras. This is probably where the mora may be relevant in Dagaare. See the following examples. If we follow the argument for the HL forms in (12) above, then LH cases in (13) appear to show that the TBU is the mora.

(13)   a. LH   b. *LH
           \ /   \ /
         baa 'river'   ba
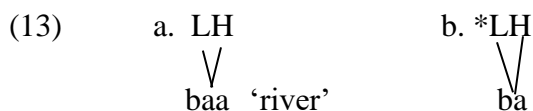
The absence of CV monomoraic LH contours in Dagaare is probably related to the observation that HL contour is the most common in tone languages (Cahill, 2007; Maddieson, 1978). Given the special case of discrepancy with rising LH contours, it can be assumed that the syllable being the TBU is not entirely straightforward in Dagaare. In this research I will assume the syllable as the TBU and leave the debate open for further investigation in terms of whether it is the mora or the syllable that constitutes the TBU.

Another point supporting the claim that the TBU is the syllable in Dagaare root from the idea that in spreading the whole syllable is affected, not just the mora. This is illustrated below.

		Nouns			verbs		
(14)							
	LH	wàà-rí	'yam-PL'		mààl-á	'make-IPFV'	
		pùò-rí	'back-SG'		tòɔ̀-rɔ́	'pound- IPFV'	
	HL	sáá-rì	'broom- SG'		túú-rò	'dig-IPFV'	
		púó-rì	'stomach- SG'		kɔ́ɔ́-rɔ̀	'farm- IPFV'	

As we can see above, the first syllable in each word is either a long vowel or a diphthong, but the tone melody is the same, regardless of what the bimoraic material of the first syllable is. If the mora is considered the TBU, then we might expect forms such as *[wàá-rí] and *[kɔ́ɔ̀-rɔ̀]. This is also the case with CVV-CV or CVVC-V forms of the verbs such as *fáá-!rá* 'seizing' or *jíél-!é* 'singing'. In these cases, we see that the first two moras are H and then there is a !H on the third mora in the suffix. They do not surface with a HL contour followed by a H, so these forms *[dáà-rá] or *[jíèl-é] are ill-formed.

Finally, it is useful to mention that other Mabia languages such as Vagla (Crouch, 1985), Moore, and Lama (Kenstowicz et al., 1988), Dagbani (Hyman, 1993), Kɔnni (Cahill, 1998, 1999) and Buli (Akanlig-Pare, 1997; Akanlig-Pare & Kenstowicz, 2002; Schwarz, 2009) have been analysed with the syllable as the TBU. Although there has not been any exhaustive research into many/all Gur/Mabia languages, it is worth assuming that the syllable being the TBU is probably a common characteristic of these languages, given that they belong to same language family.

5.2.2.2 Contour tones

When there are more tones than tone bearing units (TBUs), contour tones, if allowed, are formed usually at the edge of the word (where tone mapping ends). In many languages, syllables differ based on the number of tonal contrasts they may take (Hyman, 1988). While the majority of languages allow level tones on all syllables, many languages limit contour tones to particular syllable types. For instance, in some languages such as Hausa and some Bantu languages, contours are allowed only on heavy bimoraic syllables (Odden 2020). There are many other languages which have contours on short vowels while some languages like Kaficho have just one lexical contour, rising, which is restricted to heavy or long vowel syllables. There are yet other languages that are contourless, particularly languages which limit tones to one per mora.

In a related fashion, a survey of 105 languages (Gordon, 2001) found that 25 languages allow both rising and falling contours only on CVV(C) syllables. Twenty-nine (29) out of the 105 languages allow contour tones on syllables containing long vowels – CVV(C) and closed syllables with a sonorant coda – CVR but not on syllables with obstruent codas (CVO). Three (3) languages (Hausa, Luganda and Musey) were described as having contours on heavy syllables like CVV(C), (CVR) and CVO but never a contour on CV. A total of 36 languages had contour tones either rising or falling or both, on CV, CVV(C), CVR and CVO syllables. Finally, twelve (12) languages were found to be contourless on single syllables irrespective of the syllable type.

In Dagaare, there are two contour tones, namely falling and rising – HL and LH contours. Both HL and LH contours appear generally on CVV syllables as in *nîè* 'person.SG', *dáà* 'push' for LH and *tùó* 'baobab.SG', *wìɛ́* 'farm.SG' for LH. Note that LH is only in nouns. There are however a few cases with HL contours on CV syllables as in *nû* 'hand' and *zû* 'head'. Cross-linguistically, contour tones generally appear on final syllables. In Dagaare, however, there is an exception in the sense that LH contours occur on initial syllables in a few instances as, '*gòʊ́-rì* 'thorn-sg', *tàám-à* 'shea fruit-pl'. The pattern of association in these examples is what should have been expected for HL root plus a H suffix, resulting in HL-H but instead what we saw there was H(L)-H (i.e., downstep). Thus, the difference is that a L tone can be left floating, if necessary, but a H is never allowed to float even if the alternative results in a non-final contour.

5.2.3 High-toned suffix

A striking generalisation to note in Dagaare is that the greater proportion of nouns, both singular and plural, simple and complex, end with a high tone. This high tone could be downstepped high or regular high. Out of three hundred and fourteen (314) nouns in the database, two hundred and twenty-three (228) nouns have high-toned suffixes with only eighty-six (86) being low toned. There are three patterns: two end in H and one ends in L.

In a similar fashion, it is interesting to note that the majority of imperfective verbs have high-toned suffixes; downstepped or regular high. There are two hundred and eighteen (218) high-toned suffixes out of the total of three hundred and ten (310) imperfective forms. Ninety-two (92) are L-toned. A hypothesis then is that all nominal and imperfective suffixes in Dagaare are underlyingly high-toned and moraic (-V or -CV). In contrast, the default suffix is toneless and does not require

any moraic or segmental content (i.e., it can be zero). The full data of nouns and verbs categorised in terms of tone classes are in appendix A and B.

5.2.4   Obligatory Contour Principle

In some languages, there is no distinction between two H or two L tones and one multiply-linked H or L associated to two TBUs. This means that in such languages there is absence or inactivity of Obligatory Contour Principle (OCP); a phenomenon in which adjacent identical tones are prohibited (Leben, 1973; Suzuki, 1998; Yip, 2002; Zoll, 2003). In other languages, sequences of identical adjacent tones are disallowed, and this means the presence of OCP effects in such languages. Different languages resolve the problems of OCP in different ways (Myers, 1997).

In the context of Dagaare, OCP can be resolved by dissimilation – a process by which one of the tones changes in height. This results in what has already been referred to as tonal polarity. See the structure in (15).

(15)   UR   SR

            H H   H L
            | | → | |
            /dʊg-ɪ/   dʊg-ɪ   'pot- SG'
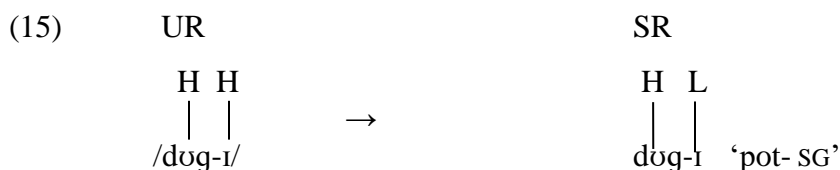
An OCP violation could be resolved by downstep (already mentioned) where a floating L intervenes between two H tones, thereby resulting forms like *bʊ́m-!á* 'thing-PL; *sʊ́ɔ́ŋ-!áá* 'rabbit-SG'. Finally, the problem of identical adjacent tones remains unchanged when the two tones do not belong to same prosodic word (PWD) which is the domain of OCP. This happens mostly with compounds. Given that the prosodic word is the domain of OCP, there can be a sequence of H-H across PWds with no resolution for OCP. In (16), TBU1 and TBU2 have the same tones because they do not belong to the same prosodic word but the polarity we see as a resolution for OCP is within the prosodic word (that is, between the verb root and AGT suffix).

(16)   H   H H   →   H (H L)
            | | | | | |
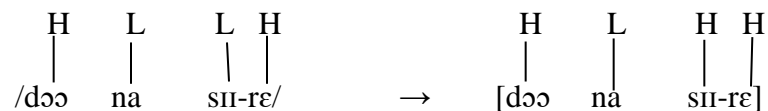   nɛn-sɪɛ-rɛ   nɛn-sɪɛ-rɛ   meat-roast-AGT (meat-roaster)
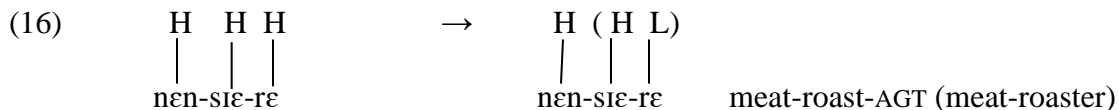
The preceding discussion shows that sequences of identical tones are not allowed within a domain; this means that the OCP is active in Dagaare. Therefore, it is going to be necessary that the OCP is invoked to address and explain the tone phenomenon in Dagaare. It is however important to note

that OCP violations are possible in the language. A point worthy of note is the effect of the future tense particles. As Anttila & Bodomo (2007) observe, these particles show that post-lexical H-H sequence are not resolved. Consider the following examples. In (17a), the verb root is L while the suffix is H. In (17b), when the L toned future marker *nà* occurs before the verb, the verb surfaces as H-H imperfective form. Similarly, in (17c), the presence of the L-toned future negation preverbal particle '*kòŋ*' leads to a H-H imperfective verb.

(17)　　a.　　à　　dɔ́ɔ　　　　**sìì**-rɛ́　　　　ná　　bʊ́-ɔ́

　　　　　　　　DET　　man.SG　　　　skin-IPFV　　　FOC　　goat-SG

　　　　　　　　'the man is skinning a goat'

　　　　b.　　à　　dɔ́ɔ　　　　nà　　**síí**-rɛ́　　　　!ná　　bʊ́-ɔ́

　　　　　　　　DET　　man.SG　　　　FUT　　skin- IPFV　　　FUT　　goat-SG

　　　　　　　　'the man will be skinning a goat'

　　　　c.　　à　　dɔ́ɔ　　　　kòŋ　　　　**síí**-rɛ́　　　　bʊ́-ɔ́

　　　　　　　　DET　　man.SG　　　　FUT.NEG　　　skin- IPFV　　　goat-SG

　　　　　　　　'the man will not be skinning a goat'

(18)　　　　Adjacent H tones within a verb

```
     H    L    L  H              H    L    H H
     |    |     \ |              |    |    | |
    /dɔɔ  na   sɪɪ-rɛ/     →    [dɔɔ  nà   sɪɪ-rɛ]
```

The examples above show that a LH verb becomes HH after a L tone. The schema in (18) is a possible explanation for H-H sequence on the verb after the future particle. By this line of reasoning, it means that there is no OCP resolution. It is also possible to assume instead that, what we see is a deletion of the root L and then spreading of the H suffix tone onto the root TBU. This therefore mean that there would be no OCP violation. This second possible explanation is schematised below.

(19)　　　　Tone spread across verbal suffix and root

```
     H    L    L  H              H    L         H
     |    |    |  |              |    |        /|
    /dɔɔ  na   sɪɪ-rɛ/     →    [dɔɔ  nà   sɪɪ-rɛ]
```
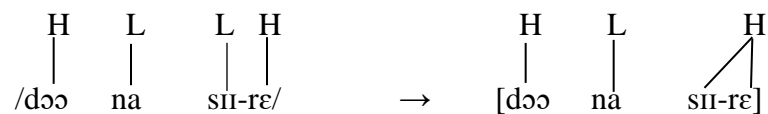
This pattern suggests a leftward spreading in verbs just like in nouns. I would conclude that in order to avoid adjacent L tones between the preverbal particle *nà* and the verbal root, the L is deleted and the H on the imperfective suffix is spread onto the root.

5.3 Analysis of tone: Optimality Theory

This section presents an account of Dagaare tone in terms of OT, where output forms are generated from input forms. The candidates are evaluated in parallel by constraints which are ranked with respect to each other. The form that violates fewest and lowly-ranked constraints wins. Before proceeding to demonstrate how the constraints interact to derive the desired outputs, I make some remarks about the representational conventions adopted for the OT tableaux in this paper. I adopt the classical OT tableau (Prince and Smolensky 1993/2004) for the derivations that follow. In this formalism, I establish a competition between the optimal form and other competing candidates with respect to each constraint. As a standard practice, I use * for a constraint violation and based on the number violations a candidate incurs on a constraint. I use *! to mark fatal violations which show that a candidate is knocked or ruled out of the competition. Constraint ranking is based on which constraints favour the optimal candidate and block competing candidates from winning or conflicting with the winner.

5.3.1   Constraint system

5.3.1.1 Basic markedness constraints

Following the common view that the notion of correspondence extends to tone and TBU relations (see Myers 1997; Zoll 2003; Pulleyblank 2004), various basic tone-wellformedness constraints are required in the analysis of Dagaare tone. Constraints against, toneless TBUs, floating tones, multiply-linked and contour tones will play vital role in accounting for the surface representations of tones. In autosegmental phonology (Goldsmith 1976), a single tonal autosegment is associated to a single TBU. When we have more tones than TBUs or more TBUs than tones, then the pattern is violated. One-to-one mapping between tones and TBUs is what is common with many languages.

As we will see below, these constraints are separated as SPECIFY (T), *FLOAT, *CONTOUR, and *T-SPREAD. It is important to note that there are explicit distinctions in terms of *T-SPREAD in high and low tones which bring about *H-SPREAD and *L-SPREAD. These distinctions are necessary

because of the spreading high and low tones. Note also that a similar distinction can be made for *FLOAT, with *H-FLOAT and *L-FLOAT being distinct constraints. Low tones can float but high tones do not. These specific distinctions, however, may only be invoked if necessary as I consider *T-SPREAD as involving both high and low tones while *FLOAT represents either high or low tone. In addition, OCP will be crucial constraint in the analysis. The set of constraints are defined below.

(20)   Basic markedness constraints
   a.   SPEC (T) (Cahill 1998, 1999, Yip 2002)
        Every TBU must be associated with a tone
   b.   *FLOAT (Yip 2002)
        Every tone must be associated to a TBU
   c.   *CONTOUR (Yip 2002; Zoll 2003)
        A TBU must not be associated with more than one tone
   d.   *T-SPREAD
        No tone must be associated with more than one TBU
   e.   OCP (Leben 1973; Suzuki 1998; Yip 2002; Zoll 2003)
        Adjacent identical tones within a domain are prohibited. For the purposes of this analysis, I treat the simple forms (stem + suffix) and complex cases such as compounds and associative constructions as the relevant domain for OCP.

Other relevant constraints will be invoked as the discussion proceeds. Before we go into the analysis and present tableaux, it must be mentioned all tones are prelinked in the input and this prelinking remains unchanged in the output. That is a tone associated to a TBU in the input will remain associated in the output except for cases involving floating tones. If a tone gets unlinked in the output e.g., L, then there will be violation * FLOAT. In the following tableau, I demonstrate how the above markedness constraints work. It should be noted that this tableau is not depicting a real word of Dagaare, and this is not how such an input would actually surface. It is purely a schematic illustration of how these constraints are evaluated.

(21)   /kog-ó/ → [kòg-ó]

	H /kog-ó/	SPEC (T)	OCP	*FLOAT	*CONT	*T-SPREAD
a.	H kog-o					*!
b.	L kog-o					*!
c.	H H kog-o		*!			
d.	L H kog-o	*!		*		
e.	H L kog-o	*!			*!	
f. ☞	L H kog-o					

The above tableau illustrates how the constraints work. Candidates (a-b) violate *T-SPREAD since there is tone spreading between the suffix and root in both cases. Candidate (c) is ruled out by OCP for identical adjacent tones; candidate (d) is ruled out by SPEC (T), and it violates * FLOAT as well given that a tone is left unassociated to a TBU. Candidate (e) violates SPEC (T) and *CONTOUR for the toneless TBU and for the rising contour on the initial TBU respectively. Finally, given just these constraints, candidate (f) is the optimal output as it satisfies all constraints. Note that SPEC (T) is never violated and although it is active, it is not necessary to keep illustrating it in the analysis.

5.3.1.2 Faithfulness constraints

In addition to the tone markedness constraints above, input-output faithfulness constraints play crucial role in tone analysis. Various MAX and DEP constraints (Mccarthy, 2011; McCarthy & Prince, 1999; Prince & Smolensky, 2004b) that penalize differences will be invoked. In OT, tones may be inserted, particularly low tones whose insertion is considered more optimal than the

insertion of high tones. To achieve this the DEP family of constraints prohibiting insertion will be required. For specific faithfulness such as that of the root, [DEP]ROOT constraint will be crucial. Constraints against tone deletion between input and output are equally crucial. This then brings us to faithfulness constraints such as MAX constraints. Underlying root tones must be maintained in the output which means that [DEP]ROOT must ensure there is faithfulness between the input and output tones on roots. Another constraint that ensures correspondence of the root tones is ROOT-ANCHOR-R (T). As the analysis progresses, other relevant faithfulness constraints will be introduced as needed. Before providing account of each tone pattern, the definitions of the faithfulness constraints are listed below.

(22)   Faithfulness constraints

    a. MAX (T)

      A tone in the input has a corresponding tone in the output (= no deletion of tones)

    b. [MAX]ROOT (T)

      A tone in the input that is in the root has a corresponding tone in the output (= no deletion of root tone)

    c. DEP (T)

      A tone in the output has a correspondent in the input (= no tone insertion)

    d. [DEP]ROOT (T)

      A tone in the output that is in the root has a corresponding tone in the input (=no tone insertion in the roots)

    e. ROOT-ANCHOR-R (T): The rightmost tone in the root in the input corresponds to a tone in the output that is associated to a TBU that is both (i) rightmost in the root, and (ii) rightmost in its tone span.

In the following tableau, I give an illustration of how these faithfulness constraints operate. Note that indices on the high tone indicate the corresponding H tone that is deleted, retained, or spread.

(23)   /kóg-ó/ → [kóg-ò]

	H₁ H₂ /kog-o/	[MAX]ᴿᴼᴼᵀ (T)	ROOT-ANCHOR-R (T)	DEP (T)	MAX (T)	[DEP]ᴿᴼᴼᵀ (T)
a. ☞	H₁ L /kog-o/			*	*	
b.	H₂ kog-o		*!		*	

Candidate (a) is the optimal output though it violates both MAX (T) and DEP (T) because the suffix H in the input is deleted and a L inserted in the output. Candidate is (b) is ruled out by ROOT-ANCHOR-R (T) and MAX (T).

5.3.2   Analysis of verbal tone

Previous studies on Dagaare tone have focused primarily on nominal tones (Anttila & Bodomo, 1996, 2000, 2007). The only work that has examined verbal tone is recently found in Angsongna (2021). Using an autosegmental-OT perspective, this study treats tone as a combination of the features [±upper] and [±raised] connected to what is described as tonal node and the tonal node is then connected to the syllable. It is an approach based on indexed constraints in which a single ranking is assumed for the entire language. The claims made in Angsongna (2021) raise some questions regarding tone feature analysis using tonal node. Dagaare is a two-toned language. So, there is no real evidence for the tonal node hypothesis as the model is not well motivated.

On the backdrop of these questions about the feature hypothesis, the current study proposes a treatment of tone as set of binary features. Thus, following the description of the verbal tone shown in section 5.2.1.1 above, I propose that the underlying melodies of the verb roots are the same as the surface tones of the default verb forms whether there is an overt suffix after the root or not. What this effectively mean is that the underlying tones in the root remain unchanged on the surface. The default forms involve a suffix which sometimes has a segmental content and is sometimes null (-Ø) but is always underlyingly toneless (probably due to the default property of the verb). So, the final or rightmost tone of the root (in case there is more than one tone, as in HL roots) spreads onto

the suffix if it not already a zero suffix or segmentally null. Here is how the underlying tonal representation of the default tones look like:

(24)   Default tone

    /H-∅/   →   [H-H]

    /L-∅/   →   [L-L]

    /HL-∅/   →   [H-L]

For the imperfectives, there is an additional tone to the right of the root tone. What the phonology does is to choose what form that additional tone takes. The imperfective suffix tone surfaces with an opposite height compared to the tone of the root – tonal polarity. This polarity effects on the imperfective forms, I assume result from the morphological process of suffixation. That is, the imperfective has a dedicated aspectual suffix unlike the default form and the presence of this suffix always affect the tonal pattern of the verb. The proposal then is that the imperfective suffix occurs with an underlying H tone which is realized as H or L based on OCP-driven constraints. The tonal representation of the imperfective forms is as follows:

(25)   Imperfective tone

    /H-H/   →   [H-L]

    /L-H/   →   [L-H]

    /HL-H/   →   [H-!H]

The question that arises is: what causes the imperfective suffix to surface with a tone opposite to the (final) root tone? The next sections will attempt to address this question. The analysis and discussion proceed as follows; section 5.3.3 presents analysis for the default verbs involving H and L roots and section 5.3.4 presents an analysis for the corresponding imperfective verbs of these roots. Given that HL verbal roots involve downstep, I do not present an analysis for them in these sections. Refer to section 5.5 for a discussion of downstep involving verbs, nouns, and other nominal expressions.

5.3.3   Default verb forms

5.3.3.1 High-toned default verb roots

This section gives an analysis for the default verb forms of the verb in Dagaare. As already mentioned above, the surface melody of the default form (as a whole) is the same as the tone

melody that the root has underlyingly. We begin with the H default root with the form *sɔ́rɪ́* 'count/read.V'. This analysis looks problematic.

(26)　　　　　H root; toneless suffix /sɔrɪ/
　　　　　　　sɔ́rɪ́ 'count/read.V'

	H ⎪ /sɔr-ɪ/	OCP	ROOT-ANCHOR-R (T)	DEP (T)	*T-SPREAD
a.	H ⎪＼ sɔr-ɪ		*!		*
b.	H　H ⎪　⎪ sɔr-ɪ	*!		*	
c. ☞	H　L ⎪　⎪ sɔr-ɪ			*	
d.	L　H ⎪　⎪ sɔr-ɪ		*!	**	

Candidate (a) is ruled out by ROOT-ANCHOR-R (T) and *T-SPREAD due to rightward spread of the root tone onto the suffix. The insertion of a new H tone on the suffix in addition to the already existing root H tone means the presence of two adjacent H tones, thereby resulting in an OCP violation as well as a DEP (T) violation for (b). Both candidates (c) and (d) look better than candidate (a) which is expected to be the winner. Candidate (c) however is better and thus emerges as optimal but is the incorrect form. Given the assumptions for the underlying representation for the imperfective forms, it appears like the current analysis would fit well for the imperfectives (and probably the nouns as will be shown later) and not the default forms. A possible way of resolving this problem and ensuring the right candidate wins is by re-ranking DEP (T) above ROOT-ANCHOR-R (T). This will certainly work for the default forms but not with the imperfective forms. The goal, however, is to propose an analysis that works for all tonal patterns involving simple forms (root + suffix) for verbs and nouns. This therefore invites an alternative analysis. To this end, I posit another anchor constraint, WORD-ANCHOR-R (T) defined as follows.

(27)　　　　WORD-ANCHOR-R (T): The rightmost tone in the word in the input corresponds
　　　　　　　to a tone in the output that is associated to a TBU that is both (i) rightmost in the word,
　　　　　　　and (ii) rightmost in its tone span.

This constraint is violated when a tone in the output is rightmost in the word and rightmost in its tone span but does not correspond to the tone that is rightmost in the input. It must outrank ROOT-ANCHOR-R (T) in order to derive the optimal output for the default H root. Let us consider the following reanalysis (28).

(28)   H root; toneless suffix /sɔ́rɪ/

sɔ́rí 'count/read.v'; {OCP, WORD-ANCHOR-R (T)} >> {RT-ANCHOR-R (T) *T-SPREAD}

	H /sɔr-ɪ/	[MAX]RT (T)	OCP	WORD-ANCHOR-R (T)	RT-ANCHOR-R (T)	DEP (T)	*T-SPREAD
a. ☞	H sɔr-ɪ				*		*
b.	H H sɔr-ɪ		*!	*		*	
c.	H L sɔr-ɪ			*!		*	

The output form in (a) wins but at the expense of RT-ANCHOR-R (T) and *T-SPREAD violations as it involves spreading of root L to the suffix and this does not correspond to the tone span of the root in the input and output; (b) is ruled out by OCP, WORD-ANCHOR-R (T) and DEP (T) for inserting a new L while (c) is checked against WORD-ANCHOR-R (T) and DEP (T). To ensure candidate (a) wins the crucial ranking that is established involves OCP, and WORD-ANCHOR-R (T) ranking above RT-ANCHOR-R (T) and *T-SPREAD. Next is the L root of the default form.

5.3.3.2 Low-toned default roots

For these forms, I assume an underlying L in the root and toneless high vowel. The tone in the root spreads to the vowel on the surface as presented in (29) for the verb *wùlì* 'show/teach.v'. The analysis shown here is exactly the same as the one in (28). The only difference is just the particular tone involved.

(29)   L root; toneless suffix /wùli/
        wùlì 'show/teach.V';{OCP,WORD-ANCHOR-R(T)} >> {RT-ANCHOR-R(T)*T-SPREAD}

	L /wul-i/	[MAX]RT (T)	OCP	WORD-ANCHOR-R (T)	RT-ANCHOR-R (T)	DEP (T)	*T-SPREAD
a. ☞	L wul-i				*		*
b.	L L wul-i		*!	*		*	
c.	L H wul-i			*!		*	

5.3.3.3 Summary

In summary, as the analysis shows the underlying tones of the default forms form are identical to its surface tones. It is observed that spreading a tone is better than inserting new tones. The crucial constraint ranking that is established for this case involves OCP,WORD-ANCHOR-R(T) outranking RT-ANCHOR-R(T)*T-SPREAD. The account of the default verbs then brings us to how tone interacts between the imperfective suffix and the verbal roots. This is examined in the next section that follows.

5.3.4   Imperfective verbs

There is always an additional tone that appears in the imperfectives relative to their default counterparts, always surfacing on the suffix syllable and realised as either H or L based on the tone class of the root. The phonology chooses between the tones as appropriate. This additional tone is what I consider as an underlying H tone which comes with the suffix already associated. Based on the tone height of the root syllable, the underlying H remains as it is or it is replaced by a L. That is, there are two possible tones for the imperfective; either it surfaces as H following a root with L or HL, or it realised as L following a root with H. This difference in the tone of the suffix is what I consider to be resulting from the morphology via suffixation. The following schema illustrates how the mechanism works.

(30)　　　Underlying and surface forms of the imperfective

a.　　/L H/　　　→　　　L H
　　　　 | |　　　　　　　　| |
　　　 wul-o　　　　　　 wul-o　'show-IPFV'

b.　/H H/　　　→　　　H L
　　　 | |　　　　　　　　 | |
　　　sɔr-ɔ　　　　　　 sɔr-ɔ　'count/read-IPFV'

c.　/HL H/　　　→　　　HLH
　　　 V |　　　　　　　　 | |
　　　baar-a　　　　　 baar-a　'finish-IPFV'

In (30a) the suffix comes with an associated H following a root with L. When the root gets associated with a TBU, the suffix remains unchanged because a polar tone is better than spreading or inserting another L for the imperfectives. In (30b), the underlying suffix H is deleted, and L inserted as a result of a dissimilatory process based on OCP. In (30c), the suffix H tone remains the same following a HL root where the L is left floating causing downstep. In effect the imperfective forms undergo tonal polarity. There is never a H-H or a L-L surface tone patterns in Dagaare imperfectives. With this in mind, I argue that the absence of surface H-H or L-L is due to dissimilation. This dissimilatory analysis of tonal polarity is identical to that of Kenstowicz et al. (1988).

5.3.4.1 High-toned imperfective roots

When we treat the imperfective suffix as an underlying H, it simply means that what we see in candidate (a) involves a deletion of the input suffix tone and insertion of L in the output, hence the violation of WORD-ANCHOR-R (T) because the tone in the right edge of the word in the input does not correspond to the one in the output. In (b) the suffix tone has the same height as the adjacent root tone and that means a violation of OCP which crucially rules it out. In (c) the root tone is deleted and then the remaining H spreads across the TBUs, hence it is ruled out by [MAX]RT (T) and the two anchor constraints as well as *T-SPREAD. In (d), the suffix H_2 tone is deleted while H_1 spreads and this violates WORD-ANCHOR-R (T) just as (a) but (d) is crucially ruled out by ROOT-ANCHOR-R (T) because the rightmost tone in the root must not only be at the right-edge of the root but it cannot be further than the right edge. Recall that the indices on the high tones indicate the corresponding H tone that is deleted, retained or spread.

(31)　　　H root; H suffix /sɔ́r-ɔ́/
　　　　　sɔ́r-ɔ̀ 'count/read-IPFV'; {[MAX]RT (T), OCP} >> {WORD-ANCHOR-R (T)}

	H₁ H₂ /sɔr-ɔ/	[MAX]RT (T)	OCP	WORD-ANCHOR-R (T)	RT-ANCHOR-T (T)	DEP (T)	*T-SPREAD
a. ☞	H₁ L sɔr-ɔ			*		*	
b.	H₁ H₂ sɔr-ɔ		*!				
c.	H₂ sɔr-ɔ	*!			*		*
d.	H₁ sɔr-ɔ			*	*!		

Given the analysis, the crucial ranking that is determined relative to the winning candidate versus competing candidates is that [MAX]RT (T) and OCP ranks above WORD-ANCHOR-R(T).

5.3.4.2 Low-toned imperfective roots

In the tableau below (32), there is a suffix H and then OCP keeps this H since the preceding root tone is of opposite height. Thus, what we see in the input is the same as the output and that means candidate (a) violates no constraint. OCP and WORD-ANCHOR-R (T) bans candidate be (b) while candidate (c) is penalized by *T-SPREAD. For this particular form of the verb, no crucial ranking is determined relative to the winning candidate.

(32) L root; H suffix /wùl-ó/
wùl-ó 'show/teach-IPFV'

	L H /wul-o/	[MAX]RT (T)	OCP	WORD-ANCHOR-R (T)	RT-ANCHOT-R (T)	DEP (T)	*T-SPREAD
a. ☞	L H wul-o						
b.	L L wul-o		*!	*		*	
c.	L wul-o			*!			*

5.3.4.3 Summary

In a nutshell, the claim is that default verb forms are what they are underlyingly. The suffix or final vowel is always toneless and so the tone of the root spreads to the final vowel on the surface. In contrast, the imperfective forms always have an aspectual suffix which comes with an additional tone to the right of the root. That is, unlike the default suffix, the imperfective suffix is underlyingly H which either remains as H on the surface or it is replaced by a L based on OCP-driven effects. This analysis shows that the absence of surface H-H and L-L in imperfectives is a result of OCP banning adjacent identical tones. Both default and imperfective forms belong to the same grammar as both patterns result from a single ranked constraint set. Tone analysis of verbs in this section appears clean and quite straightforward but can the analysis be replicated with the nominal system? The next sections attempt to address this question.

5.3.5 Analysis of nominal tone

In this section, simple/non-compound nouns are examined. By simple noun, I mean a noun root – number suffix combination. That is, all simple non-compound nouns are two-morpheme sequences (root+suffix, though the suffix can in a few cases be Ø). Simple nouns in Dagaare fall under three main surface tone patterns, H-H, H-L, L-H. There is also L-L pattern, which is severely less robust. These tone melodies are generally the same for both singulars and plurals. In such a tone system each syllable may be dominated by a tone different from the tone of other syllables. For instance, in case like *dóg-ì* 'pot-SG' and *bùg-ó* 'silo-SG', it is seen that the initial syllable has a tone that is

opposite to that of the second syllable. This contrast between the initial and final tones – tonal polarity – has been discussed in a number of languages (e.g. Anttila & Bodomo, 1996, 2000; Cahill, 1998, 1999, 2004; Hoffman, 1963; Kenstowicz et al., 1988; Newman, 1995; Pulleyblank, 1986). Accordingly, the roots with L always polarise, i.e., it always precedes a suffix with H. The H toned root conditions an opposite L on the suffix. However, cases like *kóg-ó* 'chair-SG' are not H-toned roots at all, but rather toneless roots. So, the H tone they display is actually the suffix tone that spreads to the root. Given that the L-L pattern involves only three examples, I consider it an accidental gap and I do not propose an account for them in this chapter. Here is a revisit of some examples illustrating polarity and spreading.

(33)   Tone alternation with nominal suffixes

tone	singular	plural	gloss
H-H	kóg-ó	kóg-rí	'chair'
H-L	kóg-ò	kóg-rì	'mahogany'
L-H	gòŋ-ó	gòn-ní	'silk cotton'
L-L	gbàg-à	gbàg-rì	'agama lizard'

Tonal polarity has been analysed in some Gur/Mabia languages from different perspectives. Kenstowicz, Nikiema and Ourso (1988) analysed Moore tone assuming that the alternations in the language are H-H, H-L and L-H with LL being absent as claimed in Dagaare. They propose that all suffixes are high-toned underlyingly with polarity resulting from dissimilation. Underlying H-H surfaces as HL via an OCP-driven dissimilation. Underlying L-H remains unchanged on the surface and finally the high-toned suffix spreads to the toneless stem resulting in H across stem and suffix. See below how the patterns work:

(34)   Underlying representation and surface representation of tone patterns

L-H → L-H   H-H → H-L   ØH → H-H

The conclusion from Kenstowicz et al on Moore tone is that polar suffix has underlying H where the polar effect is the outcome of a dissimilatory lowering of suffixal H next to a H-toned root.

Anttila and Bodomo (2000) provide an OT analysis of Dagaare tone with same tone classes as Moore, H-L, H-H, L-H. They propose that all suffixes are underlyingly toneless, not high. They posit the following patterns:

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(35)   Surface HH: inserted high, which spreads   ∅∅ → HH

Surface HL: lexical high, inserted L   H∅ → HL

Surface LH: lexical low, inserted high   L∅ → LH

In both Moore and Dagaare, the OCP plays an active role in driving the analysis. The question of adequate data arises however for Dagaare given that the analysis is mainly centred on simple nouns (root + suffix) to the neglect of verbs and complex structures like compounds, associative constructions, and phrasal tone.

In this chapter, I follow both the analyses of Anttila and Bodomo and Kenstowicz et al in assuming that roots are toneless, H and L. That is, there are three tonal types in the nominal roots: (i) some roots are consistently L as in [bùg] 'silo'; (ii) some roots are consistently H such as [dóg] 'pot' and (iii) some roots are L when there is no suffix particularly in compounds and H when there is a number suffix as in [tàm]-bílé 'small mountain' vs [táŋ]-á 'mountain-SG'. So, such roots alternate between L and H. Suffixes on the other hand surface are as follows; a suffix is H after a low root; it becomes L after a H root and then there are cases where both the root and the suffix are H. I will treat L and H roots as exhibiting the surface forms – they are what they are underlyingly – a L that is already linked for the L roots and a linked H for the H root. The H~L alternating cases will be treated as underlyingly toneless. Below is an illustration of each root.

(36)   Underlying nominal roots

```
    L                H
    |                |
    σ                σ                σ
    |                |                |
  /buɡ/            /doɡ/            /taŋ/
```

Similar to the case of the imperfective suffixes, and in contrast to Anttila and Bodomo (2000), I assume that all nominal suffixes are underlyingly H toned, not toneless as illustrated below.

(37)   Suffix

```
    H
    |
    σ
    |
   /V/
```

In the following section, each nominal root is analysed in terms of tableaux, starting with toneless roots.

5.3.5.1 Toneless nominal roots

In the analysis that follows, toneless roots are examined. In this case polarity is not observed as the suffix H spreads across to the root. Candidate (a) wins but at the expense of violating *T-SPREAD. It is clear here that spreading an existing H tone across to the root from the suffix is preferred over deleting and inserting a new tone. In (b) the underlying H suffix is deleted, and a L inserted; there is also an insertion of a new H on the toneless root. This insertion rules it out because of the violation of DEP (T). An insertion of a new L tone on the root in (c) also means a violation of DEP (T). Identical adjacent tones within a domain are forbidden and this explains why candidates (d) and (e) are checked against OCP. Candidates (c) and (d) also violate DEP (T) for the new tones. Finally, (f) is ruled out by WORD-ANCHOR-R (T), DEP (T) and *T-SPREAD.

(38)   Toneless root; H suffix /taŋ-á/
          táŋ-á 'mountain-SG'

	H /taŋ-a/	[MAX]RT (T)	OCP	WORD-ANCHOR-R (T)	RT-ANCHOR-R (T)	DEP (T)	*T-SPREAD
a. ☞	H táŋ-a						*
b.	H L taŋ-a			*!		*	
c.	L H taŋ-a					*!	
d.	L L taŋ-a		*!	*		**	
e.	H H taŋ-a		*!			*	
f.	L táŋ-a			*!		*	*

With respect to the winning candidate versus the other competing candidates, no crucial ranking is established in this noun form.

5.3.5.2 High-toned nominal roots

The next analysis in (39) assesses the H-L form which results from underlying /H-H/. In this case, what happens is a dissimilatory process triggered by OCP. In (a), WORD-ANCHOR-R (T) and DEP (T) is violated. What happens here is that the underlying H tone on the suffix is deleted in the output while a new L is inserted in order to satisfy polarity. Candidate (b) is crucially ruled out by OCP as a result of adjacent identical tones. In (c), the root H_1 tone is deleted while the remaining H_2 tone is spread across the two TBUs and this gets it banned by [MAX]RT (T). Candidate (d) violates WORD-ANCHOR-R (T) just as that candidate (a) but (d) is crucially ruled out by ROOT-ANCHOR-R (T) because the tone rightmost tone in the root must not only be at the right-edge but it cannot be further than the right edge. The grammar (e.g., constraint ranking) in this noun is exactly the same as seen for the imperfective form *sɔ́r-ɔ̀* 'count/read-IPFV'.

(39)   H root; H suffix /dʊ́g-í/
        dʊ́g-ì 'pot-SG'; {[MAX]RT (T), OCP} >> {WORD-ANCHOR-R (T)}

	H_1 H_2 /dʊg-ɪ/	[MAX]RT (T)	OCP	WORD-ANCHOR-R (T)	ROOT-ANCHOR-R (T)	DEP (T)	*T-SPREAD
a. ☞	H_1 L dʊg-ɪ			*		*	
b.	H_1 H_2 dʊg-ɪ		*!				
c.	H_2 dʊg-ɪ	*!			*		*
d.	H_1 dʊg-ɪ			*	*!		*

The constraint ranking that is established for the for this form is the same as that one established for H-L imperfective forms. In the next analysis, L nominal root is discussed.

5.3.5.3 Low-toned nominal roots

Finally, we turn the attention to L-H nouns which are what they are underlyingly. That is, the surface form is exactly the same as the underlying form. Candidate (a) is optimal as it does not violate any of the constraints. It is simply the same as the input. Candidate (b) is ruled out by OCP. The spread of the L tone in (c) violates WORD-ANCHOR-R (T) as there is no right edge correspondence between the input and output. In (d), the underlying root L is deleted. This fatally rules it out by [MAX]RT (T). This form is exactly the same as that of L imperfective root.

(40)   L root; H suffix /bùg-ó/
          bùg-ó 'silo-SG'

	L H /dʊg-ɪ/	[MAX]RT (T)	OCP	WORD-ANCHOR-R (T)	ROOT-ANCHOR-R (T)	DEP (T)	*T-SPREAD
a. ☞	L H bʊg-o						
b.	L L bʊg-o		*!			*	
c.	L bʊg-o			*!			*
d.	H bʊg-o	*!					*

In summary, the default verb forms have three underlying roots: H, L root and HL root. They all have underlying toneless suffixes. In the preceding analysis, I examined cases involving H and L roots (HL cases are discussed later section 5.5). Both H and L cases involve spreading a single tone across root and the final vowel and that is preferred over inserting tones on each TBU. For the imperfectives, there is always an additional tone which is underlyingly H. Then based on OCP-driven constraints, the suffix surfaces as H or L.

With simple nouns, there are three main underlying roots: toneless, H and L. Similar to the imperfective forms, the nominal suffix is underlying H and remains as H after a L root, simply spreads to a toneless root or it changes on the surface to a L based on dissimilatory effects inspired by OCP. The analysis shows that the imperfective H-L and L-H presents the exact same analysis

for the nominal H and L roots. It is important to indicate that the default verb forms, imperfective forms and simple nouns belong to the same grammar in that they are analysed via same set of constraints. That is, all these patterns result from a single ranked set of constraints.

5.4 Tone in more complex structures

5.4.1   Derived nouns (event nominalisations)

There are two common types of morphological derivations in which one involves the derivation of event/action-denoting nominals from verbs and sometimes adjectives while the other involves the derivation of agent-denoting nominals from verbs (Baker & Vinokurova, 2009). Both types of derivations are attested in Dagaare. This section focuses on event nominalisation which deals with how nouns are derived from verbs while maintaining the general meaning of the action/event/process denoted by the verbal root (Chomsky, 1968; Comrie, 1976; Comrie & Thompson, 2007). Derivations can be overtly marked by the concatenation of an affix (41a), by conversion (= zero derivation) (41b) or by a prosodic alteration such as stress or tone change (41c). Note that the forms in (b-c) are not morphologically distinct. The examples in (b) are homophonous while (c) are only distinct by way of the location of stress.

(41)   a. educate (V)   vs.   education (N)

            b. break (V)   vs.   break (N)

            c. conˈduct (V)   vs.   ˈconduct (N)

In Dagaare, nominalisation is primarily based on affixation (suffixation) in which a verb root, typically monosyllabic, is affixed by a V or CV suffix which ultimately changes the category from a verb into a noun. The process of nominalisation in Dagaare involves a morphophonological operation, invariably involving suffixation and often a resultant change in the surface tonal melody of the verb root. The nominalizing suffix [-bu/-bʊ] has the allomorphs [-bu/bʊ], [-u/-ʊ] and [-nuu/-nʊʊ] attached to the verb root. The suffix denotes an 'act of doing X' as in *díí-bú* 'act of eating'. The verb root is the same as in the default form. The tone of the root either changes when the derivational suffix is attached, or it remains unchanged. When the derivational suffix is added to a L-toned verbal root, the derived noun surfaces as either H-H as shown (42a) or L-H as in (42b). In (42a), without the suffix, the default tone of the root is L but when it is attached the derived form surfaces as H-H. This suggests that the H is a property of the suffix while the root is toneless underlyingly. The suffix H is then shared with the toneless root. This is parallel with nouns which

also display an underlying L vs. toneless contrast among low-toned roots. Also, some roots are consistently L in both the nominalized and imperfective forms; some are consistently H in both nominalized and imperfective forms. I treat these roots as behaving the same way as the L and H roots of nouns.

(42)   Tone patterns in derived nouns vs imperfective forms

a. Ø – root; H-H derived nouns

Verb root	Gloss	Derived N	Gloss	Imperfective	Gloss
di-	'eat'	díí-bú	'eat-NMLZ'	dì-ré	'eat-IPFV'
sɪ-	'skin	síí-bʊ́	'skin-NMLZ'	sɪ̀ì-rɛ́	'skin-IPFV'
tu-	'follow'	túú-bú	'follow-NMLZ'	tùù-ró	'follow-IPFV'
sɛ-	'sew'	síɛ́-bʊ́	'sew-NMLZ'	sìɛ̀-rɛ́	'sew-IPFV'
tɔ-	'pound'	tʊ́ɔ́-bʊ́	'pound-NMLZ'	tʊ̀ɔ̀-rɔ́	'pound-IPFV'
tuo-	'carry'	túó-bú	'carry-NMLZ'	tùò-ró	'carry-IPFV'
juo-	'open'	júó-bú	'open-NMLZ'	jùò-ró	'open-IPFV'
pug-	'praise'	púg-bú	'praise-NMLZ'	pùg-ró	'praise-IPFV'

In (b), the root is L while the suffix is H. These cases show polarity in order to avoid sequence of identical tones.

b. L – root; L-H derived noun

Verb root	Gloss	Derived noun	Gloss	Imperfective	Gloss
wììr-	'smoke'	wììr-úú	'smoke-NMLZ'	wìì-ré	'smoke-IPFV'
kpììr-	'hem'	kpììr-úú	'hem-NMLZ'	kpìì-ré	'hem-IPFV'
kʊ̀ʊ̀r-	'snore'	kʊ̀ʊ̀r-ʊ́ʊ́	'snore-NMLZ'	kʊ̀ʊ̀-rɔ́	'snore-IPFV'
kʊ̀ɔ̀r-	'sell'	kʊ̀ɔ̀r-ʊ́ʊ́	'sell-NMLZ'	kʊ̀ɔ̀r-ɔ́	'sell- IPFV'
mààl-	'make'	mààl-ʊ́ʊ́	'make-NMLZ'	mààl-á	'make- IPFV'
gùùn-	'stalk'	gùùn-úú	'stalk-NMLZ'	gùùn-ó	'stalk-IPFV'

The cases in (42a-b), when compared with the L-class based on the default/imperfective forms, there is evidence of two distinct tone classes – underlying L tone and underlying toneless roots. These roots are however indistinguishable from each other in the default/imperfective forms; they only contrast in terms of how they nominalize. An interesting observation is that all L-H forms involve CVVC roots, which seem to be accidental.

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In (43), when a nominalizing suffix is attached to a H-toned root, the derived noun is realised as H-L and when the suffix is added to a HL root, the derived noun is HLH (=H!H) as shown in (44).

(43)   H – root; H-L derived noun

Verb root	Gloss	Derive noun	Gloss	Imperfective	Gloss
tí-	'hold'	tíí-bù	'hold-NMLZ'	tíí-rè	'hold-IPFV'
sɛ́	'roast'	síɛ́-bò	'roast-NMLZ'	síɛ́-rè	'roast-IPFV'
tú-	'dig'	túú-bù	'dig-NMLZ'	túú-rò	'dig-IPFV'
dó-	'climb'	dúó-bù	'climb-NMLZ'	dúó-rò	'climb-IPFV'
zá-	'throw'	záá-bò	'throw-NMLZ'	záá-rà	'throw-IPFV'
jɔ́ɔ́-	'pay'	jɔ́ɔ́-bò	'pay-NMLZ'	jɔ́ɔ́-rò	'pay-IPFV'
dʊ́g-	'cook/boil'	dʊ́g-bò	'cook-NMLZ'	dʊ́g-rò	'cook-IPFV'

(44)   HL – root; H-LH = H-!H derived noun

Verb root	Gloss	Derived noun	Gloss	Imperfective	Gloss
dî-	'take'	díí-!bʊ́	'take-NMLZ'	dí-!rɛ́	'take-IPFV'
níɛ̂ŋ-	'grind'	níɛ́m-!bʊ́	'grind-NMLZ'	níɛ́n-!ɛ́	'grind-IPFV'
lîgr-	'tickle'	lígr-!ʊ́ʊ́	'tickle-NMLZ'	lígr-!ɛ́	'tickle-IPFV'

These patterns behave similarly to what is observed in the regular nouns and therefore they can be accounted for in exactly same way as the simple nouns and the imperfective forms. That is, I assume that roots are toneless, H, L and HL while the suffix is underlyingly H. Then the toneless roots involve spreading of the suffix H to the root while L and H roots involve polarity – OCP-driven deletion and polar insertion. The HL roots as in (45d) which involve downstep are discussed in section 5.5

(45)   Underlying and surface representations of derived nouns

a.   H   →   H
          | /|
       /tuu-bu/   [túú-bu]   'follow-NMLZ'

b.   H H   →   H   L
      | | | |
    /tuu-bu/   [tuu-bu]   'dig- NMLZ'

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c. L   H   →   L   H
    | | | |
    /kʋʋr-ʋʋ/   [kʋʋr-ʋʋ]   'snore- NMLZ'

d. HL H   →   H LH
    \|/ | | |
    /fuol-uu/   [fuol-uu]   'whistle- NMLZ'

Note that the imperfective forms always involve polarity, hence the absence of spreading of same tone across roots and suffixes.

5.4.2 Noun-adjective compounds

Noun-adjective (N-A) compounds consist of noun roots modified by adjectives. As already shown in the tone classes in section 5.2.1.2, adjectival compounds with nouns may result in tonal contrast based on the tonal content of the nominal root and that of the adjective. For instance, when a L tone noun root combines with an adjective of any tonal height, neither the tone of the nominal root nor the tone of the adjective changes. Similarly, when a H tone nominal root combines with a H-L or L-H adjective, there is no change in tonal content. This is shown in (46a). However, when a H tone nominal root combines with a H tone adjective, it results in downstep as in (46b) for *jí-!ŋmáá* 'short house'. So, this suggests insertion of a low between the two high tones. The parenthesis around the second hyphens below shows that the adjective forms is often just one TBU.

(46)   Noun-adjective compounds

a. Ø – roots with adjectives

Ø – root	Adjective	N-A – sg	N-A – pl	Gloss	Tone complex
bi-	ŋmáá	bì-ŋmáá	bì-ŋmáá-rá	'short child'	L-H(-)H
bì-	wɛ́gì	bì-wɛ́gì	bì-wɛ́g-rì	'tall child'	L-H(-)L
bi-	zìɛ́	bì-zìɛ́	bì-zìì-rí	'fair child'	L-L(-)H

b. H – roots with adjectives

H – root	Adjective	N-A – sg	N-A – pl	Gloss	Tone complex
jí-	ŋmáá	jí-!ŋmáá	jí-!ŋmáá-rá	'short house'	H-!H(-)H
jí-	wɛ́gì	jí-wɛ́gì	jí-wɛ́g-rì	'tall house'	H-H(-)L
jí-	zìɛ́	jí-zìɛ́	jí-zìì-rí	'red house'	H-L(-)H

The two components of each compound do not interact with respect to tonal behaviour. The examples involve adjectives of different tone melodies combining with the H and L roots. It is important to note that the nouns which are the first components of the compound do not have suffixes. Thus, a combination of a noun and adjective establishes the underlying tone of the nominal root without a suffix. The H-toned noun-adjective compounds show that downstep can be a reflection of adjacent H tones; /jí-ŋmáá/ → [jí-!ŋmáá] 'short house' (see the next section for discussion).

5.5 Downstep

5.5.1 Downstep at root-level

Downstep is a pitch-lowering phenomenon widely recognised to occur in tone languages, especially across sub-Saharan languages (Connell, 2011). As already mentioned, it involves cases in which the second of two high tones is not equally as high as the first one. Thus, downstep occurs when the intervening L tone that triggers pitch-lowering is not phonetically interpreted because it unlinked to any vowel (Pulleyblank 1986). It is generally a phenomenon associated with two-level languages, though there a few three-level languages that have downstep (e.g., Supyire, Mabia language; Carlson, 1983; Yala-Ikom, Benue-Congo; Armstrong, 1968).

While in some languages like Kɔnni (Cahill, 1999), two adjacent H tones can co-occur without any intervention, there are other languages like Supyire (Carlson, 1983) or Kishamba (Odden, 1982) in which there is downstep when two H tones occur adjacent to each other. The latter is the case for Dagaare. In Dagaare it is not possible for two H tones to occur adjacent to each other within a morphological domain (e.g., within a root or within a word) without an intervening phonetic perturbation such as a L tone (floating L). For instance, the noun root and suffix in pɔ́g-ɔ́ 'woman-SG' have just one H tone predictably on the suffix which then spreads to the stem resulting in surface [H] not [HH] while the noun bʊ́m-!á 'thing-PL' is assumed to have two H tones with L floating between the two H. In the discussion that follows, downstep in simple verbs, simple nouns, compounds and other complex patterns such as associative constructions are presented. For instance, as shown earlier in the first sections, downstep occurs when the H imperfective suffix attaches to a HL default root. Some earlier examples are listed below.

(47)   Downstep in imperfective

Perfective   Imperfective

fáà   'seize.V'   fáá-!rá   'seize-IPFV'

kɔ́rì   'cough.V'   kɔ́r-!ɔ́   'cough-IPFV'

fúólì   'whistle.V'   fúól-!ó   'whistle-IPFV'

pɛ́gì   'wash.V'   pɛ́g-!rɛ́   'wash-IPFV'

The downstep pattern in the imperfective is exactly the same as the pattern with event nominalisations shown in the preceding section. Within simple nouns, downstep occurs in a few forms, but the pattern is not entirely regular. That is in some cases, both singular and plural forms are downstepped while in others only the singular or the plural is downstepped. This is shown below.

(48)   Downstep in simple nouns

Singular   Plural   Gloss

sʊ́ɔ́ŋ-!áá   sʊ́ɔ́n-!í   'rabbit'

kpááŋ-!ʊ́ʊ́   kpíín-ì   'guinea fowl'

wáá-!bʊ́   wíí-rì   'snake'

sáán-à   sáám-!bá   'stranger'

bɔ̂ŋ   bʊ́m-!á   'thing'

In both verbs and nouns, downstep is realised at the root-level, occurring between the root and the suffix.

5.5.2   Downstep at phrase-level

Downstep may result from the combination of two adjacent H toned roots through associative constructions (a noun phrase that consist of a head noun and a following complement or another noun). Generally, the associative construction is translated as 'X of Y' e.g., 'basket of fruits. Associative constructions are also used to refer to the possession of one entity by another entity as in 'animal's tail'. The examples below show high-toned words and when they combine to form a phrase, we see downstep.

(49)   Associative constructions

       pɔ́gɔ́ !báá   'woman's dog'

       pɔ́gɔ́ !sírɛ́   'woman's husband'

       dɔ́ɔ́ !bíé   'man's child'

Moreover, compounding such as noun-adjective compounds is another morphophonological process that causes downstep in Dagaare. When a high-toned or high-low nominal root combines with a high-toned adjective, the result is always downstep. In (50) downstep is shown in noun-adjective compounds showing up at the right edge of the phonological word.

(50)   Noun-adjective compounds

Noun		Adjective		Compound	Gloss
jí-rì	'house-SG'	bílé	'small'	jí!bílé	'small house
sɔ́-rì	'path'	ŋmáá	'short'	sɔ́!ŋmáá	'short road/path'
ʧúù	'month'	fáá	'bad'	ʧúú-!fáá	'bad month'

The examples in (49-50) show phrase-level downstep which appears at the right edge of the phonological word.

As noted in Leben (2018), downstep can arise from a variety of sources. The stem/root-level and word-level downstep shows that the phenomenon can originate from different sources. For example, Anttila & Bodomo (2021) note that in Dagaare downstep has two sources: One involves a floating L specified underlyingly on a root or suffix as illustrated below.

(51)   Source of downstep in Dagaare

      HL H   H L H

       \\/ | | |

a. /bòŋ-ma/   →   [bòm-!a]   downstep, floating L from the root *bôŋ* 'thing'

      H LH   H L H

      | \\/ | | |

b. saàm-ba   →   saàm-!ba   downstep, floating L from the suffix of *sáán-à* 'stranger-SG'

The other source of downstep is when the last H at the edge of a phonological word is downstepped. This is also illustrated in (52) with the combination of the noun *sɔ́-rì* 'path/road-SG' and the adjective *ŋmáá* 'short' in the compound *sɔ́-ŋmáá* 'short path/road'.

(52)　　　 H　 H　　　　　　 H (L)H
　　　　　　 |　 |　　　　　　　 |　 |
　　　　　 sɔ-ŋmaa　　　　　 sɔ-ŋmaa　　　　　 'short path/road'

In terms of analysis, it is unclear how downstep should be formally represented. The common and traditional view is that downstep is a surface result of floating L between H tones and this means that phonologically downstep is a floating L. Another view is that downstep automatically emerges from the concatenation of two H tones particularly in compounds and associative constructions.

I provide an analysis for the imperfective verbs, compounds and associative constructions. Downstep cases independently require some constraints, namely *CONTOUR (already defined earlier), *FLOAT (defined above), COINCIDE (contour, final TBU) and *LH. COINCIDE constraint is based on the proposal of Zoll (1998, 2002) that restrictions on contour distribution are a consequence of licensing constraints that restrict complex tones to a limited set of positions. COINCIDE penalises non-final TBUs that are associated with more than one tone. The other markedness constraint relevant for the analysis of the HL roots of the verb is *LH which rules against rising contours on final TBUs. These constraints are defined below.

(53)　　　 COINCIDE (contour, final vowel) (Zoll 1996, 2003)

　　　　　 Contours are licensed only word-finally

(54)　　　 *LH

　　　　　 Rising contours on final TBUs in a prosodic word are prohibited

Note that these constraints were not represented in the analysis of the toneless, H and L roots of the nouns and the H and L roots of the verbs, but they are nonetheless present in the grammar of the language and in some particular positions in the overall constraint ranking. So, they are being applied regardless of the form of the word that is under analysis. Whatever their ranking, they do not influence the outcome for H and L roots of nouns and verbs in any way.

As a first step towards proposing an analysis for the downstep in the imperfectives, the HL root for the default form is presented in (55). Note that the tones of the verb root are identical to the surface tones of the default forms whether the roots have overt suffix or not. For the analysis of the HL default form, *CONTOUR and *FLOAT constraints are crucial. This is given in the following tableaux.

(55)   HL root /dáà/
         dáà 'push.v'; {[MAX]RT (T), MAX (T), *FLOAT} >> *CONTOUR

HL \\/ /daa/	[MAX]RT (T)	MAX (T)	*FLOAT	*CONTOUR
a. HL \\/ daa ☞				*
b. H | daa	*!	*		
c. H L | daa			*!	

Candidate (a) violates *CONTOUR but emerges as the optimal. Candidate (b) is ruled by [MAX]ROOT-(T) for deletion of underlying L tone from the root. *FLOAT rules out (c) since the L is left unassociated. To arrive at the optimal output (a), [MAX]RT (T) must outrank *CONTOUR. Also *FLOAT outranks * CONTOUR but it is not evident as to which of MAX-T and *FLOAT ranks above the other with respect to the optimal output. We therefore establish the following ranking: {[MAX]RT (T), *FLOAT } >> * CONTOUR This analysis leads us to the imperfective form involving downstep.

In (56) an analysis for the imperfective form *dáá-!rá* 'pushing' is provided based on the assumption that downstep results from floating L. The analysis shows that leaving a L tone unassociated between two H tones is preferred over having contours. This explains why candidate (a) wins at the expense of (b) which is ruled out by the constraints against contour tones. Given the prohibition against rising contours on final syllables, it simply means that the output in (c) is penalised by *LH and * CONTOUR. Candidate (d) involves a deletion of an underlying H tone, and this crucially rules it out by MAX (T). In (e), [MAX]RT (T) and MAX (T) are violated due to the deletion of underlying H tone. For candidate (f), it is the L in root of the input that is deleted and that brings about both [MAX]RT (T) and MAX (T) violation. The deletion also means that two adjacent H tones are left on the output, leading to OCP violation. As a consequence of this analysis, the following ranking is established: {[MAX]RT (T), OCP, MAX (T), COINCIDE, *LH} >> *FLOAT.

(56) dáá!rá 'push-IPFV, imperfective'
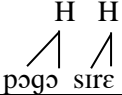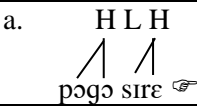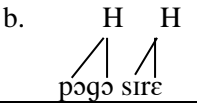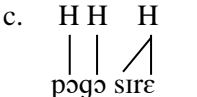
{[MAX]RT (T), OCP, MAX (T), COINCIDE, *LH }>> *FLOAT }

H L H (∨ |) /daa-ra/	[MAX]RT (T)	OCP	MAX (T)	COINCIDE (cont,final TBU)	*LH	*FLOAT
a. HLH / daa-ra ☞						*
b. H L H / daa-ra				*!		
c. H LH / daa-ra					*!	
d. H L / daa-ra			*!			
e. L H / daa-ra	*!		*			
f. H H / daa-ra	*!	*	*			

In a nutshell, having a floating L between two H tones is better than HL-H with the L associated between the two H tones. The above analysis will yield the same results for the simple nouns with downstep such as *búm-!á* 'thing-PL'. Following the generalisation that HLH is unattested on simple nouns and verbs, what we see is L floating between two H tones and the result is downstep.

The preceding analysis shows downstep as resulting from floating L tone. In the next analysis that follows in (57), downstep is treated as the result of the concatenation of two H tones on adjacent roots. By contrast to the preceding analysis, associative phrases and compounds involve underlying /H-H/ sequences surfacing as HLH (with a floating L). For the avoidance of sequences of adjacent H tones, OCP takes out candidates (57b-c) in favour of the optimal output (a).

(57) [pɔ́gɔ !síré] 'woman's husband'
OCP >> *FLOAT

H H pɔgɔ sirɛ	OCP	*FLOAT
a. H L H pɔgɔ sirɛ ☞		*
b. H H pɔgɔ sirɛ	*!	
c. H H H pɔgɔ sirɛ	*!*	

Given the similarities between this input in (57) and cases like [dʊ́g-ì] and [sɔ́r-ɔ̀] which are also underlyingly /H-H/, it is important to consider on what basis one surfaces as H-L and the other surfaces as H-!H. In other words, why is it not possible for underlying case like /dʊ́gí/ to be realised as *[dʊ́g!í] on the surface and why is it ungrammatical for underlying /pɔ́gɔ́ síré/ to surface as *[pɔ́gɔ́ sìrɛ̀]?

An explanation to this question is that, within a prosodic word, two tonal processes are possible: (i) tonal spread which involves a tone spreading from either the root to the suffix or from the suffix to the root (ii) dissimilation/polarity in which a suffix surfaces with tonal height opposite to the one preceding it. These processes are repair mechanisms to resolve OCP within prosodic words. Therefore, a case as [dʊ́g-ì] which is underlyingly H-H can only resolve OCP via dissimilatory lowering of the underlying H on the suffix because the tones are within the same domain.

In terms of examples such as the associative construction [pɔ́gɔ́ !síré] as shown in (56), what we see are H tones across prosodic words. In other words, each H in the H-H sequence belong to a separate prosodic word. Across word boundaries, when there are successive high tones, downstep occurs if both words occur within the same phonological phrase (Nespor & Vogel, 1986; Selkirk, 1986). This suggests that OCP violations across words are not tolerated which means that adjacent H tones are prohibited. The best way of avoiding the identical tones is the presence a floating L, leading to downstep. In the case of the associative phrase like [pɔ́gɔ́!síré], it is possible that the floating L is the one that marks a syntactic property like genitive. The conclusion therefore is that underlying /H-H/ may condition polarity and downstep. The choice of either polarity or downstep

is based on the morphological form of the word. That is, the choice is morpholexical. So, on the one hand underlying /H-H/ dissimilates and surfaces as [H-L] at the root/stem level. On the other hand, underlying /H-H/ survives with surface downstep [H-!H] at the word-level. This is also what Anttila & Bodomo (2019, 2021, in press) propose.

In summary, downstep in Dagaare originates from either a floating L underlyingly specified on a root/suffix or it arises from the last H tone at the right edge of a phonological word. Underlying /H-H/ becomes surface [H-L] at the root-level and it becomes [H-!H] at the word level.

5.6 Conclusion

In this chapter, verbal, nominal and other complex tone patterns are discussed. Previous analyses have either focused mainly on nouns or mainly on verbs with no clarity in terms of whether both verbs can be analysed within the same grammar and with no or little discussion of tonal interactions in other structures beyond just nouns and verbs. This study therefore presents a comprehensive discussion of tone ranging from simple verbs, simple nouns, nominalisations to complex cases like compounds and associative constructions.

With the verbs, there are three tone patterns for the default and imperfectives. For each of these patterns, the surface representations of the default forms are systematically different from that of the imperfectives. The tone patterns of the defaults include H-H, L-L, and H-L and their corresponding imperfectives involve H-L, L-H and H-!H. Within the nominal system, three main tone classes exist; H-H, H-L, L-H though there are other limited patterns like L-L and LH-L. The tone patterns in nouns are generally the same in both singular and plural forms.

I propose that the default forms involve toneless final epenthetic vowels and three root types: a H root which spreads to the final vowel; L root which spreads to the final vowel and HL root which spreads the L to the final vowel. As for the imperfectives, the suffix is underlyingly H and either remains unchanged or it changes its height depending on the tonal content of the preceding root. With nouns, the claim is that roots are underlyingly toneless, H and L while the suffix is underlyingly H. The toneless nominal roots get their surface tone via spreading from the suffix H; the H root remains unchanged while the suffix H dissimilates to L; the surface L root and its following H suffix are what they are underlyingly.

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The analysis further shows that the unattested surface melodies, H-H and L-L in imperfectives is due to OCP prohibiting adjacent identical tones, thereby leading to polar suffix tone. Based on the tone patterns, an important point worthy of mention is the location of polarity. As Pulleyblank (1986) notes, polarity effects occur at the edges of domains and this is evident in cases involving nominal and verbal patterns such as H-L, L-H and H-LH in which the polar tone occurs at the right edge. In terms of downstep, it arises from either a floating L specified on a root or suffix, or it results from sequences of H tones which gets a L floating between the high tones. Underlying /H-H/ either becomes [H-L] at the root/stem level or it becomes [H-!H] at the word-level.

Overall, the chapter gives a comprehensive discussion of tone in Dagaare. This notwithstanding, there are some cases exhibiting tonal alternations which would require attention probably in the future. Some of these cases are agentive nominalisation (via reduplication) which involves copying of a verb root. Another case involves tone change in syntactic environments such as before or after some functional categories. I will return to this in the conclusion chapter. Moreover, in spite of the evidence provided for treating the syllable as the TBU, a few examples seem to point that the mora might also be the TBU in some contexts. Whether or not such information is crucial and has some implication on Dagaare tone analysis is an open topic for discussion.

Chapter 6: Summary and Conclusions

6.1 General summary

This dissertation has given a more comprehensive discussion of the morphophonological phenomena in Dagaare involving inflectional morphology, vowel harmony patterns and tone. As a response to the limited to no description and theoretical analysis of these cases, the overall objective of this work was to give a formal account of the various patterns.

The greater part of this work is organized into three main parts. The first is the discussion of inflection in chapter 3, which shows the contrast between verbs. That is, the chapter provides evidence that the verb contrast that has been described as perfective/imperfective actually involves default vs. imperfective forms, given that there is no evidence of perfective interpretation from the so-called perfective form. The default verb form, on the one hand has an invariant high front vowel after consonant-final root whose shape does not change, irrespective of the root to which it is attached; this vowel is shown to have no inherent meaning. The imperfective on the other hand is shown to have a suffix and the shape of the vowel is dependent on the form of the vowel in the verbal root; in contrast to the default forms, the imperfective suffix is shown to have a dedicated progressive meaning regardless of the environment in which it occurs. Verbal inflection is posited to be the result of interplay of morphology, phonology and syntax.

With nominal inflection, nouns are categorized into classes based on similarity of the singular suffix and that of the plural suffix. The nouns involve ten classes which are broadly grouped into three classes: phonological, phono-semantic and semantic classes. Nominal inflection is shown to result from phonological processes such as harmony, vowel length; morphosyntactic processes such as derivation and semantic factors like individuation. Finally, within the noun phrase, number marking is shown to occur on not only nouns, but on adjectives, ideophones, demonstratives and numerals.

The second part of the larger analysis centres on vowel harmony patterns which are more comprehensively examined in chapter 4. Tongue root harmony involving simple nouns, verbs, compounds and phrases is covered. Also rounding/backness/[±low] harmony which is particularly restricted to the imperfective forms and agentive reduplication is discussed. Moreover, the details of both harmony patterns including harmonic domain, triggers, targets and directionality are

presented. Prior to the proposing an analysis for Dagaare harmony, I presented an overview of the approaches to vowel harmony in Optimality Theory.

The analysis of harmony patterns in the chapter showed that the harmonic feature in Dagaare can be bidirectional in tongue root harmony and only progressive with rounding/backness harmony. That is, tongue root harmony is analysed as morphologically conditioned – operating on two levels: root/word-level and phrase-level, both root-controlled. At the root/word-level harmony spreads rightward from the root to the suffix and at the phrase-level, the harmonic feature operates bidirectionally, from the root to the prefix/proclitic and to the suffix. Rounding harmony is analysed as morphologically restricted to the imperfective, targeting the imperfective suffix progressively – from the root to the suffix. I proposed that the presence of rounding in only the imperfective verbs is due to an underlying vowel which is specified for the feature [-high]. So, the absence of rounding in the default form (with high final vowel) is because high vowels are not targets of rounding harmony in Dagaare. This may be a result of morphological consequence: rounding harmony applies at the root-level while final [i/ɪ] applies at the word-level. With optimality theoretic approach, I showed that harmony is driven by constraints which enforce spreading of harmonic features from roots to suffixes. Finally, the presence of harmony in the pronominal clitics in possessive phrases is based on minimality constraint which motivates integration of targets into the harmonic domain.

Finally, chapter 5 covers the third major component of this dissertation – the description and analysis of tone. Here, a more detailed discussion of tone in Dagaare is presented as a response to the few studies which generally focused only on nominal tone. I presented an analysis of both verbal, nominal tone and more complex cases such as compounds and associative phrases. There are three tonal patterns for the default and imperfective forms. The surface representations of the default forms are systematically different from that of the imperfectives. For the surface default forms, there are H(-H), L(-L) and HL with their corresponding imperfectives H-L, L-H and H-!H.

In the verbal system, my analysis showed that default verb forms involve toneless suffixes and three root types: H, L root and HL root. Spreading of tone from the root to the default suffix is a preferred tone repair mechanism than insertion of new tones. For the imperfectives, the three roots, H, L, and HL occur with underlying H suffix. The surface tone realisation on the suffix is shown to be based on the tonal content of the verbal root. Similarly, nouns have underlying H suffix

against the roots: toneless, H, and L. While the toneless root involves tone spread, the L and H roots involve tone polarity conditioned by OCP just as the case of the L and H roots of the imperfectives.

With a single phonological grammar (e.g., constraint set), I have shown that all tonal patterns involving verbs and nouns can be analysed. Particularly, the H and L roots of the imperfectives are exactly the same as the H and L roots of the of the nouns. Finally, the absence of H-H and L-L is analysed to be a result of OCP-driven constraints while downstep is shown to be the outcome of a floating L specified either on a root or a suffix, or it arises from sequence of H tones.

6.2 Contributions

Generally, this dissertation makes some important contributions. In the first place, it contributes to the knowledge and understanding of Dagaare and Mabia linguistics. Particularly, the study is the first major detailed account of the phenomena such as inflectional morphology, vowel harmony and tone. It presents a more theoretical discussion than most existing studies.

Secondly, with the overview of various theoretical approaches, markedness and faithfulness devices and by proposing analyses for various patterns, this research makes an important contribution to the understanding of theories of phonology/morphology and syntax in general and how they are applied in Dagaare and possibly other Mabia languages.

6.3 Limitations and future research

Considering that Dagaare is a relatively under-described language particularly in terms of phonology and morphology, it is always inevitable to focus on some aspects leaving others aside. For instance, some morphological/phonological processes were identified in the introductory chapters especially chapter 2 without any formal account. These patterns require some attention in future research. Of relevance to the general focus of dissertation was the length and diphthong alternations that occur with the imperfective form and some nouns. As observed with the imperfective forms, there are some surface reversals in verbs involving the default forms and the imperfective forms and between singular and plural nouns. For the verbs, vowels can be short or long in the default form, and they can be short or long in the imperfective form. In some cases, short vowels in the default verb correspond to long vowels in the imperfective form. That is when

the imperfective suffix is added to the verb root, we see vowel lengthening in the root as illustrated below.

(1)   Default form   Imperfective form

    tí   'hold.v'   tíí-rè   'hold-IPFV'

    sì   'skin.v'   sìì-rɛ́   'skin-IPFV'

    tú   'dig.v'   túú-rò   'dig-IPFV'

    dà   'buy.v'   dàà-rá   'buy-IPFV'

    vɔ̀   'scorch.v'   vɔ̀ɔ́-rɔ̀   'scorch-IPFV'

The examples in (1) show high and low vowels in the default form becoming long vowels in the imperfective. In the next set of examples in (2), there are short vowels in the default verbs which alternate with diphthongs in the imperfective form.

(2)   Default form   Imperfective form

    kpɛ̀   'enter.v'   kpìɛ̀-rɛ́   'enter-IPFV'

    dó   'climb.v'   dúó-rò   'climb-IPFV'

    dɔ́   'weed.v'   dʊ́ɔ́-rɔ̀   'weed-IPFV'

With nouns, when the number suffix [-ri/-rɪ] occurs after a high vowel root, the root vowel in the plural form is long and this corresponds to a diphthong in the singular form.

(3)   Singular   Plural

    bí-é   'child-SG'   bíí-rí   'child-PL'

    zí-é   'place-SG'   zíí-rí   'place-PL'

    sí-ɛ́   'waist-SG'   síí-rí   'waist-PL'

    kú-ó   'field mouse-SG'   kúú-rí   'filed mouse-PL'

    bʊ́-ɔ́   'goat-SG'   bʊ́ʊ́-rí   'goat-PL

Another pattern that will require attention in future research involves agentive nominalization (via reduplication) which involve copying of a verb root as shown below.

(4)   Agentive reduplication

    Root-RED-suffix   Root-RED-suffix   Gloss

    'person that X'   people that X

dì-dí-ré	dì-dír-bé	'one who eats
zò-zó-rɔ́	zò-zɔ́r-bɔ́	'one who runs'
dó-dúó-rò	dó-dúór-!bó	'one who climbs'
díὲ-díέ-!rέ	díὲ-díέr-!bέ	'one who receives'

Looking at these examples, we see that when the base has L tone, its reduplicant and the suffix is H. When the base is H toned, the reduplicant is H, the suffix is L for the singular forms and !H for the plural forms and when the root is HL, the reduplicant is H while the both suffixes for singular and plural are !H.

In addition, the majority of the discussion of tone in this research primarily centred on simple verbs and nouns and cases like associative constructions and compounds. There is also data illustrating how lexical tones interact in sentences. For instance, there is evidence of tone change in Dagaare based on the specific syntactic structure/constructions. First, consider the tones of the following bare default verbs and their imperfective counterparts and then observe the tones these verbs assume in the presence of some grammatical categories such as negation particle, *bá*; future particles, *nà* and *kòŋ* and the focus/affirmative particle *lá~ná*. The following examples are just but a brief illustration of the tonal interaction with functional categories in sentences.

(5) Bare verbs

a.	wà	'come.V'	wàà-ná	'come-IPFV'
b.	sòrì	'beg.V'	sòr-ɔ́	'beg-IPFV'
c.	sɔ́rí	'count.V'	sɔ́r-ɔ̀	'count-IPFV'
d.	pέgì	'wash.V'	pέg-!rέ	'wash-IPFV'

When the focus particle *lá ~ ná*[6] occurs after a verb with a final H tone, there is downstep on *ná*. As can be seen in (6), the deafult L-L is realised as L-H before the focus particle. In (6), the imperfective maintains its L-H melody but the H-final results in downstep on *ná*.

(6)   a.   ò   **[sòrí   !ná]**   lìbí-ὲ

           3SG   beg.V   FOC   money-PL

           's/he begged for money'

b   ò   **[sòr-ɔ́   !ná]**   lìbí-è

         3SG   beg-IPFV   FOC   money-PL

         's/he is begging for money'

In the next sentences below, H-H default precedes the focus particle *lá*, and what we see is downstepped high on *lá* as in (7a). In (7b), when H-L imperfective precedes *lá*, downstep is realised on the imperfective suffix and not *lá*.

(7) a.   ò   **[sɔ́rí   !ná]**   lìbí-è
             3SG   count- INFL   FOC   money-PL
             's/he counted money'

      b.   ò   **[sɔ́r-!ɔ́   lá]**   lìbí-è
             3SG   count- IPFV   FOC   money-PL
             's/he ic counting money'

These patterns present some interesting tonal alternations and may have a bearing on the current analysis. However, at present I do not propose an analysis for them as I leave that for future examination.

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Appendix A: Verbal system of Dagaare (Central) – Field data

Sub-Appendix A. 1: Verbal morphology

The basic verb morphology of Dagaare has the verb root and aspectual suffix. Verbs are identified as default (previously perfective) vs. imperfective depending on the root. The default form is composed of the verb root and a final high vowel [i/ɪ] or it may be unmarked [∅]. The imperfective always has two overt morphemes: a root followed by either a -V or a -CV suffix. The suffix may be realised as either –**V** [-e/-ɛ, -o/-ɔ, -ə/-a] or -**CV** [-re/-rɛ], [-ro/-rɔ] [-rə/-ra], [-ne/-nɛ], [-no/-nɔ]

- Default syllable structure:
    - CV ɲɛ́ 'see.v'
    - CVV jʊ̀ò 'open.v'
    - CVC sòŋ 'help.v'
    - CVC.V wù.lì 'show.V'
    - CVVC.V kʊ̀ʊ̀.rì 'snore.V'
    - CVC.CV ɲíg.rì 'blink.V'
- Imperfective syllable structure:
    - CV.CV ɲɛ́.rɛ̀ 'see-IPFV'
    - CVV.CV jʊ̀ò.ró 'open-IPFV'
    - CV.CV wù.ló 'show-IPFV'
    - CVVC.V kʊ̀ʊ̀.rɔ́ 'snore-IPFV'
    - CVC.CV ɲíg.!ré 'blink-IPFV'

Alternations involving verbs: default and imperfectives exhibit significant surface alternations

- Short vowels in default vs short vowels in imperfective
    - dì 'eat.v' vs dì-ré 'eat-IPFV'
    - ɲɛ́ 'see.v' vs ɲɛ́-rɛ̀ 'see-IPFV'
    - zɔ̀ 'run.v' vs zɔ̀-rɔ́ 'run-IPFV'
- short high and low vowels in the default vs long vowels in the imperfective
    - tí 'hold.v' vs tíí-rɛ̀ 'hold-IPFV'
    - tʊ́ 'insult.v' vs tʊ́ʊ́-rɔ̀ 'insult-IPFV'
    - dà 'buy.v' vs dàà-rá 'buy-IPFV'
- long vowels in default vs long vowels in imperfective
    - wóó 'weave.v' vs wóó-rò 'weave-IPFV'
    - jɔ́ɔ́ 'pay.v' vs jɔ́ɔ́-rɔ̀ 'pay-IPFV'
    - bàà 'grow.v' vs bàà-rá 'grow-IPFV'
- short mid vowels in the default vs diphthongs in imperfective
    - bɛ̀ 'get sick.v' vs bìɛ̀-rɛ́ 'get sick-IPFV'
    - dó 'climb.v' vs dúó-rò 'climb-IPFV'
    - tɔ̀ 'pound.v' vs tʊ̀ɔ̀-rɔ́ 'pound-IPFV'
- diphthongs in default vs diphthongs in imperfectives

- tìὲ 'push' vs tìὲ-ɾέ 'pushing'
- jùò 'open' vs jùò-ró 'opening'
- vʊ́ɔ̀ 'uproot' vs vʊ́ɔ́-!ɾɔ́ 'uprooting'

CV-roots: CV[DEFAULT] ; CV.CV [IMPERFECTIVE] : n=15					
Root	Default	Gloss	Imperfective	Gloss	Citation form
jí-	jí	'leave'	jí-rè	'leaving'	à jí 'to leave'
dì-	dì	'eat'	dì-ré	'eating'	à dì 'to eat'
ʔì-	ʔì	'do'	ʔì-ré	'doing'	à ʔì 'to do'
dî-	dî	'take'	dí-!ré	'taking'	à dî 'to take'
lè-	lè	'fall'	lè-ré	'falling'	à lè 'to fall
lé-	lé	'tie'	lé-rè	'tying'	à lé 'to tie'
ɲɛ́-	ɲɛ́	'see'	ɲɛ́-rè	'seeing'	à ɲɛ́ 'to see'
kò-	kò	'give'	kò-ró	'giving'	à kò 'to give'
pó-	pó	'share'	pó-rò	'sharing'	à pó 'to share'
kò-	kò	'dry'	kò-ró	'drying'	à kò 'to dry'
kó-	kó	'gather (clouds)	kó-rò	'gathering (clouds)'	à kó 'to gather (clouds)'
gò-	gò	'guard'	gò-ró	'guarding'	à gò 'to guard'
zɔ̀-	zɔ̀	'run'	zɔ̀-rɔ́	'running'	à zɔ̀ 'to run'
tá-	tá	'reach'	tá-rà	'reaching'	à tá 'to reach'

CV-roots: CV[DEFAULT]; CVV.CV [IMPERFECTIVE] (long vowel): n=32					
Root	Default	Gloss	Imperfective	Gloss	Citation form
tí-	tí	'hold'	tíírè	'holding'	à tí 'to hold'
tì-	tì	'vomit'	tììré	'vomiting'	à tì 'to vomit'
pí-	pí	'select/choose'	píír-è	'selecting	à pí 'to select/choose'
ví-	ví	'demolish'	víí-rè	'demolishing'	à ví 'to demolish'
kpì-	kpì	'die'	kpìì-ré	'dying'	à kpì 'to die'
gbí-	gbí	'kneel'	gbíí-rè	'kneeling'	à gbí 'to kneel'
pí-	pí	'fed.up'	píí-rè	'getting fed.up'	à pí 'to be fed up'
sì-	sì	'skin'	sìì-ré	'skinning'	à sì 'to skin'
tú-	tú	'dig'	túú-rò	'digging'	à tú 'to dig'
tù-	tù	'follow'	tùù-ró	'following'	à tù 'to follow'
sù-	sù	'feed(e.g. baby)'	sùù-ró	'feeding(e.g.baby)'	à sù 'to feed (baby)
vú-	vú	'crawl'	vúú-rò	'crawling'	à vú 'to crawl'
zú-	zú	'steal'	zúú-rò	'stealing'	à zú 'to steal'
ɲú-	ɲú	'drink'	ɲúú-rò	'drinking'	'a ɲú 'to drink'
dú-	dú	'swim'	dúú-rò	'swimming'	à dú 'swim'
tʊ́-	tʊ́	'insult'	tʊ́ʊ́-rɔ̀	'insulting'	à tʊ́ 'to insult'
kʊ́-	kʊ́	'kill'	kʊ́ʊ́-rò	'kiling'	à kʊ́ 'to kill'
vɔ́-	vɔ́	'scorch'	vɔ́ɔ́-rɔ̀	'scorching'	à vɔ́ 'to scorch'
vá-	vá	'hit'	váá-rà	'hitting'	à vá 'to hit'

dà-	dà	'buy'	dàà-rá	'buying'	à dà 'to buy'
dá-	dá	'blow (e.g. air)'	dáá-rà	'blowing (e.g.air)'	à dá 'to blow'
zá-	zá	'throw'	záá-rà	'throwing'	à zá 'to throw'
zà-	zà	'collect'	zàà-rá	'collecting'	à zà 'to collect'
já-	já	'get mad'	jáá-rà	'getting mad'	à já 'to get mad'
là-	là	'laugh'	làà-rá	'laughing'	à là 'to laugh'
sá-	sá	'administer (enema)'	sáá-rà	'administering (enema)'	à sá 'to administer (enema)'
pà-	pá	'be.full'	pàà-rá	'getting full'	à pà 'to be full'
bà-	bà	'fix (on the ground)'	bàà-rá	'fixing(on the ground)'	à bà 'to fix'
ʔá-	ʔá	'hate'	ʔáá-rà	'hating'	à ʔá 'to hate'
kpá-	kpá	'boil'	kpáá-rà	'boiling'	à kpá 'to boil'
fá-	fá	'rob'	fáá-rà	'robbing'	à fá 'to rob'
wà-	wà	'come'	wàà-ná	'coming'	à wà 'to come'm

CV-roots: CV[DEFAULT]; CVV.CV [IMPERFECTIVE] (diphthong): n=23

Root	Default	Gloss	Imperfective	Gloss	Citation form
bɛ̀-	bɛ̀	'get sick'	bìɛ̀-rɛ́	'getting sick'	à bɛ̀ 'get sick'
ɲɛ̀-	ɲɛ̀	'fart/defecate'	ɲìɛ̀-rɛ́	'farting/deficating'	à ɲɛ̀ 'to fart/deficate'
kpɛ̀-	kpɛ̀	'enter'	kpìɛ̀-rɛ́	'entering'	à kpɛ̀ 'to enter'
pɛ́-	pɛ́	'harvest'	píɛ́-rɛ̀	'harvesting'	à pɛ́ 'to harvest'
tɛ́-	tɛ́	'spread'	tíɛ́-rɛ̀	'spreading'	à tɛ́ 'to spread'
dɛ̀-	dɛ̀	'trim'	dìɛ̀-rɛ́	'trimming'	à dɛ̀ 'to trim'
ʧɛ̀-	ʧɛ̀	'cut'	ʧìɛ̀-rɛ́	'cutting'	à ʧɛ̀ 'to cut'
sɛ̀-	sɛ̀	'sew'	sìɛ̀-rɛ́	'sewing'	à sɛ̀ 'to sew'
sɛ́-	sɛ́	'roast'	síɛ́-rɛ̀	'roasting'	à sɛ́ 'to roast'
mɛ̀-	mɛ̀	'build'	mìɛ̀-rɛ́	'building'	à mɛ̀ 'to build'
ŋmɛ̀-	ŋmɛ̀	'beat'	ŋmìɛ̀-rɛ́	'beating'	à ŋmɛ̀ 'to beat'
wɛ́-	wɛ́	'waste'	wíɛ́-rɛ̀	'wasting'	à wɛ́ 'to waste'
dó-	dó	'climb'	dúó-rò	'climbing'	à dó 'to climb'
dò-	dò	'roll'	dùò-ró	'rolling'	à dò 'to roll'
sò-	sò	'bathe'	sùò-ró	'bathing'	à sò 'to bathe'
bɔ́-	bɔ́	'find'	bʊ́ɔ́-rɔ̀	'finding'	à bɔ́ 'to find'
dɔ́-	dɔ́	'weed'	dʊ́ɔ́-rɔ̀	'weeding'	à dɔ́ 'to weed'
jɔ́-	jɔ́	'roam'	jʊ́ɔ́-rɔ̀	'roaming'	à jɔ́ 'to roam'
tɔ̀-	tɔ̀	'pound'	tʊ̀ɔ̀-rɔ́	'pounding'	à tɔ̀ 'to pound'
kɔ́-	kɔ́	'farm'	kʊ́ɔ́-rɔ̀	'farming'	à kɔ́ 'to farm'
pɔ́-	pɔ́	'curse'	pʊ́ɔ́-rɔ̀	'cursing'	à pɔ́ 'to curse'
ʧɔ́-	ʧɔ́	'hide'	ʧʊ́ɔ́-rɔ̀	'hiding'	à ʧɔ́ 'to hide'
sɔ́	sɔ́	'rub'	sʊ́ɔ́-rɔ̀	'rubbing'	à sɔ́ 'to rub'

CVV-stems: CVV[DEFAULT]; CVV-CV [IMPERFECTIVE] (long vowel): n=14

Root	Default	Gloss	Imperfective	Gloss	Citation form
wóó-	wóó	'weave'	wóó-rò	'weaving'	à wóó 'to weave'
ɔ̀ɔ̀-	ɔ̀ɔ̀	'eat/chew'	ɔ̀ɔ̀-rɔ́	'eating/chewing'	à ɔ̀ɔ̀ 'to eat/chew'
kɔ̀ɔ̀-	kɔ̀ɔ̀	'break'	kɔ̀ɔ̀-rɔ́	'breaking'	à kɔ̀ɔ̀ 'to break'
mɔ́ɔ́-	mɔ́ɔ́	'wrestle'	mɔ́ɔ́-rò	'wrestling'	à mɔ́ɔ́ 'to wrestle'
zɔ̀ɔ̀-	zɔ̀ɔ̀	'fight'	zɔ̀ɔ̀-rɔ́	'fighting'	à zɔ̀ɔ̀ 'to fight'
dɔ̀ɔ̀-	dɔ̀ɔ̀	'squat'	dɔ̀ɔ̀-rɔ́	'squatting'	à dɔ̀ɔ̀ 'to aquat'
lɔ́ɔ́-	lɔ́ɔ́	'drop'	lɔ́ɔ́-rò	'dropping'	à lɔ́ɔ́ 'to drop'
jɔ́ɔ́-	jɔ́ɔ́	'pay'	jɔ́ɔ́-rò	'paying'	à jɔ́ɔ́ 'to pay'
ɲɔ̀ɔ̀-	ɲɔ̀ɔ̀	'mate'	ɲɔ̀ɔ̀-rɔ́	'mating'	à ɲɔ̀ɔ̀ 'to mate'
kàà-	kàà	'look'	kàà-rá	'looking'	à kàà 'to look'
ŋmàà-	ŋmàà	'cut'	ŋmàà-rá	'cutting'	à ŋmàà 'to cut'
fáà-	fáà	'seize/resolve'	fáá-!rá	'seizing/resolving'	à fáà 'to seize/resolve'
dáà-	dáà	'push'	dáá-!rá	'pushing'	à dáà 'to push'
táà-	táà	'have'	táá-!rá	'having'	à táà 'to have'

CVV-stems: CVV[DEFAULT] ; CVV-CV [IMPERFECTIVE] (diphthong): n=14

Root	Perfective	Gloss	Imperfective	Gloss	Citation form
bìɛ̀-	bìɛ̀	'give way'	bìɛ̀-rɛ́	'giving way'	à bìɛ̀ 'to give way'
tìɛ̀-	tìɛ̀	'push'	tìɛ̀-rɛ́	'pushing'	à tìɛ̀ 'to push'
díɛ̀-	díɛ̀	'receive'	díɛ́-!rɛ́	'receiving'	à díɛ̀ 'to receive'
ʧĩɛ̀-	ʧĩɛ̀	'tear'	ʧĩɛ́-!rɛ́	'tearing'	à ʧĩɛ̀ 'to tear'
sìɛ̀-	sìɛ̀	'dance'	sìɛ̀-rɛ́	'dancing'	à sìɛ̀ 'to dance'
wìɛ̀-	wìɛ̀	'open'	wìɛ̀-rɛ́	'opening'	à wìɛ̀ 'to open'
jùò-	jùò	'open'	jùò-ró	'opening'	à jùò 'to open'
tùò-	tùò	'carry'	tùò-ró	'carrying'	à tùò 'to carry'
pùò-	pùò	'perforate'	pùò-ró	'perforating'	à pùò 'to perforate'
wùò-	wùò	'collect'	wùò-ró	'collecting'	à wùò 'to collect'
vúɔ̀-	vúɔ̀	'uproot'	vúɔ́-!rɔ́	'uprooting'	à vúɔ̀ 'to uproot'
tùɔ̀-	tùɔ̀	'draw'	tùɔ̀-rɔ́	'drawing'	à tùɔ̀ 'to draw'
púɔ̀-	púɔ̀	'add'	púɔ́-!rɔ́	'adding'	à púɔ̀ 'to add'
gùɔ̀-	gùɔ̀	'stop'	gùɔ̀-rɔ́	'stopping'	à gùɔ̀ 'to stop'

CVC-roots: CVC-V[DEFAULT] ; CVC-V [IMPERFECTIVE] (long vowel): n=75

r-final stems: n=51

Root	Default	Gloss	Imperfective	Gloss	Citation form
ʔîr-	ʔír-ì	'remove'	ʔír-!é	'removing'	à ʔír(ì) 'to remove'
wìr-	wìr-ì	'turn (inside out)'	wìr-é	'turning (inside out)'	à wìr(ì) 'to turn inside/out'
tìr-	tìr-ì	'give'	tìr-ɛ́	'giving'	à tìr(ì) 'to give'
fìr-	fìr-ì	'force'	fìr-ɛ́	'forcing'	'à fìr(ì) 'to force'
pìr-	pìr-ì	'peel'	pìr-ɛ́	'peeling'	à pìr(ì) 'to peel'

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gbîr-	gbír-ì	'sleep'	gbír-!é	'sleeping'	à gbír(ì) 'to sleep'
bîr-	bír-ì	'stammer'	bír-!é	'stammering'	à bírì 'to stammer'
lìr-	lìr-ì	'bottom.up'	lìr-έ	'bottoming. Up'	à lìr(ì) 'to bottom. Up'
ʧîr-	ʧír-ì	'sneeze'	ʧír-!έ	'sneezing'	à ʧír(ì) 'to sneeze'
ʤír-	ʤír-ì	'subside (e.g. rain)'	ʤír-!έ	'subsiding (e.g. rain)'	à ʤír(ì) 'to subside'
vír-	vír-í	'kick'	vír-ὲ	'kicking'	à vír(ì) 'to kick'
kpér-	kpér-í	'slice/chop'	kpér-è	'slicing/chopping'	à kpér(í) 'to slice/chop'
pèr-	pèr-ì	'carve'	pèr-έ	'carving'	à pèr(ì) 'to carve'
bèr-	bèr-ì	'trap/poison'	bèr-έ	'trapping/poisoning'	à bèr(ì) 'to trap/poison'
sêr-	sέr-ì	'shift'	sέr-!έ	'shifting'	à sέr(ì) 'to shift'
kpér-	kpér-í	'spill'	kpér-ὲ	'spilling'	à kpér(í) 'to spill'
ʔêr-	ʔέr-ì	'grind'	ʔέr-!έ	'grinding'	à ʔέr(ì) 'to grind'
wèr-	wèr-ì	'cut open'	wèr-έ	'cutting open'	à wèr(ì) 'to cut open'
lέr-	lέr-í	'bluff'	lέr-ὲ	'bluffing'	à lέr(í) 'to bluff'
jêr-	jέr-ì	'spread'	jέr-!έ	'spreading'	à jέr(ì) 'to spread'
pùr-	pùr-ì	'burst'	pùr-ó	'bursting'	à pùr(ì) 'to burst'
bùr-	bùr-ì	'soak'	bùr-ó	'soaking'	à bùr(ì) 'to soak'
kùr-	kùr-ì	'fabricate'	kùr-ó	'fabricating'	à kùr(ì) 'to fabricate'
gùr-	gùr-ì	'fold'	gùr-ó	'folding'	à gùr(ì) 'to fold'
bòr-	bòr-ì	'sow'	bòr-ó	'sowing'	à bòr(ì) 'to sow'
pôr-	pór-ì	'pour'	pór-!ó	'pouring'	à pór(ì) 'to pour'
kòr-	kòr-ì	'get.old'	kòr-ó	'getting.old'	à kòr(ì) 'to get.old'
ŋmór-	ŋmór-í	'crush'	ŋmór-ɔ̀	'crushing'	à ŋmór(í) 'to crush'
vór-	vór-í	'pierce'	vór-ɔ̀	'piercing'	à vór(í) 'to pierce'
gór-	gór-í	'pluck(feathers)'	gór-ɔ̀	'plucking (feathers)'	à gór(í) 'to pluck'
lôr-	lór-ì	'untie'	lór-!ó	'untying'	à lór(ì) 'to untie'
kòr-	kòr-ì	'hug'	kòr-ó	'hugging'	à kòr(ì) 'to hug'
bòr-	bòr-ì	'get.lost'	bòr-ó	'getting.lost'	à bòr(ì) 'to be lost'
sòr-	sòr-ì	'plead/beg'	sòr-ó	'pleading/begging'	à sòr(ì) 'to plead/beg'
pôr-	pór-ì	'pluck'	pór-!ó	'plucking'	à pór(ì) 'to pluck'
kôr-	kór-ì	'cough'	kór-!ó	'coughing'	à kór(ì) 'to cough'
tòr-	tòr-ì	'share'	tòr-ó	'sharing'	à tòr(ì) 'to share'
ʔôr-	ʔór-ì	'get rotten'	ʔór-!ó	'getting rotten'	à ʔór(ì) 'to get rotten'
mór-	mór-í	'swell'	mór-ɔ̀	'swelling'	à mór(í) 'to swell'
ɲòr-	ɲòr-ì	'detest'	ɲòr-ó	'detesting'	à ɲòr(ì) 'to detest'
pàr-	pàr-ì	'by-pass'	pàr-á	'by-passing'	à pàr(ì) 'to by-pass'
fár-	fár-í	'foam'	fár-à	'foaming'	à fár(í) 'to foam'
ʔàr-	ʔàr-ì	'stand'	ʔàr-á	'standing'	à ʔàr(ì) 'to stand'
kàr-	kàr-ì	'chase/drive away'	kàr-á	'chasing/driving away'	à kàr(ì) 'to chase/drive'

Root	Default	Gloss	Imperfective	Gloss	Citation form
nár-	nár-í	'plan/prepare'	nár-à	'planning/preparing'	'à nár-(í) 'to pla/prepare'
jàr-	jàr-ì	'wear'	jàr-á	'wearing'	à jàr(ì) 'to wear'
vár-	vár-í	'castrate'	vár-à	'castrating'	à vár(í) 'to castrate'
bàr-	bàr-ì	'leave/stop'	bàr-á	'leaving/stopping'	à bàr(ì) 'to leave/stop'
màr-	màr-ì	'set (e.g. fire)'	màr-á	'setting (fire)'	'à màr(ì) 'to set'
sàr-	sàr-ì	'slide/slip'	sàr-á	'sliding/slipping'	à sár(í) 'to slide/slip'
ŋmâr-	ŋmár-ì	'break/crush'	ŋmár-!á	'breaking/crushing'	à ŋmár(ì) 'to break'

<p style="text-align:center">l-final stems: n=24</p>

Root	Default	Gloss	Imperfective	Gloss	Citation form
pìl-	pìl-ì	'cover.up'	pìl-é	'covering.up'	à pìl(ì) 'to cover up'
víl-	víl-í	'entwine'	víl-è	'entwining'	à víl(í) 'to entwine'
dʒíl-	dʒíl-í	'surround'	dʒíl-è	'surrounding'	à dʒíl(í) 'to surround'
sîl-	síl-ì	'decant'	síl-!έ	'decanting'	à síl(ì) 'to decant'
míl-	míl-í	'fence'	míl-è	'fencing'	à míl(í) 'to fence'
wíl-	wíl-í	'dismantle'	wíl-è	'dismantling'	à wíl(í) 'to dismatle'
kpìl-	kpìl-ì	'fade (e.g. clothes)'	kpìl-έ	'fading (e.g. clothes)'	à kpìl(ì) 'to fade'
jèl-	jèl-ì	'say'	jèl-έ	'saying'	à jèl(ì) 'to say'
sèl-	sèl-ì	'transplant'	sèl-έ	'transplanting'	à sèl(ì) 'to transplant'
kpêl-	kpél-ì	'pluck'	kpél-!έ	'plucking (fruits)'	à kpél(ì) 'to pluck (fruits)'
zèl-	zèl-ì	'lift'	zèl-έ	'lifting'	à zèl(ì) 'to lift'
ɲêl-	ɲél-ì	'melt'	ɲél-!έ	'melting'	à ɲél(ì) 'to melt'
wêl-	wél-ì	'split'	wél-!έ	'splitting'	à wél(ì) 'to split'
búl-	búl-í	'germinate'	búl-ò	'germinating'	à búl(í) 'to germinate'
júl-	júl-í	'leak'	júl-ò	'leaking'	à júl(í) 'to leak'
wùl-	wùl-ì	'show'	wùl-ó	'showing'	à wùl(ì) 'to show'
kúl-	kúl-í	'go home'	kúl-ò	'going home'	à kúl(ì) 'to go home'
mòl-	mòl-ì	'be.wet'	mòl-ɔ́	'being.wet'	à mòl(ì) 'to be wet'
tôl-	tól-ì	'be.hot'	tól-!ɔ́	'being.hot'	à tól(ì) 'to be hot'
vɔ́l-	vɔ́l-í	'swallow'	vɔ́l-ɔ̀	'swallowing'	à vɔ́l(í) 'to swallow'
pɔ̀l-	pɔ̀l-ì	'grow/mature'	pɔ̀l-ɔ́	'growing/maturing'	à pɔ̀l(ì) 'to grow/mature'
zɔ́l-	zɔ́l-í	'be foolish'	zɔ́l-ɔ̀	'being foolish'	à zɔ́l(í) 'to be foolish'
fâl-	fál-ì	'slap'	fál-!á	'slapping'	à fál(ì) 'to slap'
bàl-	bàl-ì	'get.tired'	bàl-á	'getting tired'	à bàl(ì) 'to get tired'

<p style="text-align:center">CVC-stems: CVC.V[DEFAULT] ; CVC.V [IMPERFECTIVE]</p>

<p style="text-align:center">ŋ-final stems: n=13</p>

Root	Default	Gloss	Imperfective	Gloss	Citation form
píŋ-	píŋ	'shake'	píŋ-è	'shaking'	à píŋ 'to shake'
tʃĩŋ-	tʃĩŋ	'walk'	tʃĩn-è	'walking'	à tʃĩŋ 'to walk'

Root	Default	Gloss	Imperfective	Gloss	Citation form
zìŋ-	zìŋ	'sit'	zìn-ɛ́	'sitting'	à zìŋ 'to sit'
sèŋ-	sèŋ	'fornicate/adulterate'	sèn-ɛ́	'fornicating/adulterating'	à sèŋ 'to
vêŋ-	vêŋ	'allow'	vɛ́n-!ɛ́	'allowing'	à vêŋ 'to allow'
tòŋ-	tòŋ	'work'	tòn-ɔ́	'working'	à tòŋ 'to work'
dòŋ-	dòŋ	'bite'	dòn-ɔ́	'biting'	à dòŋ 'to bite'
mòŋ-	mòŋ	'stir'	mòn-ɔ́	'stirring'	à mòŋ 'to stir'
gɔ́ŋ-	gɔ́ŋ	'make.noise'	gɔ́n-ɔ̀	'making noise'	à gɔ́ŋ 'to make nose'
nɔ́ŋ-	nɔ́ŋ	'massage'	nɔ́n-ɔ̀	'massaging'	à nɔ́ŋ 'to massage'
kòŋ-	kòŋ	'cry'	kòn-ó	'crying'	à kòŋ 'to cry'
wòŋ-	wòŋ	'hear'	wòn-ó	'hearing'	à wòŋ 'to hear'
gâŋ-	gâŋ	'lie down'	gán-!á	'lying down'	à gâŋ 'to lie down'

<div align="center">

CVC-stems: CVC.V[DEFAULT] ; CVC.CV [IMPERFECTIVE] (geminates)

ŋ-final stems: n=11

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Root	Default	Gloss	Imperfective	Gloss	Citation form
bìŋ-	bìŋ	'put down'	bìn-né	'putting.down'	à bìŋ 'to put down'
sîŋ-	sîŋ	'wake'	sín-!né	'waking'	à sîŋ 'to wake'
ʔìŋ-	ʔìŋ	'put.in/inside'	ʔìn-né	'putting.in/inside'	à ʔìŋ 'to put.in/inside'
pêŋ-	pêŋ	'borrow/lend'	pén-!né	'borrowing/lending'	à pêŋ 'to borrow/lend'
zêŋ-	zêŋ	'shake'	zén-!né	'shaking'	à zêŋ 'to shake'
tʃòŋ-	tʃòŋ	'burn'	tʃòn-nɔ́	'burning'	à tʃòŋ 'to burn'
sòŋ-	sòŋ	'help'	sòn-nɔ́	'helping'	à sòŋ 'to help'
ʔòŋ-	ʔòŋ	'fetch'	ʔòn-nɔ́	'fetching'	à ʔòŋ 'to fetch'
dàŋ-	dàŋ	'stir/disturb'	dàn-ná	'stirring/disturbing'	à dàŋ 'to stir/disturb'
sâŋ-	sâŋ	'heal/trat/'	sán-!ná	'heaking/treating'	à sâŋ 'to heal/treat'
làŋ-	làŋ	'gather/meet'	làn-ná	'gathering/meeting'	à làŋ 'to gather/meet'

<div align="center">

CVC-stems: CVC.V[DEFAULT] ; CVC.CV [IMPERFECTIVE]: n=18

g-final stems: n=18

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Root	Default	Gloss	Imperfective	Gloss	Citation form
síg-	sígí	'come down'	síg-rè	'coming down'	à sígí 'to come down'
dìg-	dìgì	'chase'	dìg-ré	'chasing'	à dìgì 'to chase'
tìg-	tìgì	'trat'	tìg-ré	'treating'	à tìgì 'to treat'
lêg-	légì	'break/obstruct'	lɛ́g-!ré	'breaking/obstructing'	à légì 'to block/obstruct'
sèg-	sègì	'dance'	sèg-ré	'dancing'	à sègì 'to dance'
sɛ́g-	sɛ́gí	'write'	sɛ́g-rè	'writing'	à sɛ́gí 'to write'
pêg-	pégì	'wash'	pég-!ré	'washing'	à pégì 'to wash'
wêg-	wégì	'split/hatch'	wɛ́g-!rɛ́	'splitting/hatching'	à wégì 'to wash'
tèg-	tègì	'shoot'	tèg-ré	'shooting'	à tègì 'to shoot'
pùg-	pùgì	'praise'	pùg-ró	'praising'	à pùgì 'to praise'

gbúg-	gbúgí	'regurgitate'	gbúg-rò	'regurgitating'	à gbúg-í 'to regurgitate'
dóg-	dógí	'boil/cook'	dóg-rò	'boiling/cooking'	à dógí 'to cook/boil'
pòg-	pògì	'close'	pòg-ró	'closing'	à pògì 'to close'
ɲôg-	ɲógì	'catch'	ɲóg-!rɔ́	'catching'	à ɲógì 'to catch'
dɔ̀g-	dɔ̀gì	'give birth'	dɔ̀g-rɔ́	'giving birth'	à dɔ̀gì 'to give birth'
ʧɔ̂g-	ʧɔ̀gì	'stab/inject'	ʧɔ̀g-rɔ́	'stabbing/injecting'	à ʧɔ̀gì 'to stab/inject'
sàg-	sàgì	'accept/believe'	sàg-rá	'accepting/believing'	à sàgì 'to accept/believe'
tàg-	tàgì	'pull'	tàg-rá	'pulling'	à tàgì 'to pull'

CVVC-stems: CVVC-V[DEFAULT] ; CVVC-V [IMPERFECTIVE]: n=54					
r-final stems: n=34					
Root	**Default**	**Gloss**	**Imperfective**	**Gloss**	**Citation form**
píìr-	píírì	'treat (e.g. bruises)'	píír-!é	'treating(bruises)'	à píír(ì) 'to treat(bruises)
vììr-	vììrì	'turn.round'	vììr-é	'turning round'	à vììr(ì) 'to turn round'
wììr-	wììrì	'smoke (e.g. meat)'	wììr-é	'smoking(e.g. meat)'	à wììr(ì) 'to smoke'
kpììr-	kpììrì	'hem'	kpììr-é	'hemming'	à kpììr(ì) 'to hem'
ʧììr-	ʧíírì	'deny'	ʧíír-!é	'denying'	à ʧíír(ì) 'to deny'
pììr-	pììrí	'sweep'	pììr-ɛ́	'sweeping'	à pììr(í) 'to sweep'
sììr-	sììrì	'be.tight'	sììr-ɛ́	'getting tight'	à sììr(ì) 'to be tight'
fììr-	fììrì	'blow(nose)'	fììr-ɛ́	'blow(nose)'	à fììr(ì) 'to blow'
ʤììr-	ʤììrí	'go behind/round/'	ʤììr-ɛ́	'going behind/round'	À ʤììr(í) 'to go round/'
tíèr-	tíérì	'think'	tíér-!ɛ́	'thinking'	à tíér(ì) 'to think'
ʧìèr-	ʧìèrì	'contribute'	ʧìèr-ɛ́	'contributing'	à ʧìèr(ì) 'to contribute'
ʔíèr-	ʔíérì	'wipe out'	ʔíér-!ɛ́	'wiping out'	à ʔíér(ì) 'to wipe out'
wíèr-	wíérì	'search'	wíér-!ɛ́	'searching'	à wíér(ì) 'to search'
kùùr-	kùùrì	'dredge/dig/'	kùùr-ó	'/dredging/digging'	à kùùr(ì) 'to dredge/dig'
tùùr-	tùùrì	'pick'	tùùr-ó	'picking'	à tùùr(ì) 'to pick'
nòòr-	nòòrì	'dress'	nòòr-ɔ́	'dressing'	à nòòr(ì) 'to dress'
sòòr-	sòòrì	'ask'	sòòr-ɔ́	'asking'	à sòòr(ì) 'to ask'
kòòr-	kòòrì	'snore'	kòòr-ɔ́	'snoring'	à kòòr(ì) 'to snore'
ʧŏòr-	ʧŏórì	'hiss'	ʧŏór-!ɔ́	'hissing'	à ʧŏór(ì) 'to hiss'
tŏòr-	tŏórì	'spit'	tŏór-!ɔ́	'spitting'	à tŏór(ì) 'to spit'
ʧŭùr-	ʧŭúrì	'doze'	ʧŭúr-!ɔ́	'dozing'	à ʧŭúr(ì) 'to doze'
dúòr-	dúórì	'urinate'	dúór-!ó	'urinating'	à dúór(ì) 'to urinate'
pùòr-	pùòrì	'greet/pray'	pùòr-ó	'greeting/praying'	à pùòr(ì) 'to greet/pray'
fúòr-	fúórì	'sip'	fúó!r-ó	'sipping'	à fúór(ì) 'to sip'
kòòr-	kòòrì	'sell'	kòòr-ɔ́	'selling'	à kòòr(ì) 'to sell'
kɔ̀ɔ̀r-	kɔ̀ɔ̀rì	'delay'	kɔ̀ɔ̀r-ɔ́	'delaying'	à kɔ̀ɔ̀r(ì) to delay'

Root	Default	Gloss	Imperfective	Gloss	Citation form
gə́ə̀r-	gə́ə́rì	'belch'	gə́ə́r-!ɔ́	'belching'	à gə́ə́r(ì) 'to belch'
hə́ə̀r-	hə́ə́rì	'yawn'	hə́ə́r-!ɔ́	'yawning'	à hə́ə́r(ì) 'to yawn'
báàr-	báárì	'finish'	báár-!á	'finishing'	à báár(ì) 'to finish'
háàr-	háárì	'shoo'	háár-!á	'shooing'	à háár(ì) 'to shoo'
ɲààr-	ɲààrì	'grind(roughly)'	ɲààr-á	'grinding(roughly)	à ɲààr(ì) to grind(roughly)
fààr-	fààrì	'massage'	fààr-á	'massaging'	à fàar(ì) 'to massage'
váàr-	váárì	'rinse'	váár-!á	'rinsing'	à váár(ì) 'to rinse'
jààr-	jààrì	'spill'	jààr-á	'spilling'	à jààr(ì) 'to spill'

l-final stems: n=17

Root	Default	Gloss	Imperfective	Gloss	Citation form
píìl-	píílì	'start'	pííl-!ɛ́	'starting'	à pííl(ì) 'to start'
mììl-	mììlì	'wipe/smear'	mììl-ɛ́	'wiping/smearing'	à mìil(ì) 'to wipe/smear'
ʧíìl-	ʧíílì	'slice'	ʧííl-!ɛ́	'slicing'	à ʧííl(ì) 'to slice'
jíèl-	jíélì	'sing'	jíél-!ɛ́	'singing'	à jíél(ì) 'to sing'
bìèl-	bìèlì	'accompany'	bìèl-ɛ́	'accompanying'	à bìèl(ì) 'to accompany'
ŋmìèl-	ŋmìèlí	'twist'	ŋmìèl-ɛ́	'twisting'	à ŋmìèl(í) 'to twist'
fúòl-	fúólì	'whistle'	fúól-!ó	'whistling'	à fúól(ì) 'to whistle'
wúól-	wúólì	'bark'	wúól-!ó	'barking'	à wúól(ì) 'to bark'
kùòl-	kùòlì	'fertilize'	kùòl-ó	'fertilizing'	à kùòl(ì) 'to fertilize'
bɔ̀ɔ̀l-	bɔ̀ɔ̀lì	'call'	bɔ̀ɔ̀l-ɔ́	'calling'	à bɔ̀ɔ̀l(ì) 'to call'
tɔ́ɔ̀l-	tɔ́ɔ́lì	'send'	tɔ́ɔ́l-!ɔ́	'sending'	à tɔ́ɔ́l(ì) 'to send'
zɔ́ɔ̀l-	zɔ́ɔ́lì	'wither'	zɔ́ɔ́l-!ɔ́	'withering'	à zɔ́ɔ́l(ì) 'to wither'
mààl-	mààlì	'make'	mààl-á	'making'	à mààl(ì) 'to make'
sààl-	sààlì	'sharpen'	sààl-á	'sharpening'	à sààl(ì) 'to sharpen'
kààl-	kààlì	'gather'	kààl-á	'gathering'	à kààl(ì) 'to gather'
wáàl-	wáálì	'steam'	wáál-!á	'steaming'	à wáál(ì) 'to steam'
jààl-	jààlì	'widen'	jààl-á	'widening'	à jààl(ì) 'to widen'

n-final stems: n=3

Root	Default	Gloss	Imperfective	Gloss	Citation form
ŋmììn-	ŋmììnì	'wrinkle'	ŋmììn-ɛ́	'wrinkling'	à ŋmìin(ì) 'to wrinkle'
ŋmɔ̀ɔ̀n-	ŋmɔ̀ɔ̀nì	'hum'	ŋmɔ̀ɔ̀n-ɔ́	'humming'	à ŋmɔ̀ɔ̀n(ì) 'to hum'
vɔ̀ɔ̀n-ì	vɔ̀ɔ̀nì	'vibrate'	vɔ̀ɔ̀n-ɔ́	'vibrating'	à vɔ̀ɔ̀n(ì) 'to vibrate'
gùùn-	gùùnì	'stalk'	gùùn-ó	'stalking'	à gùùn(ì) 'to stalk'

CVCC-stems: CVCC-V[DEFAULT] ; CVCC-V [IMPERFECTIVE]: n=16

Root	Default	Gloss	Imperfective	Gloss	Citation form
ɲîgr-	ɲígr-í	'blink'	ɲígr-!é	'blinking'	à ɲígrí 'to blink'

sìgr-	sìgrì	'hiccough'	sìgr-é	'hiccoughing'	à sìgr(ì) 'to hiccough'
lîgr-	lígrì	'tickle'	lígr-!έ	'tickling'	à lígr(ì) 'to tickle'
wìnl-	wìnlì	'roll'	wìnl-é	'rolling'	à wìnl(ì) 'to roll'
bènl-	bènlì	'deceive'	bènl-έ	'deceiving'	à bènl(ì) 'to deceive'
tʃ̀ènl-ì	tʃ̀ènlì	'listen'	tʃ̀ènl-é	'listening'	à tʃ̀ènl(ì) 'to listen'
lègr-	lègrì	'turn/capsize'	lègr-ɛ́	'turning/capizing'	à lègr(ì) 'to turn/capsize'
hêgr-	hέgrì	'pant'	hέgr-!ɛ	'panting'	hέgr(ì) 'to pant'
mògr-	mògrì	'suck'	mògr-ɔ́	'sucking'	mògr(ì)
tɔ̀gl-	tɔ̀glì	'imitate'	tɔ̀gl-ɔ́	'imitating'	à tɔ̀gl(ì) 'to imitate'
sôgl-	sɔ́glì	'hide'	sɔ́gl-!ɔ́	'hiding'	à sɔ́gl(ì) 'to hide'
jôgl-	jɔ́glì	'babysit'	jɔ́gl-!ɔ́	'babysitting'	à jɔ́gl(ì) 'to babysit'
dôgl-	dɔ́glì	'boil'	dɔ́gl-!ɔ́	'boiling'	à dɔ́gl(ì) 'to boil'
zàgr-	zàgrí	'refuse'	zàgr-á	'refusing'	à zàgr(í) 'to refuse'
zânl-	zánlì	'swing'	zánl-!á	'swinging'	à zánl(ì) 'to swing'
jàgl-	jàglí	'hang'	jàgl-á	'hanging'	à jàgl(í) 'to hang'

CVC-stems: CVC-CV[DEFAULT] ; CVC-CV [IMPERFECTIVE]: n=10

Root	Default	Gloss	Imperfective	Gloss	Citation form
kpìn-	kpìnnì	'quench'	kpìn-né	'quenching'	à kpìnnì 'to quench'
dèn-	dènnì	'straighten'	dèn-né	'straightening'	à dènnì 'to straighten'
lèn-	lènnì	'taste'	lèn-nέ	'tasting'	à lènnì 'to taste'
pèn-	pènnì	'rest'	pèn-nέ	'resting'	à pènnì 'to rest'
ɲùn-	ɲùnnì	'smell'	ɲùn-nó	'smelling'	à ɲùnnì 'to smell'
ɲûn-	ɲúnnì	'evaporate'	ɲún-!nó	'evaporating'	à ɲúnnì 'to evaporate'
zôn-	zónnì	'hesitate'	zón-!nó	'hesitating'	à zónnì 'to hesitate'
lòn-	lònnì	'speed up'	lòn-nó	'speeding up'	à lònnì 'to speed up'
tʃòn-	tʃònnì	'drip'	tʃòn-nó	'dripping'	à tʃònnì 'to drip'
zàn-	zànnì	'dream'	zàn-ná	'dreaming'	à zànnì 'to dream'
mân-	mánnì	'measure'	mán-!ná	'measuring'	à mánnì 'to measure'

Sub-Appendix A.2: Tone classes in verbs

Verbs in Dagaare involve three tone classes for the default and imperfective forms. The defaut form has the classes: L, H and HL and their corresponding imperfective classes are L-H, H-L and HLH (H-!H). Below is the list of verbs in each class.

Tone classes in verbs

Default L; Imperfective LH; n=157

Root	Default	Gloss	Imperfective	Gloss
dì-	dì	'eat'	dì-ré	'eating'
ʔì-	ʔì	'do'	ʔì-rɛ́	'doing'
lè-	lè	'fall'	lè-ré	'falling'
kʊ̀-	kʊ̀	'give'	kʊ̀-rɔ́	'giving'
kò-	kò	'dry'	kò-ró	'drying'
gò-	gò	'guard'	gò-ró	'guarding'
zɔ̀-	zɔ̀	'run'	zɔ̀-rɔ́	'running'
tì-	tì	'vomit'	tììré	'vomiting'
sì-	sì	'skin'	sìì-rɛ́	'skinning'
kpì-	kpì	'die'	kpìì-ré	'dying'
tù-	tù	'follow'	tùù-ró	'following'
sù-	sù	'feed(e.g. baby)'	sùù-ró	'feeding(e.g.baby)'
dà-	dà	'buy'	dàà-rá	'buying'
là-	là	'laugh'	làà-rá	'laughing'
pà-	pà	'be.full'	pàà-rá	'getting full'
bà-	bà	'fix (on the ground)'	bàà-rá	'fixing(on the ground)'
wà-	wà	'come'	wàà-ná	'coming'
zà-	zà	'collect'	zàà-rá	'collecting'
bɛ̀-	bɛ̀	'get sick'	bìɛ̀-rɛ́	'getting sick'
dɛ̀-	dɛ̀	'trim'	dìɛ̀-rɛ́	'trimming'
ɲɛ̀-	ɲɛ̀	'fart/defecate'	ɲìɛ̀-rɛ́	'farting/deficating'
kpɛ̀-	kpɛ̀	'enter'	kpìɛ̀-rɛ́	'entering'
ʧɛ̀-	ʧɛ̀	'cut'	ʧìɛ̀-rɛ́	'cutting'
sɛ̀-	sɛ̀	'sew'	sìɛ̀-rɛ́	'sewing'
mɛ̀-	mɛ̀	'build'	mìɛ̀-rɛ́	'building'
ŋmɛ̀-	ŋmɛ̀	'beat'	ŋmìɛ̀-rɛ́	'beating'
dò-	dò	'roll'	dùò-ró	'rolling'
sò-	sò	'bathe'	sùò-ró	'bathing'
tɔ̀-	tɔ̀	'pound'	tʊ̀ɔ̀-rɔ́	'pounding'
ɔ̀ɔ̀-	ɔ̀ɔ̀	'eat/chew'	ɔ̀ɔ̀-rɔ́	'eating/chewing'
zɔ̀ɔ̀-	zɔ̀ɔ̀	'fight'	zɔ̀ɔ̀-rɔ́	'fighting'
dɔ̀ɔ̀-	dɔ̀ɔ̀	'squat'	dɔ̀ɔ̀-rɔ́	'squatting'
kɔ̀ɔ̀-	kɔ̀ɔ̀	'break'	kɔ̀ɔ̀-rɔ́	'breaking'
ɲɔ̀ɔ̀-	ɲɔ̀ɔ̀	'mate'	ɲɔ̀ɔ̀-rɔ́	'mating'
kàà-	kàà	'look'	kàà-rá	'looking'
ŋmàà-	ŋmàà	'cut'	ŋmàà-rá	'cutting'
bìɛ̀-	bìɛ̀	'give way'	bìɛ̀-rɛ́	'giving way'
tìɛ̀-	tìɛ̀	'push'	tìɛ̀-rɛ́	'pushing'
sìɛ̀-	sìɛ̀	'dance'	sìɛ̀-rɛ́	'dancing'
wìɛ̀-	wìɛ̀	'open'	wìɛ̀-rɛ́	'opening'

jùò-	jùò	'open'	jùò-ró	'opening'
tùò-	tùò	'carry'	tùò-ró	'carrying'
tòɔ̀-	tòɔ̀	'draw'	tòɔ̀-ró	'drawing'
pùò-	pùò	'perforate'	pùò-ró	'perforating'
wùò-	wùò	'collect'	wùò-ró	'collecting'
tòɔ̀-	tòɔ̀	'draw'	tòɔ̀-ró	'drawing'
gòɔ̀-	gòɔ̀	'stop'	gòɔ̀-rɔ́	'stopping'
wìr-	wìr-	'turn (inside out)'	wìr-ɛ́	'turning (inside out)'
tìr-	tìrì	'give'	tìr-ɛ́	'giving'
fìr-	fìrì	'force'	fìr-ɛ́	'forcing'
lìr-	lìrì	'bottom.up'	lìr-ɛ́	'bottoming. Up'
pìr-	pìrì	'peel'	pìr-ɛ́	'peeling'
pèr-	pèrì	'carve'	pèr-ɛ́	'carving'
bèr-	bèrì	'trap/poison'	bèr-ɛ́	'trapping/poisoning'
wèr-	wèrì	'cut open'	wèr-ɛ́	'cutting open'
pùr-	pùrì	'burst'	pùr-ó	'bursting'
bùr-	bùrì	'soak'	bùr-ó	'soaking'
kùr-	kùrì	'fabricate'	kùr-ó	'fabricating'
gùr-	gùrì	'fold'	gùr-ó	'folding'
kòr-	kòrì	'get.old'	kòr-ɔ́	'getting.old'
kòr-	kòrì	'hug'	kòr-ó	'hugging'
bɔ̀r-	bɔ̀rì	'get.lost'	bɔ̀r-ɔ́	'getting.lost'
sɔ̀r-	sɔ̀rì	'plead/beg'	sɔ̀r-ɔ́	'pleading/begging'
tɔ̀r-	tɔ̀rì	'share'	tɔ̀r-ɔ́	'sharing'
ɲɔ̀r-	ɲɔ̀rì	'detest'	ɲɔ̀r-ɔ́	'detesting'
pàr-	pàrì	'by-pass'	pàr-á	'by-passing'
kàr-	kàrì	'chase/drive away'	kàr-á	'chasing/driving away'
jàr-	jàrì	'wear'	jàr-á	'wearing'
bàr-	bàrì	'leave/stop'	bàr-á	'leaving/stopping'
màr-	màrì	'set (e.g. fire)'	màr-á	'setting (fire)'
sàr-	sàrì	'slide/slip'	sàr-á	'sliding/slipping'
pìl-	pìlì	'cover.up'	pìl-é	'covering.up'
kpìl-	kpìlì	'fade (e.g. clothes)'	kpìl-ɛ́	'fading (e.g. clothes)'
jɛ̀l-	jɛ̀lì	'say'	jɛ̀l-ɛ́	'saying'
sɛ̀l-	sɛ̀lì	'transplant'	sɛ̀l-ɛ́	'transplanting'
zɛ̀l-	zɛ̀lì	'lift'	zɛ̀l-ɛ́	'lifting'
wùl-	wùlì	'show'	wùl-ó	'showing'
mùl-	mùlì	'be.wet'	mùl-ɔ́	'being.wet'
pɔ̀l-	pɔ̀lì	'grow/mature'	pɔ̀l-ɔ́	'growing/maturing'
bàl-	bàlì	'get.tired'	bàl-á	'getting tired'
zìŋ-	zìŋ	'sit'	zìn-ɛ́	'sitting'
sɛ̀ŋ-	sɛ̀ŋ	'fornicate/adulterate'	sèn-ɛ́	'fornicating/adulterating'
ʔìŋ-	ʔìŋ	'put.in/inside'	ʔìn-nɛ́	'putting.in/inside'
tòŋ-	tòŋ	'work'	tòn-ɔ́	'working'
dòŋ-	dòŋ	'bite'	dòn-ɔ́	'biting'
mòŋ-	mòŋ	'stir'	mòn-ɔ́	'stirring'
kòŋ-	kòŋ	'cry'	kòn-ó	'crying'
wòŋ-	wòŋ	'hear'	wòn-ó	'hearing'
ʧòŋ-	ʧòŋ	'burn'	ʧòn-nɔ́	'burning'
sòŋ-	sòŋ	'help'	sòn-nɔ́	'helping'

ʔɔ̀ŋ-	ʔɔ̀ŋ	'fetch'	ʔɔ̀n-nɔ́	'fetching'
dàŋ-	dàŋ	'stir/disturb'	dàn-ná	'stirring/disturbing'
làŋ-	làŋ	'gather/meet'	làn-ná	'gathering/meeting'
dìg-	dìgì	'chase'	dìg-ré	'chasing'
tìg-	tìgì	'trat'	tìg-rɛ́	'treating'
sɛ̀g-	sɛ̀gì	'dance'	sɛ̀g-rɛ́	'dancing'
tɛ̀g-	tɛ̀gì	'shoot'	tɛ̀g-rɛ́	'shooting'
pùg-	pùgì	'praise'	pùg-ró	'praising'
dɔ̀g-	dɔ̀gì	'give birth'	dɔ̀g-rɔ́	'giving birth'
ʧɔ̀g-	ʧɔ̀gì	'stab/inject'	ʧɔ̀g-rɔ́	'stabbing/injecting'
sàg-	sàgì	'accept/believe'	sàg-rá	'accepting/believing'
tàg-	tàgì	'pull'	tàg-rá	'pulling'
vììr-	vììrì	'turn.round'	vììr-é	'turning round'
wììr-	wììrì	'smoke (e.g. meat)'	wììr-é	'smoking(e.g. meat)'
kpììr-	kpììrì	'hem'	kpììr-é	'hemming'
pììr-	pììrí	'sweep'	pììr-ɛ́	'sweeping'
sììr-	sììrì	'be.tight'	sììr-ɛ́	'getting tight'
ʧìèr-	ʧìèrì	'contribute'	ʧìèr-ɛ́	'contributing'
kùùr-	kùùrì	'dredge/dig/'	kùùr-ó	'/dredging/digging'
tùùr-	tùùrì	'pick'	tùùr-ó	'picking'
nòòr-	nòòrì	'dress'	nòòr-ɔ́	'dressing'
sòòr-	sòòrì	'ask'	sòòr-ɔ́	'asking'
kòòr-	kòòrì	'snore'	kòòr-ɔ́	'snoring'
kòɔ̀r-	kòɔ̀rì	'sell'	kòɔ̀r-ɔ́	'selling'
kɔ̀ɔ̀r-	kɔ̀ɔ̀rì	'delay'	kɔ̀ɔ̀r-ɔ́	'delaying'
pùòr-	pùòrì	'greet/pray'	pùòr-ó	'greeting/praying'
ɲààr-	ɲààrì	'grind(roughly)'	ɲààr-á	'grinding(roughly)'
fààr-	fààrì	'massage'	fààr-á	'massaging'
jààr-	jààrì	'spill'	jààr-á	'spilling'
mììl-	mììlì	'wipe/smear'	mììl-ɛ́	'wiping/smearing'
bìèl-	bìèlì	'accompany'	bìèl-ɛ́	'accompanying'
ŋmìèl-	ŋmìèlí	'twist'	ŋmìèl-ɛ́	'twisting'
kùòl-	kùòlì	'fertilize'	kùòl-ó	'fertilizing'
bòɔ̀l-	bòɔ̀lì	'call'	bòɔ̀l-ɔ́	'calling'
mààl-	mààlì	'make'	mààl-á	'making'
sààl-	sààlì	'sharpen'	sààl-á	'sharpening'
kààl-	kààlì	'gather'	kààl-á	'gathering'
jààl-	jààlì	'widen'	jààl-á	'widening'
ŋmììn-	ŋmììnì	'wrinkle'	ŋmììn-ɛ́	'wrinkling'
ŋmòòn-	ŋmòònì	'hum'	ŋmòòn-ɔ́	'humming'
vòòn-ì	vòònì	'vibrate'	vòòn-ɔ́	'vibrating'
gùùn-	gùùnì	'stalk'	gùùn-ó	'stalking'
wìnl-	wìnlì	'roll'	wìnl-é	'rolling'
bɛ̀nl-	bɛ̀nlì	'deceive'	bɛ̀nl-ɛ́	'deceiving'
ʧɛ̀nl-	ʧɛ̀nlì	'listen'	ʧɛ̀nl-ɛ́	'listening'
sìgr-	sìgrì	'hiccough'	sìgr-é	'hiccoughing'
lɛ̀gr-	lɛ̀grì	'turn/capsize'	lɛ̀gr-ɛ́	'turning/capizing'
mògr-	mògrì	'suck'	mògr-ɔ́	'sucking'
tɔ̀gl-	tɔ̀glì	'imitate'	tɔ̀gl-ɔ́	'imitating'
zàgr-	zàgrì	'refuse'	zàgr-á	'refusing'

Root	Perfective	Gloss	Imperfective	Gloss
jàgl-	jàglì	'hang'	jàgl-á	'hanging'
kpìn-	kpìnnì	'quench'	kpìn-né	'quenching'
dèn-	dènnì	'straighten'	dèn-nέ	'straightening'
lèn-	lènnì	'taste'	lèn-nέ	'tasting'
pèn-	pènnì	'rest'	pèn-nέ	'resting'
lòn-	lònnì	'speed up'	lòn-nó	'speeding up'
ɲùn-	ɲùnnì	'smell'	ɲùn-nó	'smelling'
ʧòn-	ʧònnì	'drip'	ʧòn-nó	'dripping'
zàn-	zànnì	'dream'	zàn-ná	'dreaming'

Default H; imperfective HL ; n=74

Root	Perfective	Gloss	Imperfective	Gloss
jí-	jí	'leave'	jí-rè	'leaving'
lé-	lé	'tie'	lé-rè	'tying'
ɲέ-	ɲέ	'see'	ɲέ-rὲ	'seeing'
pó-	pó	'share'	pó-rò	'sharing'
kó-	kó	'gather (clouds)'	kó-rò	'gathering (clouds)'
tá-	tá	'reach'	tá-rà	'reaching'
tí-	tí	'hold'	tíírè	'holding'
pí-	pí	'select/choose'	píír-è	'selecting
ví-	ví	'demolish'	víí-rè	'demolishing'
gbí-	gbí	'kneel'	gbíí-rè	'kneeling'
pí-	pí	'fed.up'	píí-rὲ	'getting fed.up'
tú-	tú	'dig'	túú-rò	'digging'
vú-	vú	'crawl'	vúú-rò	'crawling'
zú-	zú	'steal'	zúú-rò	'stealing'
ɲú-	ɲú	'drink'	ɲúú-rò	'drinking'
dú-	dú	'swim'	dúú-rò	'swimming'
tɔ́-	tɔ́	'insult'	tɔ́ɔ́-rɔ̀	'insulting'
kɔ́-	kɔ́	'kill'	kɔ́ɔ́-rɔ̀	'kiling'
vɔ́-	vɔ́	'scorch'	vɔ́ɔ́-rə̀	'scorching'
vá-	vá	'hit'	váá-rà	'hitting'
dá-	dá	'blow (e.g. air)'	dáá-rà	'blowing (e.g.air)'
zá-	zá	'throw'	záá-rà	'throwing'
já-	já	'get mad'	jáá-rà	'getting mad'
sá-	sá	'administer (enema)'	sáá-rà	'administering (enema)'
ʔá-	ʔá	'hate'	ʔáá-rà	'hating'
kpá-	kpá	'boil'	kpáá-rà	'boiling'
fá-	fá	'rob'	fáá-rà	'robbing'
pέ-	pέ	'harvest'	píέ-rὲ	'harvesting'
tέ-	tέ	'spread'	tíέ-rὲ	'spreading'
sέ-	sέ	'roast'	síέ-rὲ	'roasting'
wέ-	wέ	'waste'	wíέ-rὲ	'wasting'
dó-	dó	'climb'	dúó-rò	'climbing'
bɔ́-	bɔ́	'find'	bɔ́ɔ́-rɔ̀	'finding'
dɔ́-	dɔ́	'weed'	dɔ́ɔ́-rɔ̀	'weeding'
jɔ́-	jɔ́	'roam'	jɔ́ɔ́-rɔ̀	'roaming'
kɔ́-	kɔ́	'farm'	kɔ́ɔ́-rɔ̀	'farming'
pɔ́-	pɔ́	'curse'	pɔ́ɔ́-rɔ̀	'cursing'
ʧɔ́-	ʧɔ́	'hide'	ʧɔ́ɔ́-rɔ̀	'hiding'

só	só	'rub'	sɔ́ɔ́-rɔ̀	'rubbing'
wóó-	wóó	'weave'	wóó-rò	'weaving'
mɔ́ɔ́-	mɔ́ɔ́	'wrestle'	mɔ́ɔ́-rɔ̀	'wrestling'
lɔ́ɔ́-	lɔ́ɔ́	'drop'	lɔ́ɔ́-rɔ̀	'dropping'
jɔ́ɔ́-	jɔ́ɔ́	'pay'	jɔ́ɔ́-rɔ̀	'paying'
vírí-	vírí	'kick'	vír-ɛ̀	'kicking'
kpér-	kpérí	'slice/chop'	kpér-ɛ̀	'slicing/chopping'
kpér-	kpérí	'spill'	kpér-ɛ̀	'spilling'
lɛ́r-	lɛ́rí	'bluff'	lɛ́r-ɛ̀	'bluffing'
vór-	vórí	'pierce'	vór-ɔ̀	'piercing'
gór-	górí	'pluck(feathers)'	gór-ɔ̀	'plucking (feathers)'
ŋmór-	ŋmórí	'crush'	ŋmór-ɔ̀	'crushing'
sɔ́r-	sɔ́rí	'count'	sɔ́r-ɔ̀	'counting'
mór-	mórí	'swell'	mór-ɔ̀	'swelling'
fár-	fárí	'foam'	fár-à	'foaming'
nár-	nárí	'plan/prepare'	nár-à	'planning/preparing'
vár-	várí	'castrate'	vár-à	'castrating'
míl-	mílí	'fence'	míl-ɛ̀	'fencing'
wíl-	wílí	'dismantle'	wíl-ɛ̀	'dismantling'
dʒíl-	dʒílí	'surround'	dʒíl-è	'surrounding'
búl-	búlí	'germinate'	búl-ò	'germinating'
júl-	júlí	'leak'	júl-ò	'leaking'
vól-	vólí	'swallow'	vól-ɔ̀	'swallowing'
zɔ́l-	zɔ́lí	'be.foolish'	zɔ́l-ɔ̀	'being.foolish'
píŋ-	píŋ	'shake'	pín-ɛ̀	'shaking'
góŋ-	góŋ	'make.noise'	gón-ɔ̀	'making noise'
nóŋ-	nóŋ	'massage'	nón-ɔ̀	'massaging'
síg-	sígí	'come down'	síg-rè	'coming down'
sɛ́g-	sɛ́gí	'write'	sɛ́g-rè	'writing'
gbúg-	gbúgí	'regurgitate'	gbúg-rò	'regurgitating'
dóg-	dógí	'boil/cook'	dóg-rɔ̀	'boiling/cooking'

Default HL; imperfective HLH (=H!H) n=69

dî-	dî	'take'	dí-!rɛ́	'taking'
fáà-	fáà	'seize/resolve'	fáá-!rá	'seizing/resolving'
dáà-	dáà	'push'	dáá-!rá	'pushing'
táà-	táà	'have'	táá-!rá	'having'
díɛ̀-	díɛ̀	'receive'	díɛ́-!rɛ́	'receiving'
tʃĩ̀ɛ̀-	tʃĩ̀ɛ̀	'tear'	tʃĩ́ɛ́-!rɛ́	'tearing'
vóɔ̀-	vóɔ̀	'uproot'	vóɔ́-!rɔ́	'uprooting'
póɔ̀-	póɔ̀	'add'	póɔ́-!rɔ́	'adding'
ʔîr-	ʔírì	'remove'	ʔír-!é	'removing'
gbîr-	gbírì	'sleep'	gbír-!é	'sleeping'
bîr-	bírì	'stammer'	bír-!é	'stammering'
tʃîr-	tʃírì	'sneeze'	tʃír-!ɛ́	'sneezing'
sêr-	sérì	'shift'	sér-!ɛ́	'shifting'
ʔêr-	ʔérì	'grind'	ʔér-!ɛ́	'grinding'
ʔêr-	ʔérì	'grind'	ʔér-!ɛ́	'grinding'
pôr-	pórì	'pour'	pór-!ɔ́	'pouring'
lôr-	lórì	'untie'	lór-!ó	'untying'

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pɔ̂r-	pórì	'pluck'	pór-!ɔ́	'plucking'
kɔ̂r-	kórì	'cough'	kór-!ɔ́	'coughing'
ʔɔ̂r-	ʔórì	'get rotten'	ʔór-!ɔ́	'getting rotten'
ŋmâr-	ŋmárì	'break/crush'	ŋmár-!á	'breaking/crushing'
kpêl-	kpélì	'pluck'	kpél-!ɛ́	'plucking (fruits)'
ɲêl-	ɲélì	'melt'	ɲél-!ɛ́	'melting'
wêl-	wélì	'split'	wél-!ɛ́	'splitting'
tôl-	tólì	'be.hot'	tól-!ɔ́	'being.hot'
fâl-	fálì	'slap'	fál-!á	'slapping'
vêŋ-	vêŋ	'allow'	vén-!ɛ́	'allowing'
gâŋ-	gâŋ	'lie down'	gán-!á	'lying down'
sîŋ-	sîŋ	'wake'	sín-!nɛ́	'waking'
pêŋ-	pêŋ	'borrow/lend'	pén-!nɛ́	'borrowing/lending'
zêŋ-	zêŋ	'shake'	zén-!nɛ́	'shaking'
sâŋ-	sâŋ	'heal/trat/'	sán-!ná	'heaking/treating'
lêg-	légì	'break/obstruct'	lɛ́g-!rɛ́	'breaking/obstructing'
pêg-	pégì	'wash'	pég-!rɛ́	'washing'
wêg-	wégì	'split/hatch'	wég-!rɛ́	'splitting/hatching'
píìr-	píírì	'treat (e.g. bruises)'	píír-!ɛ́	'treating(bruises)'
ʧîìr-	ʧíírì	'deny'	ʧíír-!ɛ́	'denying'
tíèr-	tíérì	'think'	tíér-!ɛ́	'thinking'
ʔíèr-	ʔíérì	'wipe out'	ʔíér-!ɛ́	'wiping out'
wíèr-	wíérì	'search'	wíér-!ɛ́	'searching'
ʧǒòr-	ʧóórì	'hiss'	ʧóór-!ɔ́	'hissing'
tóòr-	tóórì	'spit'	tóór-!ɔ́	'spitting'
ʧǔùr-	ʧúúrì	'doze'	ʧúúr-!ɔ́	'dozing'
dúòr-	dúórì	'urinate'	dúór-!ó	'urinating'
fúòr-	fúórì	'sip'	fúó!r-ó	'sipping'
gɔ́ɔ̀r-	gɔ́ɔ́rì	'belch'	gɔ́ɔ́r-!ɔ́	'belching'
hɔ́ɔ̀r-	hɔ́ɔ́rì	'yawn'	hɔ́ɔ́r-!ɔ́	'yawning'
báàr-	báárì	'finish'	báár-!á	'finishing'
háàr-	háárì	'shoo'	háár-!á	'shooing'
váàr-	váárì	'rinse'	váár-!á	'rinsing'
píìl-	píílì	'start'	pííl-!ɛ́	'starting'
ʧǐìl-	ʧíílì	'slice'	ʧííl-!ɛ́	'slicing'
jíèl-	jíélì	'sing'	jíél-!ɛ́	'singing'
fúòl-	fúólì	'whistle'	fúól-!ó	'whistling'
tóɔ̀l-	tóɔ́lì	'send'	tóɔ́l-!ɔ́	'sending'
zóɔ̀l-	zóɔ́lì	'wither'	zóɔ́l-!ɔ́	'withering'
ɲîgr-	ɲígrì	'blink'	ɲígr-!ɛ́	'blinking'
lîgr-	lígrì	'tickle'	lígr-!ɛ́	'tickling'
hêgr-	hégrì	'pant'	hégr-!ɛ	'panting'
sôgl-	sóglì	'hide'	sógl-!ɔ́	'hiding'
jôgl-	jóglì	'babysit'	jógl-!ɔ́	'babysitting'
dôgl-	dóglì	'boil'	dógl-!ɔ́	'boiling'
zânl-	zánlì	'swing'	zánl-!á	'swinging'
ɲûn-	ɲúnnì	'evaporate'	ɲún-!nó	'evaporating'
zôn-	zónnì	'hesitate'	zón-!nó	'hesitating'
mân-	mánnì	'measure'	mán-!ná	'measuring'

Appendix B: Nominal system of Dagaare

Sub-Appendix B. 1: Nominal morphology (noun classes)

The list of nouns from my data is given for each noun class.

Noun classes

Class 1: singular: V; plural bV: (Human & kinship class): n=19

Class 1A: singular: V; plural: bV (human count nouns): n=10					
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
dɔ̀ɔ̀-	dóɔ́	dó-bɔ́	'man,	dɔ̀ɔ̀-fáá 'bad man'	
sìr-	sír-ɛ́	sír-bá	'husband'	sìr-sǒŋ 'good husband'	
níŋ-	ní-ɛ̀	nú-bà	'person'	níŋ-!fáá 'bad person'	
sèn-	sén-í	sén-bá	'fiancé/fiancée'	sèn-fáá 'bad fiance/fiancee'	
pɔ̀g-	póg-ɔ́	póg-bá	'woman'	pɔ̀g-vìláá 'nice woman'	
kúɔ̀r-	kúɔ́r-!áá	kúɔ́r-!bá	'farmer'	kúɔ̀ r-fáá 'bad farmer'	
sáán-	sáán-à	sáám-!bá	'stranger'	sáán-!fáá 'bad stranger'	
ɲèntà-	ɲèntá-á	ɲèntáá-bá	'co-wife'	ɲèntà-fáá 'bad co-wife'	
nàɲìg-	nàɲìg-é	nàɲìg-bé	'thief'	nàɲìg-fáá 'bad thief'	
nínsààl-	nínsààl-áá	nínsààl-bá	'human'	nínsààl-fáá 'bad human'	
Class 1B: singular: V, -ba, zero; plural: -mine (kinship class): n=9					
i. *singular: V; plural: -mine: n=5*					
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
bíɛ̀r-	bíɛ́r-ì	bíɛ̀r-mìné	'brother'	bíɛ̀r-fáá 'bad brother'	
kpìèm-	kpíɛ́m-á	kpìèm-mìné	'elder sister'	kpìèm-fáá 'bad sister'	
dìèm-	dìèm-á	dìèm-mìné	'in-law'	dìèm-fáá 'bad in-law'	
pùr-	pùr-óó	pùr-mìné	'aunt'	pùr-fáá 'bad aunt'	
dàʧì-	dàʧì-ɛ́	dàʧì-mìné	'bro/sis in-law'	dàʧì-fáá 'bad bro/sis in-law'	
ii. *singular: -ba; plural: mine: n=1*					
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
árí-	árí-!bá	árí-mìné	'uncle'	árí-!fáá 'bad uncle'	
iii. *singular: zero; plural: -mine: n=3*					
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
mà-	má	má-mìné	'mother'	mà-fáá 'bad mother'	
bá-	bâ	bá-mìné	'father'	bá-!fáá 'bad father'	
jɔ́ɔ́-	jɔ́ɔ̀	jɔ́ɔ́-mìné	'sibling'	**jɔ́ɔ́**-!fáá 'bad sibling'	

Class 2: singular: V{-i/-ɪ, -e/-ɛ, -o/-ɔ, -u/-ʊ, a}; plural: CV{-ri/-rɪ; ni/-nɪ}: n=84 (Complete set)

Class 2A: singular: V{-i/-ɪ, -e/-ɛ, -o/-ɔ, -u/-ʊ, -a}; plural: -ri/-rɪ	

i.   Singular: -i/-ɪ; plural: -ri/-rɪ: n=8

Root	Singular	Plural	Gloss	Evidence for root choice	
vĭg-	vĭg-ì	vĭg-rì	'owl'	vĭg-bílé 'little owl'	
sìg-	síg-í	síg-rí	'hut'	sìg-bílé 'small hut'	
bìg-	bìg-í	bìg-rí	'law'	bìg-fáá 'bad law'	
pὲg-	pέg-í	pέg-rí	'shell'	pὲg-bílé 'small shell'	
Ɂέg-	Ɂέg-ì	Ɂέg-rì	'crocodile'	Ɂέg-!bílé 'small crocodile'	
dóg-	dóg-ì	dóg-rì	'pot'	dóg-!bílé 'small pot'	
bòg-	bòg-í	bòg-rí	'hole'	bòg-bílé 'small hole'	
ɲòbòg-	ɲòbòg-í	ɲòbòg-rí	'nose'	ɲòbòg-bílé 'small nose'	

ii.   Singular: -e/-ɛ; plural: -ri/-rɪ: n=13

Root	Singular	Plural	Gloss	Evidence for root choice	
gbὲ-	gbì-é	gbὲ-rí	'forehead'	gbὲ-bílé 'small forehead'	
dὲ-	dì-é	dὲ-rí	'house/room'	dὲ-bílé 'small house/room'	
pὲ-	pì-ɛ́	pὲ-rí	'basket'	pὲ-bílé 'small basket'	
wὲ-	wì-ɛ́	wὲ-rí	'farm'	wὲ-bílé 'small farm'	
bì-	bí-é	bíí-rí	'child'	bì-fáá 'bad child'	
zì-	zí-é	zíí-rí	'place'	zì-fáá 'bad place'	
pì-	pì-é	pìì-rí	'rock'	pì-bílé 'small rock'	
pì	pí-ɛ́	píí-rí	'roof'	pì-bílé 'small roof'	
sì-	sí-ɛ́	síí-rí	'waist'	sì-fáá bad waist'	
sí	sí-ὲ	síí-rì	'soul'	sí-!fáá 'bad soul'	
tʃĭ-	tʃĭ-ὲ	tʃíí-rì	'squirrel'	tʃĭ-!fáá 'bad squirrel'	
zìg-	zíg-ɛ́	zíg-rí	'back'	zìg-bílé 'small back'	
dàtʃì	dàtʃì-ɛ́	dàtʃìì-rí	'parrot'	dàtʃì-bílé 'small parrot'	

iii.   Singular: -o/-ɔ; plural: -ri/-rɪ: n=18

Root	Singular	Plural	Gloss	Evidence for root choice	
tò-	tù-ó	tò-rí	'baobab tree'	tò-bílé 'small baobab tree'	
dò-	dù-ó	dò-rí	'warthog'	dò-bílé 'small warthog'	
ɲù-	ɲù-ó	ɲùù-rí	'navel'	ɲù-bílé 'small navel'	
sù-	sù-ó	sùù-rí	'knife'	sù-bílé 'small knife'	
dɔ̀	dò-ɔ́	dò-rí	'dawadawa'	dò-bírì 'dawadawa seed'	
gɔ̌-	gǔ-ɔ̀	gòó-rì	'thorn'	gɔ̌-bílé 'small thorn'	
pò-	pó-ɔ́	póó-rí	'stomach'	pò-bílé 'small stomach'	
wò-	wó-ɔ́	wóó-rí	'bag'	wò-bílé 'small bag'	
bò-	bó-ɔ́	bóó-rí	'goat'	bò-bílé 'small goat'	
nɔ́-	nó-ɔ̀	nóó-rì	'chicken/fowl'	nɔ́-!bílé 'small chicken/fowl'	
mɔ̀-	mó-ɔ́	móó-rí	'grass'	mɔ̀-fáá 'bad grass'	
kóg-	kóg-ò	kóg-rì	'mahogany'	kóg-wέgì 'tall mahogany'	
kòg-	kóg-ó	kóg-rí	'chair'	kòg-bílé 'small chair'	
bùg-	bùg-ó	bùg-rí	'silo'	bùg-bílé 'small silo'	
bìríjù-	bìríjù-ó	bìríjùù-rí	'duck'	bìríjù-bílé 'small duck'	
pàsòg-	pasóg-ó	pàsóg-rí	'back'	pàsòg-bílé 'small back'	
pòsòg-	pòsóg-ó	pòsóg-rí	'back'	pòsòg-bílé 'small back'	

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jĕntò-	jĕntʊ́-ɔ́	jĕntʊ́ʊ́-rí	'gall bladder'	jĕntò-bílé 'small gall bladder'	
nàʧʊ́ʧʊ̀g-	nàʧʊ́ʧʊ̀g-ɔ́	nàʧʊ́ʧʊ̀g-rí	'ankle'	nàʧʊ́ʧʊ̀g-bílé 'small ankle'	

iv.	*singular: -u/-ʊ; plural: -ri/-rɪ: n=5*				
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
ɲù-	ɲú-ú	ɲúú-rí	'neck'	ɲù-bílé 'small neck'	
wà-	wà-ó	wàà-rí	'yam'	wà-bílé 'small yam'	
sà-	sá-ó	sá-rí	'kind of food'	sà-fáá 'bad food'	
dà-	dà-ó	dàà-rí	'stick'	dà-bílé 'small stick'	
zùg-	zúg-ú	zúg-rí	'python'	zùg-bílé 'small python'	

v.	*singular: a; plural: -ri/-rɪ: n=16*				
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
ɲá-	ɲá-à	ɲáá-rì	'chest'	ɲá-!bílé 'small chest'	
bà-	bà-á	bà-rí	'river'	bà-bílé 'small river'	
bà-	bá-á	báá-rí	'dog'	bà-bílé 'small dog (puppy)'	
dà-	dà-á	dà-rí	'market'	dà-bílé 'small market'	
kàtá-	kàtá-à	kàtáá-rì	'cobra'	kàtá-!bílé 'small cobra'	
bàg-	bág-á	bág-rí	'shoulder'	bàg-bílé 'small shoulder'	
dág-	dág-à	dág-rì	'box'	dág-!bílé 'small box'	
zàg-	zàg-á	zàg-rí	'courtyard'	zàg-bílé 'small courtyard'	
gbàg-	gbág-á	gbág-rí	'basket'	gbàg-bílé 'small basket'	
gbàg-	gbàg-à	gbàg-rì	'lizard'	gbàg-bílé 'small lizard'	
dàbág-	dàbág-à	dàbág-rì	'teak'	dàbág-!bílé	
sínsàg-	sínság-á	sínság-rí	'rattle'	sínsàg-bílé 'small rattle'	
kálínkà-	kálínká-à	kálínkáá-rì	'wasp'	kálínkà-bílé 'small wasp'	
gàlíŋgà-	gàlíŋgá-à	gàlíŋgáá-rì	'crow'	gàlíŋgà-bílé 'small crow'	
dèbúósà-	dèbúósá-á	dèbúósáá-rí	'dragonfly'	dèbúósà-bílé 'small dragonfly'	
gŏŋgòmbág-	gŏŋgòmbág-á	gŏŋgòmbág-rí	'praying mantis'	gŏŋgòmbág-bílé 'small mantis'	

Class 2B: singular: V{-e/-ɛ, -o/-ɔ, -a}; plural: -ni/-nɪ

i.	*singular: -e/-ɛ; plural: -nɪ: n=6*				
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
ʔìŋ-	ʔíŋ-ɛ́	ʔín-ní	'body'	ìɱ-fáá 'bad body'	
tìŋ-	tíŋ-ɛ́	tín-ní	'town/ground'	tìm-bílé 'small town/ground'	
jèŋ-	jèŋ-é	jèn-ní	outside'	jèɱ-fáá 'bad outside'	
lìŋ-	líŋ-é	lín-ní	'lid (of bowl)'	lìm-bílé 'small lid'	
zòmìŋ-	zòmìŋ-ɛ́	zòmìn-ní	'friend'	zòmìɱ-fáá 'bad friend'	
gbèlìŋ-	gbèlìŋ-é	gbèlìn-ní	'bell'	gbèlìm-bílé 'small bell'	

ii.	*singular: -o/-ɔ; plural: -nɪ: n=12*				
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
dùŋ-	dúŋ-ó	dún-ní	'animal'	dùɱ-fáá 'bad animal'	
lŏŋ-	lŏŋ-ò	lŏn-nì	'hour.drum'	lŏm-bílé 'small hourglass drum'	
gòŋ-	gòŋ-ó	gòn-ní	'silk cotton'	gòm-bílé 'small silk cotton'	
dòŋ-	dòŋ-ɔ́	dún-ní	'mosquito'	dòm-bílé 'small mosquito'	
bòŋ-	bòŋ-ɔ́	bòn-ní	'donkey'	bòm-bílé 'small donkey'	
ʔòŋ-	ʔòŋ-ɔ́	ʔòn-ní	'mouse'	ʔòm-bílé 'small mouse'	

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Root	Singular	Plural	Gloss	Evidence for root choice	
fɔ́ŋ-	fɔ́ŋ-ɔ̀	fɔ́n-nì	'section/suburb'	fɔ́m-!bílé 'small suburb/section'	
lɔ̀ŋ-	lɔ́ŋ-ɔ́	lɔ́n-ní	'frog'	lɔ̀m-bílé 'small frog'	
sɔ̀ŋ-	sɔ́ŋ-ɔ́	sɔ́n-ní	'basket (a kind)'	sɔ̀m-bílé 'small basket'	
kɔ̀rìŋ-	kɔ̀rìŋ-ɔ́	kɔ̀rìn-ní	'partridge'	kɔ̀rìm-bílé 'small patridge'	
bùrùŋ-	bùrùŋ-ó	bùrùn-ní	'zebra'	bùrìm-bílé 'small zebra'	
nàpúlòŋ-	nàpúlòŋ-ó	nàpúlòn-ní	'calf'	nàpúlòm-bílé 'small calf'	

iii.   singular: -a; plural: -nɪ: n= 5

Root	Singular	Plural	Gloss	Evidence for root choice	
bàŋ-	bàŋ-á	bàn-ní	'lizard'	bàn-dáá 'male lizard'	
tàŋ-	táŋ-á	tán-ní	'mountain'	tàm-bílé 'small mountain'	
gàŋ-	gàŋ-á	gàn-ní	'kraal'	gàŋ-kpɛ̂ŋ 'big kraal'	
nàŋ-	náŋ-á	nán-ní	'scorpion'	nàm-bílé 'small scorpion'	
bàŋ-	báŋ-á	bán-ní	'bracelet'	bàm-bílé 'small bracelet'	

Class 3: singular: -ɪ/-ɪɪ; plural: V: n=47

i.   singular: -i/-ɪ; plural: -e/-ɛ: n=18

Root	Singular	Plural	Gloss	Evidence for root choice	
bìr-	bìr-í	bìr-ɛ́	'breast'	bìr-bílé 'small breast'	
ʔííl-	ʔííl-!íí	ʔííl-ɛ̀	'horn'	íìl-bílé 'small horn'	
dʒìíl-	dʒìíl-íí	dʒìíl-è	'vein'	dʒìíl-bílé 'small vein'	
dʒél-	dʒél-!íí	dʒél-è	'egg'	dʒél-!fáá 'bad egg'	
jèl-	jél-í	jél-ɛ́	'issue'	jèl-bílé 'smal issue'	
sìèn-	síén-íí	síém-ɛ́	porcupine'	sìèm-bílé 'small porcupine'	
tìèn-	tìèn-í	tìèm-ɛ́	'beard'	tìèm̩-fáá 'bad beard'	
pèn-	pèn-í	pèm-ɛ́	'abdomen'	pèm-bílé 'small abdomen'	
nén-	nén-ì	ném-ɛ̀	'meat'	ném-!bílé 'small meat'	
kpèr-	kpér-íí	kpér-éé	'gizzard'	kpèr-bílé 'small gizzard'	
fèr-	fér-íí	fér-éé	'air potato'	fèr-bílé 'small air potato'	
kɔ̀r-	kɔ̀r-í	kɔ̀-ɛ́	'pocket'	kɔ̀r-bílé	
ŋmín-	ŋmín-ì	ŋmím-ɛ̀	'deity'	ŋmím-!fáá 'bad deity'	
nàfìr-	nàfír-íí	nàfír-ɛ́ɛ́	'hoof'	nàfìr-bílé 'small hoof'	
zùpìl-	zúpíl-í	zúpíl-é	'hat/cap'	zùpìl-bílé 'small hat/cap'	
díndìgl-	díndígl-í	díndigl-é	'eel'	díndìgl-bílé 'small eel'	
mùntʃèl-	mùntʃél-í	mùntʃél-é	'buttock'	mùntʃèl-bílé	
zámákpíkpìr-	zámákpíkpìr-í	zámákpíkpìr-é	'black bat'	zámákpíkpìr-bílé 'small black bat'	

ii.   singular: -i/-ɪ; plural: -e/-ɛ: n=15

Root	Singular	Plural	Gloss	Evidence for root choice	
mùn-	mún-í	mún-ó	'bottom'	mùm-bílé 'bottom'	
pòl-	pòl-í	pòl-ó	'path'	pòl-bílé 'small path'	
dʒùgl-	dʒùgl-ì	dʒùgl-ò	'vulture'	dʒùgl-bílé 'small vulture'	
jùòn-	jùòn-í	jùòm-ó	'year'	jùòn-fáá 'bad year'	
dòɔ́l-	dòɔ́l-íí	dòɔ́l-ɔ̀	'mudfish'	dòɔ́l-bílé 'small mudfish'	
bùfùl-	bùfùl-í	bùfùl-ó	'leech'	bùfùl-jágà 'many leeches'	
tʃókòl-	tʃókòl-í	tʃókòl-ó	'spoon'	tʃókòl-bílé 'small spoon'	

dòpùùr-	dòpúúr-í	dòpúúr-ó	'flower'	dòpùùr-vìèláá 'beautiful flower'	
dùŋkùn-	dùŋkùn-í	dùŋkùm-ó	'knee'	dùŋkùm-bílé 'small knee'	
dàŋgòl-	dàŋgól-í	dàŋgól-ó	'cudgel'	dàŋgòl-bílé 'small cudgel'	
nòmúòl-	nòmùól-íí	nòmùól-ò	'yolk'	nòmúòl-bílé 'small yolk'	
dàndùl-	dàndúl-í	dàndúl-ó	'maggot'	dàndùl-jágà 'many maggots'	
sòlùòn-	sòlùòn-í	sòlùòm-ó	'sky'	sòlùòn-vìèláá 'beautiful sky'	
gòlìŋgúòl-	gòlìŋgùól-íí	gòlìŋgùól-ò	'milipede'	gòlìŋgúòl-bílé 'small milipede'	
dǎ̀ǎ̀gòòn-	dǎ̀ǎ̀gòòn-í	dǎ̀ǎ̀gòòm-ó	'wall'	dǎ̀ǎ̀gòòm-bílé 'small wall'	

iii. *singular: -i/-ɪ; plural: a: n= 14*

Root	Singular	Plural	Gloss	Evidence for root choice	
pàn-	pán-í	pám-á	'door'	pàm-bílé 'small door'	
màn-	màn-í	màm-á	'sea/ocean'	màm-bílé 'small sea'	
gbán-	gbán-ì	gbám-à	'skin/leather'	gbám-bílé 'small leather'	
ŋmàn-	ŋmán-í	ŋmám-á	'calabash'	ŋmàm-bílé 'small calabash'	
ŋmǎn-	ŋmǎn-íí	ŋmǎm-à	'dove'	ŋmǎm-bílé 'small dove'	
ŋmá-	ŋmá!n-íí	ŋmám-à	'fruit'	ŋmám-!bílé 'small fruit'	
vààl-	váál-í	váál-á	'leaf'	vààl-zìè 'red leaf'	
kpàgl-	kpágl-í	kpágl-á	'bedbug'	kpàgl-bílé 'small bedbug'	
gbángbàl-	gbángbál-í	gbángbál-á	'compound'	gbángbàl-kpêŋ 'big compound'	
kpànkpàn-	kpànkpàn-í	kpànkpàm-á	'arm'	kpànkpàm-bílé 'small arm'	
kámáán-	kámáá!n-í	kàmáán-à	'maize'	kámáán-nòóŋ 'sweet maize'	
sémáán-	sémáá!n-í	sémáán-à	'pepper'	sémáán-jágà 'plenty pepper'	
dànkpàl-	dànkpàl-í	dànkpàl-á	'walk.stick'	dànkpàl-bílé 'small walk stick'	
làmbààl-	làmbààl-í	làmbààl-á	'tribal mark'	làmbààl-bílé 'small tribal mark	

Class 4: singular: -bu/-bʊ; plural: -ri/-rɪ: n=5

Root	singular	plural	gloss	evidence for root choice	
wá-	wáá-!bó	wíí-rì	'snake'	wá-!bílé 'small snake'	
vá-	váá-!bó	váá-rì	'leaf'	vá-!bílé 'small leaf'	
gǒ-	gùó-bú	gùó-rì	'kola'	gǒ-bílé 'small kola'	
gómátì-	gómátìì-bó	gómátìì-rí	'chameleon'	gómátì-bílé 'small chameleon'	
kpòŋkpò-	kpòŋkpó-bú	kpòŋkpó-rí	'cassava'	kpòŋkpò-fáá 'bad cassava'	

Class 5: singular: ∅; plural: -CV{-ri/-rɪ, -ni/-nɪ}: n=15 (count nouns)

i. *Singular: ∅; plural: -ri/-rɪ: n=12*

Root	Singular	Plural	Gloss	Evidence for root choice	
làà-	láá	láá-rí	'bowl'	làà-bílé 'small bowl'	
zû-	zû	zú-rì	'head'	zú-!bílé 'small head'	
wóó-	wóò	wóó-rì	'elephant'	wóó-!bílé 'small elephant'	
jóó-	jóò	jóó-rì	'sibling'	jóó-!bílé 'young sibling'	
dàjùù-	dàjúú	dàjúú-rí	'rat'	dàjùù-bílé 'small rat'	
tùù-	túú	túú-rí	'eagle'	tùù-bílé 'small eagle'	
tùù-	túú	túú-rí	'forest'	tùù-fáá 'bad forest'	
ʧúú-	ʧùù	ʧúú-rì	'month/moon'	ʧúú-gbùlí 'full moon/month'	

làntà-	làntá	làntá-rí	'tree squirrel'	làntà-bílé 'small tree squirrel'	
gálíŋgà-	gálíŋgá	gálíŋgá-rí	'garden'	gálíŋgà-bílé 'small garden'	
màrífà-	màrífà	màrífà-rí	'gun'	màrífà-bílé 'small gun'	
tílèntò-	tí!léntó	tí!léntó-rí	'hornbill'	tílèntò-bílé 'small hornbill'	

ii.   Singular:Ø; plural: -ni/-nɪ: n=3

Root	Singular	Plural	Gloss	Evidence for root choice	
kɔ̀lʊ̀ŋ-	kɔ̀lʊ́ŋ	kɔ̀lʊn-ní	'well'	kɔ̀lʊ̀n-zùlúŋ 'deep well'	
tònzûŋ-	tònzûŋ	tònzún-nì	'headpad'	tònzúm-bílé 'small headpad'	
kòríndʒòŋ-	kòrín!dʒóŋ	kòrín!dʒón-ní	'harp'	kòríndʒòm-bílé 'small harp'	

Class 6: singular: -ri/rɪ; plural: V, bV: N=67 (count nouns)

i.   singular: -ri/-rɪ; plural: -e/-ɛ: n=53

Root	Singular	Plural	Gloss	Evidence for root choice	
jí-	jí-rì	jí-è	'house/home'	jí-!bílé 'small house/home'	
mí-	mí-rì	mí-è	'rope'	mí-!ŋmáá 'short rope'	
pì-	pìì-rí	pì-é	'rock'	pì-bílé 'small rock'	
zè-	zìè-rí	zè-ɛ́	'soup'	zè-nɔ̀ɔ́ŋ 'tasty soup'	
jè-	jìè-rí	jè-ɛ́	'jaw'	jè-bílé 'small jaw'	
nɛ́-	níɛ́-rì	nɛ́-ɛ̀	'grinder'	nɛ́-!bílé	
gbɛ́-	gbɛ́-rì	gbɛ́-ɛ̀	'leg'	gbɛ́-!bílé 'small leg'	
zò-	zóó-rí	zó-ɛ́	'tail'	zò-ŋmáá 'short tail'	
kù-	kùù-rí	kù-é	'hoe'	kù-bílé 'small hoe'	
jó-	júó-rì	jó-è	'name'	jó-!fáá 'bad name'	
pó-	púó-rì	pó-è	'stomach'	pó-!bílé 'stomach'	
pò-	pùò-rí	pò-é	'back'	pò-bílé 'small back'	
kò-	kùò-rí	kò-é	'funeral'	kò-kpêŋ 'big funeral'	
nó-	nóó-rì	nó-è	'mouth'	nó-!fáá 'bad mouth'	
kó-	kóó-rì	kó-ɛ̀	'gourd'	kó-!bílé 'small gourd'	
tò-	tóó-rí	tó-ɛ́	'mortar'	tò-bílé 'small mortar'	
vò-	vóó-rí	vó-ɛ́	'hole/opening'	vò-bílé 'small opening'	
pá-	páá-rì	pɛ́-ɛ̀ (pá-ɛ̀)	'genital'	'pá-!bílé' small genital'	
sá-	sáá-rì	sɛ́-ɛ̀ (sá-ɛ̀)	'broom'	sá-!bílé 'small broom'	
dá-	dá-rì	dɛ́-ɛ̀ (dá-ɛ̀)	'ladder'	dá-!bílé 'small ladder'	
só-	só-rì	só-è	'path'	só-!bílé 'small path'	
síbí-	síbí-rì	síbí-è	'bee'	síbí-jágà 'many bees'	
zǐbí-	zǐbí-rì	zǐbí-è	'millet'	zǐbí-jágà 'plenty millet'	
lìbí-	lìbí-rì	lìbí-è	'money'	lìbí-!bílé 'small money'	
zǐntì-	zǐntí-rí	zǐntí-ɛ́	'tongue'	zǐntì-bílé 'small tongue'	
fíntì-	fíntí-rí	fíntí-ɛ̀	'ring'	fíntì-bílé 'small ring'	
pòntí-	pòntí-rì	pòntí-ɛ̀	'toad'	pòntí-!bílé 'small toad'	
kóntì-	kón!tí-rí	kón!tí-ɛ́	'cheek'	kóntì-bílé 'small cheek'	
nímbí-	nímbí-rì	nímbí-è	'eye'	nímbí-!bílé 'small eye'	
kòkɔ́-	kòkɔ́-rì	kòkɔ́-ɛ̀	'throat'	kòkɔ́-!bílé 'small throat'	
lòmbò	lòmbó-rí	lòmbó-é	'side'	lòmbò-bílé 'small side'	
mùmbí-	mùmbí-rì	mùmbí-e	'anus'	mùmbí-!bílé 'small anus'	
làmbí-	làmbí-rì	làmbí-è	'testicle'	làmbí-!bílé 'small testicle'	
núbì-	núbì-rí	núbì-é	'finger'	núbì-bílé 'small finger'	
síkpèg-	síkpég-rí	síkpég-é	'hip'	Síkpèg-bile 'small hip'	

	Singular	Plural	Gloss	Evidence for stem choice	
gbébì-	gbébì-rí	gbébì-é	'toe'	gbébì-bílé 'small toe'	
zúkɔ́	zúkɔ́ɔ́-rì	zúkɔ́-ɛ̀	'skull'	zúkɔ́-!bílé	
kómbì-	kómbí-rí	kómbí-è	'tomato'	kómbì-bílé 'small tomato'	
súmí-	súmí-rì	'thread'	súmí-è	súmí-!ŋmáá 'short thread'	
tìg-	tíg-rí	tíg-é	'feast'	tìg-kpêŋ 'big feast'	
nébì-	nébì-rì	nébí-è	'grind stone'	nébì-bílé 'small grind stone'	
tàmpó-	tàmpúó-rì	tàmpó-è	'garb. dump'	tàmpúó-bílé small garb.dump'	
tèmbí-	tèmbí-rì	tèmbí-è	'brick'	tèmbí-!bílé 'small brick'	
kpàtì-	kpàtì-rí	kpàtì-ɛ́	'chimpanzee'	kpàtì-bílé 'small chimpanzee'	
sàsí-	sàsí-rì	sàsí-ɛ̀	'grasscutter'	sàsí-bílé 'small grasscutter'	
kàká-	kàká-rì	kàkɛ́-ɛ̀ (kàká-ɛ̀)	'stalk (maize)'	kàká-!ŋmáá 'short stalk'	
nɛ̀ɲí-	nɛ̀ɲí-!rí	nɛ̀ɲí-è	'potato'	nɛ̀ɲí-!bílé 'small potato'	
gbàtà-	gbàtá-rí	gbàtɛ́-ɛ́ (gbàtá-ɛ́)	'pond'	gbàtà-bílé 'small pond'	
sàkpálímbì-	sàkpálímbí-rí	sàkpálímbí-é	'kidney'	sàkpálímbì-bílé 'small kidney'	

ii.   singular: -ri/rı; plural: -o/-ɔ: n=2

	Singular	Plural	Gloss	Evidence for stem choice	
lùg-	lúg-rí	lúg-ó	'pillar'	**lùg**-bílé 'small pillar'	
bàlùg-	bàlùg-rí	bàlùg-ó	'armpit'	**bàlùg**-ɲúú 'smelly armpit'	

iii.   singular: -ri/-rı; plural: a: n=4

Stem	Singular	Plural	Gloss	Evidence for stem choice	
bàg-	bàg-rí	bàg-á	'shrine'	bàg-fáá 'bad shrine'	
ɲàg-	ɲág-rí	ɲág-á	'root'	ɲàg-bílé 'small root'	
síkpág-	síkpág-!rí	síkpág-à	'proverb'	síkpág-!fáá 'bad proverb'	
bàlìŋkpàg-	bàlìŋkpàg-rí	bàlìŋkpàg-á	'tick'	bàlìŋkpàg-bílé 'small tick'	

iv.   singular: -ri/-rı; plural: bV: n=7

Stem	Singular	Plural	Gloss	Evidence for stem choice	
kɔ̀ɔ̀-	kɔ́ɔ́-rí	kɔ́-bó	'bone'	kɔ̀ɔ̀-kpêŋ 'big bone'	
sɔ̀ɔ̀-	sɔ́ɔ́-rí	sɔ́-bó	'liver'	sɔ̀ɔ̀-bílé 'small liver'	
ɲɔ̀ɔ̀-	ɲɔ́ɔ́-rí	ɲɔ́-bó	'intestine'	ɲɔ̀ɔ̀-bílé 'small intestine'	
jɔ̀ɔ̀-	jɔ̀ɔ̀-rí	jɔ̀-bó	'termite'	jɔ̀ɔ̀-bílé 'small termite'	
tɔ̀ɔ̀-	tɔ̀ɔ̀-rì	tɔ̀-bɔ̀	'tobacco'	tɔ̀ɔ̀-jágà 'plenty tobacco'	
tòò-	tòò-rí	tò-bó	'ear'	tòò-bílé 'small ear'	
sìnsòò-	sìnsòò-rí	sìnsò-bó	'grasshopper'	sìnsòò-bílé 'small grasshopper'	

Class 7: singular: -∅, -V, bV; plural: -nɛɛ, -V: n=10 (Mass nouns)

i.   singular: zero; plural: -néé: n=4 (unmarked singular; marked singular)

Stem	Singular	Plural	Gloss	Evidence for stem choice	
dáá-	dáá	dáá-!nɛ́ɛ́	'alcohol (types)'	dáá-zìɛ́ 'pito/red beer'	
káá-	káá	káá-!nɛ́ɛ́	'oil'(types)	káá-!tólóŋ 'hot oil'	
kɔ̀n-	kɔ̀ɔ́	kɔ̀ɔ́-nɛ́ɛ́	'water (types)'	kɔ̀n-sǒŋ 'good water'	
tĩ̀ĩ̀-	tĩ̀ĩ̌	tĩ̀ĩ̌-nɛ́ɛ́	'medicine (types)'	tĩ̀ĩ̌-tɔ́ɔ́ 'bitter medicine'	

ii.   singular: V; plural: -nɛɛ: n=2

Stem	Singular	Plural	Gloss	Evidence for stem choice	

tèn-	tén-í	tén-nέέ	'soil' (types)	tèn-nɔ̀ɔ́ŋ 'fertile soil'	
bέŋ-	bέŋ-ὲ	bén-!néέ	'beans' (types)	bén-zìέ 'red beans'	

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Class 7B: singular: bʊ; plural: V: n=4

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Stem	Singular	Plural	Gloss	Evidence for stem choice	
gbὲm-	gbὲm-bʊ́	gbὲm-έ	'comb (rooster)'	gbὲn-zìέ 'red comb'	
dʒĕn-	dʒĕm-bʊ́	dʒĕn-îi	'groundnut'	dʒĕn-nɔ̀ɔ́ŋ 'sweet groundnut'	
zŏm-	zŏm-bʊ́	zŏm-à	'fish'	zŏm-bílé 'small fish'	
tàm-	tám-bʊ́	tám-á	'bow'	tàm-bílé 'small bow'	

Class 8: singular: aa; plural: -ɪɪ/-ii/-hɪ: n=23 (count nouns)

Stem	Singular	Plural	Gloss	Evidence for stem choice	
ɲìr-	ɲír-áá	ɲír-í	'ant'	ɲìr-bílé 'small ant'	
bìl-	bíl-áá	bíl-íí	'anthill'	bìl-bílé 'small anthill'	
sìl-	sìl-áá	sìl-hí	'hawk'	sìl-bílé 'small hawk'	
kòr-	kòr-áá	kòr-hí	'village'	kòr-bílé 'small village'	
kɔ̀l-	kɔ́l-áá	kɔ́l-hí	'stream'	kɔ̀l-bílé 'small stream'	
gbăl-	gbàl-áà	gbăl-hí	'bamboo'	gbăl-wέgì 'tall bamboo'	
wàl-	wál-áá	wál-hí	'antelope'	wàl-bílé 'small antelope'	
kpăl-	kpàl-àà	kpăl-hí	'sling'	kpăl-bílé 'small sling'	
gɔ̀r-	gɔ́r-áá	gɔ́r-íí	'sickle'	gɔ̀r-bílé 'small sickle'	
bὲr-	bέr-áá	bέr-íí	'trap/poison'	bὲr-bílé 'small trap'	
bàr-	bàr-áá	bàr-íí	'razor'	bàr-bílé 'small razor'	
vùùr-	vúúr-ɔ́ɔ́	vúúr-íí	'bellow'	vùùr-bílé 'small bellow'	
fòôr-	fòôr-àà	fòôr-îi	'lung'	fòôr-bílé 'small lung'	
dààŋ-	dààŋ-áá	dààn-í	'hearth'	dààm-bílé 'small hearth'	
tààŋ-	tááŋ-áá	tààn-í	'shea fruit'	tààm-bílé 'small she fruit'	
pààŋ-	pááŋ-áá	páán-í	'cricket'	pààn-dáá 'male cricket'	
ɲàán-	ɲààn-àà	ɲààn-îi	'wise person'	ɲààm-bílé small wise person'	
jááŋ-	jááŋ-áá	jáá!n-í	'grandchild'	jááŋ-!fáá 'bad grandchild'	
wìèl-	wìèl-áá	wìèl-í	'twin'	wìèl-fáá 'bad twin'	
lòɔ̀r-	lɔ́ɔ́r-áá	lɔ́ɔ́r-íí	'tiger'	lòɔ̀r-bílé 'small tiger'	
sɔ́ɔ̀ŋ-	sɔ́ɔ́ŋ-áá	sɔ́ɔ́!n-í	'rabbit'	sɔ́ɔ́m-bílé 'small rabbit'	
kɔ̀kɔ̌l-	kɔ̀kɔ̀l-àà	kɔ̀kɔ̀l-hí	'cat'	kɔ̀kɔ̌l-bílé 'small cat'	
nàgăn-	nàgàn-áà	nàgàn-îi	'tendon'	nàgăn-bílé 'small tendon'	

Class 9: (nominalized class): n=52 (event nouns)

i.	singular: -bu/-bʊ; no plural: n= 41				
Root	**Singular**	**Plural**	**Gloss**	**Citation form**	
dì-	díí-bú	-	'act of eating'	à dì 'to eat'	
sì-	síí-bʊ́	-	'act of skinning'	à sì 'to skin'	
sέ-	síέ-bʊ̀	-	'act of roasting'	à sέ 'to roast'	
sὲ-	síέ-bʊ́	-	'act of sewing'	à sέ 'to sew'	
dó-	dúó-bù	-	'act of climbing'	à dó 'to climb'	
dɔ́-	dʊ́ɔ́-bɔ̀	-	'act of weeding'	à dɔ́ 'to weed'	
tɔ̀-	tʊ́ɔ́-bʊ́	-	'act of pounding'	à tɔ̀ 'to pound'	
kɔ́-	kʊ́ɔ́-bɔ̀	-	'act of farming'	à kɔ́ 'to farm'	
sɔ́-	sʊ́ɔ́-bɔ̀	-	'act of rubbing'	à sɔ́ 'to rub'	

bɔ́-	bɔ́ɔ́-bò	-	'act of finding'	à bɔ́ 'to find'
pɔ́-	pɔ́ɔ́-bò	-	'act of cursing'	à pɔ́ 'to curse'
zá-	záá-bò	-	'act of throwing'	à zá 'to throw'
ʔá-	ʔáá-bò	-	'act of hating'	à ʔá 'to hate'
vú-	vúú-bù	-	'act of crawling'	à vú 'to crawl'
lé-	líé-bù	-	'act of tying'	à lé 'to tie'
tùò-	túó-bú	-	'act of carrying'	à tùò 'to carry'
jùò-	júó-bú	-	'act of opening'	à jùò 'to open'
jɔ́ɔ́-	jɔ́ɔ́-bò	-	'act of paying'	à jɔ́ɔ́ 'to pay'
jáà-	jáá-!bɔ́	-	'act of revenging'	à jáà 'to revenge'
nár-	nár-bò	-	'getting ready'	à nárí 'to plan/prepare'
vár-	vár-bò	-	'act of castrating'	à várí 'to castrate'
tàg-	tág-bú	-	'act of pulling'	à tàgì 'to pull'
sàg-	ság-bú	-	'act of agreeing'	à sàgì 'to agree'
dòŋ-	dúm-bú	-	'act of biting'	à dòŋ 'to bite'
nòŋ-	nòm-bú	-	'act of liking'	à nòŋ 'to like'
ʧĩ̀l-	ʧĩ́l-!bɔ́	-	'act of slicing'	à ʧĩ́lì 'to slice'
kpììr	kpììr-bú	-	'act of hemming'	à kpììrì 'to hem'
kùr-	kúr-bú	-	'act of fabricating'	à kùrì 'to fabricate'
fír-	fír-bɔ́	-	'act of forcing'	à fírì 'to force/command'
dɔ́g-	dɔ́g-bò	-	'act of cooking'	à dɔ́gí 'to cook'
pùg-	púg-bú	-	'act of praising'	à pùgì 'to praise'
sèg-	sèg-bú	-	'act of dancing'	à sègì 'to dance'
níɛ̀ŋ-	níɛ́m-!bɔ́	-	'act of gridning'	à níɛ̀ŋ 'to grind'
vɔ́l-	vɔ́l-bò	-	'act of swallowing'	à vɔ́lí 'to swallow'
ɲààŋ-	ɲààm-bɔ́	-	'act of being wise'	à ɲààŋ 'to be wise'
kòòr-	kɔ́ɔ́r-bɔ́	-	'act of scratching'	à kòòrì 'to scratch'
kòŋ-	kóm-bú	-	'act of crying'	à kòŋ 'to cry'
bèr-	bér-bú	-	'act of poisoning'	à bèrì 'to poison/trap'
bàl-	bál-bú	-	'getting tired'	à bàlì 'to be tired'
kpɛ̂l-	kpɛ́l-!bɔ́	-	'act of plucking'	à kpɛ́lì 'to pluck'
pɔ̀g-	pɔ́g-bɔ́	-	'act of closing'	à pɔ̀gì 'to close'

ii. singular: -uu/-ʊʊ; no plural: n=9

Root	Singular	Plural	Gloss	Citation form
wììr-	wììr-úú	-	'act of smoking'	à wììrì 'to smoke (e.g. meat)
gùùn-	gùùn-úú	-	'act of stalking'	à gùùnì 'to stalk (e.g. animal)
kòòr-	kòòr-ɔ́ɔ́	-	'act of snoring'	à kòòrì 'to snore'
ŋmòòn-	ŋmòòn-ɔ́ɔ́	-	'act of humming'	à ŋmòònì 'to hum'
fúòl-	fúó!l-úú	-	'act of whistling'	à fúólì 'to whistle'
mààl-	mààl-ɔ́ɔ́	-	'act of making'	à mààlì 'to make'
lîgr-	lígr-!ɔ́ɔ́	-	'act of tickling'	à lígrì 'to tickle'
dɔ̂gr-	dɔ́gr-!ɔ́ɔ́	-	'act of punishing'	à dɔ́grì 'to punish'
sɔ̂gl-	sɔ́g!lɔ́ɔ́	-	'act of hiding'	à sɔ́glì 'to hide'

iii. singular: -nuu/-nʊʊ; no plural: n=2

Root	Singular	Plural	Gloss	Evidence for stem choice
ɲûn-	ɲún-!núú	-	'act of evaporating'	à ɲúnnì 'to evaporate'
tàn-	tàn-nɔ́ɔ́	-	'act of shouting'	à tànnì 'to shout at'

Class 10: (mass nouns): n=6

Root	Singular	Plural	Gloss	Evidence for root choice
bùùl-	-	búúl-úŋ	'porridge'	bùùl 'to stir/cooking' → búúl-úŋ 'a liquid resulting from the act of stirring/cooking – porridge'
vóòr-	-	vóó!r-óŋ	'breath'	vóòr 'breathe' →vóó!r-óŋ 'air from the act of breathing – breath
bààl-	-	bààl-óŋ	'sickness'	bààl 'get soft/weak' → bààl-óŋ 'quality from this act, resulting in sickness'
jààr-	-	jààr-óŋ	'salt'	jààr 'remove/mine' → jààr-óŋ 'some quantity of particles/items obtained from this act – salt
dúòr-	-	dúó!r-úŋ	'urine'	dúòr 'uniate' → dúó!r-úŋ 'liquid resulting from this act – urine
bìr-	-	bìr-óŋ	'milk'	bǐr 'breast' → bìr-óŋ 'liquid that comes from breast – milk

Sub-Appendix B. 2: Tone classes in nouns

A. Regular nouns: simple nouns (root + suffix); regular tone classes

L roots; L-L singular/plural; n=3					
Root	Singular	Plural	Gloss	Evidence for root choice	
tɔ̀ɔ̀- L	tɔ̀ɔ̀-rì LL	tò-bɔ̀ LL	'tobacco'	tɔ̀ɔ̀-jágà 'plenty tobacco'	
gbàg- L	gbàg-à LL	gbàg-rì LL	'lizard'	gbàg-bílé 'small lizard'	
dʒùgl- L	dʒùgl-ì LL	dʒùgl-ò LL	'vulture'	dʒùgl-bílé 'small vulture'	

L roots; L-H singular/plural; n=43					
Root	Singular	plural	Gloss	Evidence for stem choice	
pì- L	pìì-é LH	pìì-rí LH	'rock'	pì-bílé 'small rock'	
ɲù- L	ɲù-ó LH	ɲùù-rí LH	'navel'	ɲù-bílé 'small navel'	
sù- L	sù-ó LH	sùù-rí LH	'knife'	sù-bílé 'small knife'	
dè- L	dì-é LH	dè-rí LH	'house/room'	dè-bílé 'small house/room'	
gbè- L	gbì-é LH	gbè-rí LH	'forehead'	gbè-bílé 'small forehead'	
pè- L	pì-ɛ́ LH	pè-rí LH	'basket'	pè-bílé 'small basket'	
wè- L	wì-ɛ́ LH	wè-rí LH	'farm'	wè-bílé 'small farm'	
dò- L	dù-ó LH	dò-rí LH	'warthog'	dò-bílé 'small warthog'	
tò- L	tù-ó LH	tò-rí LH	'baobab tree'	tò-bílé 'small baobab tree'	
dɔ̀ L	dɔ̀-ɔ́ LH	dɔ̀-rí LH	'dawadawa'	dɔ̀-bírí 'dawadawa seed'	
dà- L	dà-ɔ́ LH	dàà-rí LH	'stick'	dà-bílé 'small stick'	
wà- L	wà-ɔ́ LH	wàà-rí LH	'yam'	wà-bílé 'small yam'	
bà- L	bà-á LH	bà-rí LH	'river'	bà-bílé 'small river'	
dà- L	dà-á LH	dà-rí LH	'market'	dà-bílé 'small market'	
kù- L	kùù-rí LH	kù-é LH	'hoe'	kù-bílé 'small hoe'	
zè- L	zìè-rí LH	zè-ɛ́ LH	'soup'	zè-nòɔ́ŋ 'tasty soup'	
jè- L	jìè-rí LH	jè-é LH	'jaw'	jè-bílé 'small jaw'	
pò- L	pùò-rí LH	pò-é LH	'back'	pò-bílé 'small back'	
kò- L	kùò-rí LH	kò-é LH	'funeral'	kò-kpê ŋ 'big funeral'	
jɔ̀ɔ̀- L	jɔ̀ɔ̀-rí LH	jò-bɔ́ LH	'termite'	jɔ̀ɔ̀-bílé 'small termite'	
tòò- L	tòò-rí LH	tò-bó LH	'ear'	tòò-bílé 'small ear'	
bìg- L	bìg-í LH	bìg-rí LH	'law'	bìg-fáá 'bad law'	
bùg- L	bùg-ó LH	bùg-rí LH	'silo'	bùg-bílé 'small silo'	
bɔ̀g- L	bɔ̀g-í LH	bɔ̀g-rí LH	'hole'	bɔ̀g-bílé 'small hole'	
zàg- L	zàg-á LH	zàg-rí LH	'courtyard'	zàg-bílé 'small courtyard'	
bàg- L	bàg-rí LH	bàg-á LH	'shrine'	bàg-fáá 'bad shrine'	
bàr- L	bàr-áá LH	bàr-íí LH	'razor'	bàr-bílé 'small razor'	
bòŋ- L	bòŋ-ɔ́ LH	bòn-ní LH	'donkey'	bòm-bílé 'small donkey'	
jèŋ- L	jèŋ-é LH	jèn-ní LH	outside'	jèm-fáá 'bad outside'	
gòŋ- L	gòŋ-ó LH	gòn-ní LH	'silk cotton'	gòm-bílé 'small silk cotton'	
ʔɔ̀ŋ- L	ʔɔ̀ŋ-ɔ́ LH	ʔɔ̀n-ní LH	'mouse'	ʔɔ̀m-bílé 'small mouse'	
bàŋ- L	bàŋ-á LH	bàn-ní LH	'lizard'	bàn-dáá 'male lizard'	
gàŋ- L	gàŋ-á LH	gàn-ní LH	'kraal'	gàŋ-kpê ŋ 'big kraal'	
tìèn- L	tìèn-í LH	tìèm-ɛ́ LH	'beard'	tìèn-fáá 'bad beard'	
pèn- L	pèn-í LH	pèm-ɛ́ LH	'abdomen'	pèm-bílé 'small abdomen'	
kɔ̀ n- L	kɔ̀ ɔ́ LH	kɔ̀ɔ̀-nɛ́ɛ́ LH	'water (types)'	kɔ̀n-sɔ̌ ŋ 'good water'	
màn- L	màn-í LH	màm-á LH	'sea/ocean'	màm-bílé 'small sea'	
tɪ̀ɪ - L	tɪɪ LH	tɪ̀ɪ-nɛ́ɛ́ LH	'medicine	tɪ̀ɪ - tʊ́ɔ́ 'bitter medicine'	

			(types)'		
sìl- L	sìl-áá LH	sìl-hí LH	'hawk'	sìl-bílé 'small hawk'	
gbὲm- L	gbὲm-bʊ́ LH	gbὲm-έ LH	'comb (rooster)'	gbὲn-zìέ 'red comb'	
kòr- L	kòr-áá LH	kòr-hí LH	'village'	kòr-bílé 'small village'	
wìèl- L	wìèl-áá LH	wìèl-í LH	'twin'	wìèl-fáá 'bad twin'	
dààŋ- L	dààŋ-áá LH	dààn-í LH	'hearth'	dààm-bílé 'small hearth'	

∅ roots; H-H singular/plural; n=59

Stem	Singular	Plural	Gloss	Evidence for root choice	
bì- L	bíí-é HH	bíí-rí HH	'child'	bì-fáá 'bad child'	
zì- L	zíí-é HH	zíí-rí HH	'place'	zì-fáá 'bad place'	
pì L	pí-έ HH	píí-rí HH	'roof'	pì-bílé 'small roof'	
sì- L	sí-έ HH	síí-rí HH	'waist'	sì-fáá bad waist'	
ɲù- L	ɲú-ú HH	ɲúú-rí HH	'neck'	ɲù-bílé 'small neck'	
bò- L	bʊ́-ɔ́ HH	bʊ́ʊ́-rí HH	'goat'	bò-bílé 'small goat'	
pò- L	pʊ́-ɔ́ HH	pʊ́ʊ́-rí HH	'stomach'	pò-bílé 'small stomach'	
wò- L	wʊ́-ɔ́ HH	wʊ́ʊ́-rí HH	'bag'	wò-bílé 'small bag'	
mò- L	mʊ́-ɔ́ HH	mʊ́ʊ́-rí HH	'grass'	mò-fáá 'bad grass'	
sà- L	sá-ʊ́ HH	sá-rí HH	'kind of food'	sà-fáá 'bad food'	
bà- L	bá-á HH	báá-rí HH	'dog'	bà-bílé 'small dog (puppy)'	
sìèn- L	síén-í HH	síém-έ HH	'porcupine'	sìèm-bílé 'small porcupine'	
sìg- L	síg-í HH	síg-rí HH	'hut'	sìg-bílé 'small hut'	
zò- L	zʊ́ʊ́-rí HH	zʊ́-έ HH	'tail'	zò-ŋmáá 'short tail'	
tò- L	tʊ́ʊ́-rí HH	tʊ́-έ HH	'mortar'	tò-bílé 'small mortar'	
vò- L	vʊ́ʊ́-rí HH	vʊ́-έ HH	'hole/opening	vò-bílé 'small opening'	
kɔ̀ɔ̀- L	kɔ́ɔ́-rí HH	kɔ́-bó HH	'bone'	kɔ̀ɔ̀-kpê ŋ 'big bone'	
sɔ̀ɔ̀- L	sɔ́ɔ́-rí HH	sɔ́-bó HH	'liver'	sɔ̀ɔ̀-bílé 'small liver'	
ɲɔ̀ɔ̀- L	ɲɔ́ɔ́-rí HH	ɲɔ́-bó HH	'intestine'	ɲɔ̀ɔ̀-bílé 'small intestine'	
ɲàg- L	ɲág-rí HH	ɲág-á HH	'root'	ɲàg-bílé 'small root'	
sìg- L	síg-í HH	síg-rí HH	'hut'	sìg-bílé 'small hut'	
zìg- L	zíg-έ HH	zíg-rí HH	'back'	zìg-bílé 'small back'	
pὲg- L	pέg-í HH	pέg-rí HH	'shell'	pὲg-bílé 'small shell'	
kòg- L	kóg-ó HH	kóg-rí HH	'chair'	kòg-bílé 'small chair'	
bàg- L	bág-á HH	bág-rí HH	'shoulder'	bàg-bílé 'small shoulder'	
gbàg- L	gbág-á HH	gbág-rí HH	'basket'	gbàg-bílé 'small basket'	
lìŋ- L	líŋ-é HH	líŋ-ní HH	'lid (of bowl)'	lìm-bílé 'small lid'	
ʔìŋ- L	ʔíŋ-é HH	ʔíŋ-ní HH	'body'	ìm-fáá 'bad body'	
tìŋ- L	tíŋ-έ HH	tíŋ-ní HH	'town/ground'	tìm-bílé 'small town/ground'	
dùŋ- L	dúŋ-ó HH	dúŋ-ní HH	'animal'	dùŋ-fáá 'bad animal'	
dòŋ- L	dɔ́ŋ-ɔ́ HH	dɔ́ŋ-ní HH	'mosquito'	dòm-bílé 'small mosquito'	
lòŋ- L	lɔ́ŋ-ɔ́ HH	lɔ́n-ní HH	'frog'	lòm-bílé 'small frog'	
sòŋ- L	sɔ́ŋ-ɔ́ HH	sɔ́n-ní HH	'basket (kind)'	Sòm-bílé 'small basket'	
bàŋ- L	báŋ-á HH	bán-ní HH	'bracelet'	bàm-bílé 'small bracelet'	
tàŋ- L	táŋ-á HH	tán-ní HH	'mountain'	tàm-bílé 'small mountain'	
nàŋ- L	náŋ-á HH	nán-ní HH	'scorpion'	nàm-bílé 'small scorpion'	
vààl-L	váál-í HH	váál-á HH	'leaf'	vààl-zìέ 'red leaf'	
kpàgl- L	kpágl-í HH	kpágl-á HH	'bedbug'	kpàgl-bílé 'small bedbug'	

pàn- L	pán-í HH	pám-á HH	'door'	pàn-bílé 'small door'	
ŋmàn- L	ŋmán-í HH	ŋmám-á HH	'calabash'	ŋmàn-bílé 'small calabash'	
dɔ̀ɔ̀- L	dɔ́ɔ́ HH	dɔ́-bɔ́ HH	'man,	dɔ̀ɔ̀-fáá 'bad man'	
tùù- L	túú H	túú-rí HH	'eagle'	tùù-bílé 'small eagle'	
tùù- L	túú H	túú-rí HH	'forest'	tùù-fáá 'bad forest'	
làà- L	láá H	láá-rí HH	'bowl'	làà-bílé 'small bowl'	
tèn- L	tén-í HH	tén-nɛ́ɛ́ HH	'soil' (types)	tèn-nòɔ́ŋ 'fertile soil'	
tàm- L	tám-bʊ́ HH	tám-á HH	'bow'	tàm-bílé 'small bow'	
ɲìr- L	ɲír-áá HH	ɲír-í HH	'ant'	ɲìr-bílé 'small ant'	
vùùr- L	vúúr-ɔ́ɔ́ HH	vúúr-íí HH	'bellow'	vùùr-bílé 'small bellow'	
bèr- L	bér-áá HH	bér-íí HH	'trap/poison'	bèr-bílé 'small trap'	
gɔ̀r- L	gɔ́r-áá HH	gɔ́r-íí HH	'sickle'	gɔ̀r-bílé 'small sickle'	
lòɔ̀r- L	lóɔ́r-áá HH	lóɔ́r-íí HH	'tiger'	lòɔ̀r-bílé 'small tiger'	
sìr- L	sír-ɛ́ HH	sír-bá HH	'husband'	sìr-sǒŋ 'good husband'	
sèn- L	sén-í HH	sén-bá HH	'fiancé/fiancée'	sèn-fáá 'bad fiance/fiancee'	
pɔ̀g- L	pɔ́g-ɔ́ HH	pɔ́g-bá HH	'woman'	pɔ̀g-vìláá 'nice woman'	
bìl- L	bíl-áá HH	bíl-íí HH	'anthill'	bìl-bílé 'small anthill'	
kòl- L	kól-áá HH	kól-hí HH	'stream'	kòl-bílé 'small stream'	
wàl- L	wál-áá HH	wál-hí HH	'antelope'	wàl-bílé 'small antelope'	
pààŋ- L	pááŋ-áá HH	páán-í HH	'cricket'	pààn-dáá 'male cricket'	

H roots; H-L singular/plural; n=27

Root	Singular	Plural	Gloss	Evidence for root choice	
dág- H	dág-à HL	dág-rì HL	'box'	dág-!bílé 'small box'	
níŋ- H	ní-ɛ̀ HL	nó-bà HL	'person'	níŋ-fáá 'bad person'	
nó- H	nó-ò HL	nóó-rì HL	'chicken/fowl'	nó-bílé 'small chicken/fowl'	
ɲá- H	ɲá-à HL	ɲáá-rì HL	'chest'	ɲá-!bílé 'small chest'	
ʧúú- H	ʧúù HL	ʧuu-rì HL	'month/moon'	ʧúú-gbùlí 'full moon/month'	
wɔ́ɔ́- H	wɔ́ɔ̀ HL	wɔ́ɔ́-rì HL	'elephant'	wɔ́ɔ́-!bílé 'small elephant'	
jɔ́ɔ́- H	jɔ́ɔ̀ HL	jɔ́ɔ́-rì HL	'sibling'	jɔ́ɔ́-!bílé 'young sibling'	
jí- H	jí-rì HL	jí-è HL	'house/home'	jí-bílé 'small house/home'	
zú- H	zû HL	zú-rì HL	'head'	zú-!bílé 'small head'	
mí- H	mí-rì HL	mí-è HL	'rope'	mí-ŋmáá 'short rope'	
né- H	níé-rì HL	né-ɛ̀ HL	'grinder'	né-bílé	
gbɛ́- H	gbɛ́-rì HL	gbɛ́-ɛ̀ HL	'leg'	gbɛ́-bílé 'small leg'	
jó- H	júó-rì HL	jó-è HL	'name'	jó-!fáá 'bad name'	
pó- H	púó-rì HL	pó-è HL	'stomach'	pó-!bílé 'stomach'	
só- H	só-rì HL	só-è HL	'path'	só-!bílé 'small path'	
nɔ́- H	nɔ́ɔ́-rì HL	nɔ́-ɛ̀ HL	'mouth'	nɔ́-!fáá 'bath mouth'	
kɔ́- H	kɔ́ɔ́-rì HL	kɔ́-ɛ̀ HL	'gourd'	kɔ́-!bílé 'small gourd'	
pá- H	páá-rì HL	pɛ́-ɛ̀ (pá-ɛ̀) HL	'genital'	pá-!bílé' small genital'	
sá- H	sáá-rì HL	sɛ́-ɛ̀ (sá-ɛ̀) HL	'broom'	sá-!bílé 'small broom'	
dá- H	dá-rì HL	dɛ́-ɛ̀ (dá-ɛ̀) HL	'ladder'		
dóg- H	dóg-ì HL	dóg-rì HL	'pot'	dóg-!bílé 'small pot'	
wég H	wég-ɛ̀ HL	wég-rì HL	'log'	wég-!ŋmáá 'short log'	
kóg- H	kóg-ò HL	kóg-rì HL	'mahogany'	kóg-wégì 'tall mahogany'	
fɔ́ŋ- H	fɔ́ŋ-ɔ̀ HL	fɔ́n-nì HL	'section'	fɔ́m-!bílé 'small suburb/section'	
nɛ́n- H	nɛ́n-ì HL	nɛ́m-ɛ̀ HL	'meat'	nɛ́m-!bílé 'small meat'	
gbán- H	gbán-ì HL	gbám-à HL	'skin/leather'	gbám-bílé 'small leather'	

<div align="center">

LH roots; LH-L singular/plural; n=7
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Root	Singular	Plural	Gloss	Evidence for root choice	
gǒ- LH	gǒ-ɔ̀ LH-L	gòó-rì LH-L	'thorn'	gǒ-bílé 'small thorn'	
vǐg- LH	vǐg-ì LH-L	vǐg-rì LH-L	'owl'	vǐg-bílé 'little owl'	
lǒŋ- LH	lǒŋ-ò LH-L	lǒn-nì LH-L	'hour.drum'	lǒm-bílé 'small hourglass drum'	
dɛ̌g- LH	dɛ̌g-rì LH-L	dɛ̌g-ɛ̀ LH-L	'dirt'		
gbǎl- LH	gbàl-áà LH-L	gbǎl-hí LH-L	'bamboo'	gbǎl-wɛ́gì 'tall bamboo'	
kpǎl- LH	kpàl-áà LH-L	kpǎl-hì LH-L	'sling'	kpǎl-bílé 'small sling'	
ɲàán- LH	ɲààn-áà LH-L	ɲààn-íì LH-L	'wise person'	ɲààm-bílé small wise person'	

<div align="center">

HL roots; H-!H singular/plural; n=1
H root; H-!H singular/plural; n=1
</div>

Root	Singular	Plural	Gloss	Evidence for root choice	
sɔ́ɔ̀ŋ- HL	sɔ́ɔ́!ŋ-áá H!H	sɔ́ɔ́!n-í H!H	'rabbit'	sɔ́ɔ̀m-bílé 'small rabbit'	
jááŋ- H	jáá!ŋ-áá H!H	jáá!n-í H!H	'grandchild'	jááŋ-!fáá 'bad grandchild'	

B. Nominalisations (nouns derived from verbs)

    i.   L roots; L-H derived nouns; n=8

Root	Derived noun		Gloss	Citation form	
kpììr L	kpììr-bú LH	-	'act of hemming'	à kpììrì 'to hem'	
kòɔ̀r- L	kòɔ̀r-bó LH	-	'act of scratching'	à kòɔ̀rì 'to scratch'	
ɲààŋ- L	ɲààm-bó LH	-	'act of being wise'	à ɲààŋ 'to be wise'	
wììr- L	wììr-úú LH	-	'act of smoking'	à wììrì 'to smoke (e.g. meat)	
kòòr-L	kòòr-óó LH	-	'act of snoring'	à kòòrì 'to snore'	
gùùn- L	gùùn-úú LH	-	'act of stalking'	à gùùnì 'to stalk'	
tàn- L	tàn-nóó LH	-	'thundering'	à tànnì 'to thunder'	
mààl- L	mààl-óó LH	-	'act of making'	à mààlì 'to make'	

    ii.   L roots; H-H derived nouns; n=19

Root	Derived noun	-	Gloss	Citation form	
dì- L	díí-bú HH	-	'act of eating'	à dì 'to eat'	
sì- L	síí-bó HH	-	'act of skinning'	à sì 'to skin'	
kò- L	kóó-bó HH	-	'act of giving'	à kò 'to give'	
tùò- L	túó-bú HH	-	'act of carrying'	à tùò 'to carry'	
jùò- L	júó-bú HH	-	'act of opening'	à jùò 'to open'	
sɛ̀- L	síɛ́-bó HH	-	'act of sewing'	à sɛ́ 'to sew'	
tɔ̀- L	tɔ́ɔ́-bó HH	-	'act of	à tɔ̀ 'to pound'	

Root	Derived noun		Gloss	Citation form	
			pounding'		
fìr- L	fír-bɔ́ HH	-	'act of forcing'	à fìrì 'to force/command'	
kùr- L	kúr-bú HH	-	'act of fabricating'	à kùrì 'to fabricate'	
bɛ̀r- L	bɛ́r-bɔ́ HH	-	'act of poisoning'	à bɛ̀rì 'to poison/trap'	
bàl- L	bál-bɔ́ HH	-	'getting tired'	à bàlì 'to be tired'	
pùg- L	púg-bú HH	-	'act of praising'	à pùgì 'to praise'	
sɛ̀g- L	sɛ́g-bɔ́ HH	-	'act of dancing'	à sɛ̀gì 'to dance'	
pɔ̀g- L	pɔ́g-bɔ́ HH	-	'act of closing'	à pɔ̀gì 'to close'	
tàg- L	tág-bɔ́ HH	-	'act of pulling'	à tàgì 'to pull'	
sàg- L	ság-bɔ́ HH	-	'act of agreeing'	à sàgì 'to agree'	
dòŋ- L	dɔ́m-bɔ́ HH	-	'act of biting'	à dòŋ 'to bite'	
nòŋ- L	nɔ́m-bɔ́ HH	-	'act of liking'	à nòŋ 'to like'	
kòŋ- L	kɔ́m-bú HH	-	'act of crying'	à kòŋ 'to cry'	

iii.   H roots; H-L derived nouns; n=23

Root	Derived noun		Gloss	Citation form	
vú- H	vúú-bù HL	-	'act of crawling'	à vú 'to crawl'	
tú- H	túú-bù HL	-	'act of digging'	à tú 'to dig'	
tù- H	túú-bú HH	-	'act of following'	à tù 'to follow'	
dú - H	dúú-bù HL	-	'act of swimming'	à dú 'to swim'	
zú - H	zúú-bù HL	-	'act of stealing'	à zú 'to steal'	
tɔ́- H	tɔ́ɔ́-bò HL	-	'act of insulting'	à tɔ́ 'to insult'	
kɔ́- H	kɔ́ɔ́-bò HL	-	'act of killing'	à kɔ́ 'to kill'	
lé- H	líé-bù HL	-	'act of tying'	à lé 'to tie'	
sɛ́- H	síɛ́-bò HL	-	'act of roasting'	à sɛ́ 'to roast'	
dó- H	dúó-bù HL	-	'act of climbing'	à dó 'to climb'	
dɔ́- H	dɔ́ɔ́-bò HL	-	'act of weeding'	à dɔ́ 'to weed'	
kɔ́- H	kɔ́ɔ́-bò HL	-	'act of farming'	à kɔ́ 'to farm'	
sɔ́- H	sɔ́ɔ́-bò HL	-	'act of rubbing'	à sɔ́ 'to rub'	
bɔ́- H	bɔ́ɔ́-bò HL	-	'act of finding'	à bɔ́ 'to find'	
pɔ́- H	pɔ́ɔ́-bò HL	-	'act of cursing'	à pɔ́ 'to curse'	
jɔ́ɔ́- H	jɔ́ɔ́-bò HL	-	'act of paying'	à jɔ́ɔ́ 'to pay'	
zá- H	záá-bò HL	-	'act of throwing'	à zá 'to throw'	
ʔá- H	ʔáá-bò HL	-	'act of hating'	à ʔá 'to hate'	
nár- H	nár-bò HL	-	'getting ready'	à nárí 'to plan/prepare'	
vár- H	vár-bò HL	-	'act of castrating'	à várí 'to castrate'	
vɔ́l- H	vɔ́l-bò HL	-	'act of swallowing'	à vɔ́lí 'to swallow'	
dɔ́g- H	dɔ́g-bò HL	-	'act of cooking'	à dɔ́gí 'to cook'	

iv.   HL roots; H-!H derived nouns; n=7

Root	Derived noun		Gloss	Citation form	
jáà- HL	jáá-!bʊ́ H!H	-	'act of revenging'	à jáà 'to revenge'	
ʧìil- HL	ʧííl-!bʊ́ H!H	-	'act of slicing'	à ʧíílì 'to slice'	
fúòl- HL	fúó!l-úú H!H	-	'act of whistling'	à fúólì 'to whistle'	
kpê l- HL	kpɛ́l-!bʊ́ H!H	-	'act of plucking'	à kpélì 'to pluck'	
níɛŋ- HL	níém-!bʊ́ H!H	-	'act of gridning'	à níɛ̀ŋ 'to grind'	
dôgr- HL	dʊ́gr-!ʊ́ʊ́ H!H	-	'act of punishing'	à dʊ́grì 'to punish'	
sôgl- HL	sʊ́gl-!ʊ́ʊ́ H!H	-	'act of hiding'	A sʊ́glì 'to hide'	

v.   Simple nouns with irregular tone patters; n=14

Root	Singular	Plural	Gloss	Evidence for root choice	
bɛ́ŋ- H	bɛ́ŋ-è HL	bɛ́n-!nɛ́ɛ̀ H!H	'beans' (types)	bɛ́n-zìɛ́ 'red beans'	
sáán- H	sáán-à HL	sáám-!bá H!H	'stranger'	sáán-!fáá 'bad stranger'	
dáá - H	dáà HL	dáá -!nɛ́ɛ̀ H!H	'alcohol (types)'	dá á -zìɛ́ 'pito/red beer'	
káá - H	káà HL	káá -!nɛ́ɛ̀ H!H	'oil'(types)	káá -tʊ́l!ʊ́ŋ 'hot oil'	
wá-H	wáá!bʊ́ H!H	wíí-rì HL	'snake'	wá-!bílé 'small snake'	
vá-H	váá!bʊ́ H!H	váá-rì HL	'leaf'	vá-!bílé 'small leaf'	
dʒɛ́l- H	dʒɛ́l-!íí H!H	dʒɛ́l-ɛ̀ HL	'egg'	dʒɛ́l-!fáá 'bad egg'	
ʔíil- H	ʔííl-!íí H!H	ʔííl-ɛ̀ HL	'horn'	íil-bílé 'small horn'	
dʒìíl- LH	dʒìíl-íí LH-H	dʒìíl-è LH-L	'vein'	dʒìíl-bílé 'small vein'	
dòɔ́l- LH	dòɔ́l-íí LH-H	dòɔ́l-ɔ̀ LH-L	'mudfish'	dòɔ́l-bílé 'small mudfish'	
ŋmăn- LH	ŋmăn-íí LH-H	ŋmăm-à LH-L	'dove'	ŋmăm-bílé 'small dove'	
gŏ- LH	gùó-bú LH-H	gùó-rì LH-L	'kola nut'	gŏ-bílé 'small kola'	
dʒĕn- LH	dʒĕm-bʊ́ LH-H	dʒĕn-íì LH-L	'groundnut'	dʒĕ n-nòɔ́ŋ 'sweet groundnut'	
zŏm- LH	zŏm-bʊ́ LH-H	zŏ m-à LH-L	'fish'	zŏ m-bílé 'small fish'	

C. Complex/polymorphemic nouns
   i.   Regular tone classes

L roots; L-H singular/plural; n=30

Root	Singular	Plural	Gloss	Evidence for root choice	
dàʧì L	dàʧì-ɛ́ LH	dàʧìì-rí LH	'parrot'	dàʧì-bílé 'small parrot'	
ɲòbòg- L	ɲòbòg-í LH	ɲòbòg-rí LH	'nose'	ɲòbòg-bílé 'small nose'	
pàsòg- L	pàsóg-ó LH	pàsóg-rí LH	'back'	pàsòg-bílé 'small back'	
pòsòg- L	pòsóg-ó LH	pòsóg-rí LH	'back'	pòsòg-bílé 'small back'	
gbèlìŋ- L	gbèlìŋ-é LH	gbèlìn-ní LH	'bell'	gbèlìm-bílé 'small bell'	
zòmìŋ- L	zòmìŋ-ɛ́ LH	zòmìn-ní LH	'friend'	zòmì-fáá 'bad friend'	
bùrìŋ- L	bùrìŋ-ó LH	bùrìn-ní LH	'zebra'	bùrìm-bílé	
kòrìŋ- L	kòrìŋ-ɔ́ LH	kòrìn-ní LH	'partridge'	kòrìm-bílé 'small patridge'	
dèpùùr- L	dèpúúr-í LH	dèpúúr-ó LH	'flower'	dèpùùr-vìèláá 'beautiful flower'	
nàfìr- L	nàfír-íí LH	nàfír-ɛ́ɛ̀ LH	'hoof'	nàfìr-bílé 'small hoof'	
mùnʧèl- L	mùnʧél-í LH	mùnʧél-é LH	'buttock'	mùnʧèl-bílé	
bùfùl- L	bùfùl-í LH	bùfùl-ó LH	'leech'	bùfùl-jágà 'many leeches'	

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dàndùl- L	dàndúl-í LH	dàndúl-ó LH	'maggot'	dàndùl-jágà 'many maggots'	
sə̀lùòn- L	sə̀lùòn-í LH	sə̀lùòm-ó LH	'sky'	sə̀lùòn-vìèláá 'beautiful sky'	
dàŋgòl- L	dàŋgól-í LH	dàŋgól-ó LH	'cudgel'	dàŋgòl-bílé 'small cudgel'	
dùŋkùn- L	dùŋkùn-í LH	dùŋkùm-ó LH	'knee'	dùŋkùm-bílé 'small knee'	
dã̀ã̀gùòn- L	dã̀ã̀gùòn-í LH	dã̀ã̀gùòm-ó	'wall'	dã̀ã̀gùòm-bílé 'small wall'	
làmbààl- L	làmbààl-í LH	làmbààl-á LH	'tribal mark'	làmbààl-bílé 'small tribal mark	
dànkpàl- L	dànkpàl-í LH	dànkpàl-á LH	'walk.stick'	dànkpàl-bílé 'small walk stick'	
kpànkpàn- L	kpànkpàn-íLH	kpànkpàm-áLH	'arm'	kpànkpàm-bílé 'small arm'	
kpòŋkpò- L	kpòŋkpó-bú LH	kpòŋkpó-rí LH	'cassava'	kpòŋkpò-fáá 'bad cassava'	
dàjùù- L	dàjúú LH	dàjúú-rí LH	'rat'	dàjùù-bílé 'small rat'	
làntà- L	làntá LH	làntá-rí LH	'tree squirrel'	làntà-bílé 'small tree squirrel'	
kɔ̀lɔ̀ŋ- L	kɔ̀lɔ́ŋ LH	kɔ̀lɔ́n-ní LH	'well'	kɔ̀lɔ̀n-zùlúŋ 'deep well'	
lòmbò L	lòmbó-rí LH	lòmbó-é LH	'side'	lòmbò-bílé 'small side'	
kpàtì- L	kpàtì-rí LLH	kpàtì-ɛ́ LLH	'chimpanzee'	kpàtì-bílé 'small chimpanzee'	
gbàtà- L	gbàtá-rí LHH	gbàtɛ́-ɛ̀ LHH	'pond'	gbàtà-bílé 'small pond'	
sìnsòò- L	sìnsòò-rí LH	sìnsò-bó LH	'grasshopper'	sìnsòò-bílé 'small grasshopper'	
bàlìŋkpàg-LL	bàlìŋkpàg-rí LH	bàlìŋkpàg-á LH	'tick'	bàlìŋkpàg-bílé 'small tick'	
bàlùg- LL	bàlùg-rí LH	bàlùg-ó LH	'armpit'	bàlùg-ɲúú 'smelly armpit'	

H roots; H-L singular/plural; n=4					
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
síbí- H	síbí-rì HL	síbí-è HL	'bee'	síbí-jágà 'many bees'	
zúkɔ́ H	zúkɔ́ɔ̀-rì HL	zúkɔ́-è HL	'skull'	zúkɔ́-!bílé	
súmí- H	súmí-rì HL	súmíè HL	'thread'	súmí-!ŋmáá 'short thread'	
nímbí- H	nímbí-rì HL	nímbí-è HL	'eye'	nímbí-!bílé 'small eye'	

LH-stems; LHL singular/plural; n=14					
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
kàtá- LH	kàtá-à LHL	kàtáá-rì LHL	'cobra'	kàtá-bílé 'small cobra'	
dàbág- LH	dàbág-à LHL	dàbág-rì LHL	'teak'	dàbág-!bílé	
zìbí- LH	zìbí-rì LHL	zìbí-è LHL	'millet'	zìbí-jágà 'plenty millet'	
lìbí- LH	lìbí-rì LHL	lìbí-è LHL	'money'	lìbí-!bílé 'small money'	
tònzúŋ- LH	tònzúŋ LHL	tònzún-nì LHL	'headpad'	tònzúm-bílé 'small headpad'	
pɔ̀ntí- LH	pɔ̀ntí-rì LHL	pɔ̀ntí-è LHL	'toad'	pɔ̀ntí-bílé 'small toad'	
kɔ̀kɔ́- LH	kɔ̀kɔ́-rì HLH	kɔ̀kɔ́-ɛ̀ HLH	'throat'	kɔ̀kɔ́-bílé 'small throat'	
mùmbí- LH	mùmbí-rì LHL	mùmbí-è LHL	'anus'	mùmbí-bílé 'small anus'	
làmbí- LH	làmbí-rì LHL	làmbí-è LHL	'testicle'	làmbí-bílé 'small testicle'	
tàmpó- LH	tàmpúó-rì LHL	tàmpó-è LHL	'garb. dump'	tàmpúó-bílé small garb.dump'	
tèmbí- LH	tèmbí-rì LHL	tèmbí-è LHL	'brick'	tèmbí-!bílé 'small brick'	
sàsí- LH	sàsí-rì LHL	sàsí-ɛ̀ LHL	'grasscutter'	sàsí-bílé 'small grasscutter'	
kàká- LH	kàká-rì LHL	kàkɛ́-ɛ̀ LHL	'stalk (maize)	kàká-ŋmáá 'short stalk'	
nə̀ɲí- LH	nə̀ɲíí-rí LH	nə̀ɲí-è LHL	'potato'	nə̀ɲí-bílé 'small potato'	

Root	singular	Plural	Gloss	evidence	
HL-stems; HH singular/plural; n=9					
sínsàg- HL	sínság-á HHH	sínság-rí HHH	'rattle'	sínsàg-bílé 'small rattle'	
díndìgl- HL	díndígl-í HH	díndigl-é HH	'electric fish'	díndìgl-bílé 'small eel'	
gbángbàl- HL	gbángbál-í HH	gbángbál-á HH	'compound'	gbángbàl-kpê ŋ 'big compound'	
gálíŋgà- HL	gálíŋgá HH	gálíŋgá-rí HH	'garden'	gálíŋgà-bílé 'small garden'	
fíntì- HL	fíntí-rí HH	fíntí-ɛ́ HH	'ring'	fíntì-bílé 'small ring'	
kómbì- HL	kómbí-rí HH	kómbí-è HH	'tomato'	kómbì-bílé 'small tomato'	
síkpèg- HL	síkpég-rí HH	síkpég-é HH	'hip'	síkpèg-bile 'small hip'	
kóntì- HL	kón!tí-rí H!H	kón!tí-ɛ́ H!H	'cheek'	kóntì-bílé 'small cheek'	
tílèntò- HL	tí!léntó H!H	tí!léntó-rí H!H	'hornbill'	tílèntó-bílé 'small hornbill'	
HL-stems; HL-H singular/plural; n=7					
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
tʃókòl- HL	tʃókòl-í HLH	tʃókòl-ó HLH	'spoon'	tʃókòl-bílé 'small spoon'	
gómátì- HL	gómátìì-bó HLH	gómátìì-rí HLH	'chameleon'	gómátì-bílé 'small chameleon'	
núbì- HL	núbì-rí HLH	núbì-é HLH	'finger'	núbì-bílé 'small finger'	
gbébì- HL	gbébì-rí HLH	gbébì-é HLH	'toe'	gbébì-bílé 'small toe'	
nébì- HL	nébì-rí HLH	nébì-è HLH	'grind stone'	nébì-bílé 'small grind stone'	
zámákpíkpìr- HL	zámákpíkpìr-í HLH	zámákpíkpìr-é HLH	'black bat'	zámákpíkpìr-bílé 'small black bat'	
kálínkà- HL	kálínká-à HLH	kálínkáá-rì HLH	'wasp'	kálínkà-bílé 'small wasp'	
LHL roots; LHLH singular/plural;n=3					
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
bìríjù- LHL	bìríjù-ó LHLH	bìríjùù-rí LHLH	'duck'	bìríjù-bílé 'small duck'	
nàtʃótʃòg- LHL	nàtʃótʃòg-ó LHLH	nàtʃótʃòg-rí LHLH	'ankle'	nàtʃótʃòg-bílé 'small ankle'	
nàpúlòŋ- LHL	nàpúlòŋ-ó LHLH	nàpúlòn-ní LHLH	'calf'	nàpúlòm-bílé 'small calf'	
LHL roots; LHL singular/plural; n=3					
Root	**Singular**	**Plural**	**Gloss**	**Evidence for root choice**	
gàlíŋgà- LHL	gàlíŋgá-à LHL	gàlíŋgáá-rì LHL	'crow'	gàlíŋgà-bílé 'small crow'	
kòkɔ̌l- LHL	kòkɔ̌l-áà LHL	kòkɔ̌l-hí LHL	'cat'	kòkɔ̌l-bílé 'small cat'	
nàgăn- LHL	nàgànáà LHL	nàgàn-íì LHL	'tendon'	nàgăn-bílé 'small tendon'	
kòríndʒòŋ- LHL	kòrín!dʒóŋ LH!H	kòrín!dʒón-ní LH!H	'harp'	kòríndʒòm-bílé 'small harp'	
sàkpálímbì- LHL	sàkpálímbí-rí LH	sàkpálímbí-é LH	'kidney'	sàkpálímbí-bílé 'small kidney'	
jěntò- LHL	jěntó-ó LH	jěntóó-rí LH	'gall bladder'	jěntó-bílé 'small gall bladder'	
dòbúòsà- LHL	dòbúósá-á LH	dòbúósáá-rí LH	'dragonfly'	dòbúósá-bílé 'small dragonfly'	
zǐntì- LHL	zǐ ntí-rí LH	zǐ ntí-ɛ́ LH	'tongue'	zǐ ntí-bílé 'small tongue'	

ii.   Polymorphemic nouns with irregular tones n=6

Root	Singular	Plural	Gloss	Evidence for root choice	
sɛ́máán- H	sɛ́máá!n-íH!H	sɛ́máán-à HL	'pepper'	sɛ́máán-jágà 'plenty pepper'	
kámáán- H	kámáá!n-í H!H	kàmáán-à HL	'maize'	kámáán-nòɔ́ŋ 'sweet maize'	
síkpág- H	síkpág-!rɪ HH!H	síkpág-à HL	'proverb'	síkpág-!fáá 'bad proverb'	
nə̀múòl- LHL	nə̀mùól-íí LH-H	nə̀mùól-ò LHL	'yolk'	nə̀múòl-bílé 'small yolk'	
gə̀lìŋgúòl-LHL	gə̀lìŋgùól-íí LHH	gə̀lìŋgùól-ò LHL	'milipede'	gə̀lìŋgúòl-bílé 'small milipede'	
màrífà- LHL	màrífà LHL	màrífà-rí LHLH	'gun'	màrífà-bílé 'small gun'	