# Modelling baatɔnum perfect morphology in HPSG

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**Abstract**

This paper aims at modelling the perfect morphology in baatɔnum. The perfect is marked both syntactically and morphologically. While the perfect form of the verb selects the indicative pronoun on the syntactic ground, the morphology acts by choosing the appropriate verb stem. The analysis is couched within HPSG.
**Key words**: HPSG, inflection, stem, perfect, stem space.

**Résumé**

Le present article traite de la formation de l'accompli qui est à la fois morphologique et syntaxique. En effet la forme de l'accompli sélectionne le pronom de l'accompli comme sujet. Sur le plan morphologique en revanche, le thème verbal approprié est choisit. L'analyse est conduite dans le modèle HPSG.
**Mots clés** : HPSG, flexion, thème, accompli, espace thématique.

# Modelling baatɔnum perfect morphology in HPSG[1]

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## 0. Introduction

Baatɔnum [bariba] is a Gur language that belongs to the Central South branch according to Manessy (1999). Baatɔnum has a wide extension from Nigeria to Benin and has accordingly several dialects. This article is based on Nikki-Parakou dialect (Welmers 1952). The paper investigates on Baatɔnum perfect morphology which is shown (Soutar 1970 ; Horn 1998 ; Grossenbacher 1974, Horn 1998) to have a great significance in Baatɔnum verb morphology. The perfect is marked both syntactically and morphologically. On the syntactic ground, the perfect verb form selects an indicative pronoun while the morphology chooses the appropriate verb stem. It is indeed shown that the perfect inflection has a phonetically empty suffix following Grossenbacher (1974). In §1 I present Baatɔnum verb structure as well as some problems related to the perfect. A lexeme based account is proposed in §2 within HSPG model. §3 stands for the conclusion.

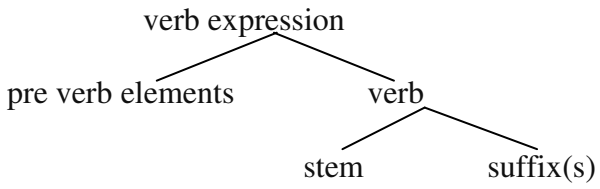
## 1. The data

In this section I will present Baatɔnum verb structure (§1.1), the perfect morphology (§1.2), and a literature review on Baatɔnum perfect morphology (§1.3).

### 1.1 Baatɔnum verb

To describe Baatɔnum verb structure it is necessary to distinguish the verb lexeme from the word following Aronoff (1994). The word is the inflected verb form which is employed in a verb phrase, and therefore involved in a syntactic network. On the other hand the lexeme is an abstract entity. I will refer to the word as the verb expression. The lexeme/word distinction is relevant for Baatɔnum data because various pre verb elements are involved in tense, mood aspect and negation interpretation. Among these pre verb elements are the pronouns which basically mark mood. For the purpose of this paper I assume the simplified verb structure in (1).

(1)




[1] The first version of this paper was presented at the 25th West African Languages Congress. I want to thank Dave Roberts, Kassan Badameli, Gray Plunkett, Koffi Sambiéni and Rémy Bole-Richard for their helpful comments.

As shown by the tree in (1), a verb expression consist of a verb preceded by some pre verb elements and the verb. The verb consists in turn of a stem and one or more suffixes.

Baatɔnum is a non null subject language. The pronoun in the minimal subject. It is the closest element to the verb within the pre verb elements. As noticed above the pronoun bears the basic mood distinction, namely indicative, subjunctive[2] and conditional. The subjunctive pronoun is also used to construct the imperative. The examples in (2) illustrate the three kinds of pronoun.

| | | | | |
|---|---|---|---|---|
| (2) | a. | sá | dā | 'We went' |
| | | 3.PL.IND[3] | go | |
| | b. | sú | dā | 'Let's go' |
| | | 3.PL.SBJ | go | |
| | c. | sàǹ | dā | 'If we go...' |
| | | 3.PL.COND | go | |

A verb stem can be extended either by a derivational or an inflectional suffix. Derivational suffixes undergo recursion unlike inflectional suffixes. As expected, the inflectional suffix is always in last position when cooccuring with a derivational suffix. Following Toungara (1996), Welmers (1952), Gouroubéra (2005), Horn (1998) and Soutar (1970) I present inflectional and derivational suffixes as follows.

| +∅ | +∅ | +ɔ | +a | +de | +e | +e | +e | +mɔ́ | +u | +FV | +o |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SBJ | COND | INC | PERF | EXP | DUR | NEG | HAB | PROG | STA | INF | IMP |

TABLE 1– *Inflectional suffixes* (first version)

| (su)ku | (si)di | (s)ia | ia | ma | na | +∅ | si | da | da | â | sia |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ITERATIVE | | INV | INCH | ALL | REC | TRAN | APP | PAS | ADV | BEN | CAUS |

TABLE 2– *Derivational suffixes*

The inflectional suffixes in greyed cells in table 1 necessitate some comments. Actually perfect, durative, negative, habitual, and stative suffixes are not common to all verb forms. In all cases it is impossible to justify the distributional gaps. This cases are problematic because inflection is formally defined as the phonological part which is common to all words occurring in a given context. For example, the (syncretic) suffix +e occurs only when the final vowel of the verb is –a. In other words, whether one assume a suffixe +e in both three cases there are several exceptions that remain

[2] The third person plural subjunctive pronoun is expletive in simple clauses where it marks the infinitive like 'to' in English. Example : bù d-ā 'aller'
3PL.SBJ aller FV

[3] The following abbreviations symbols are used in this paper: PL: plural, SG: singular, IND: indicative, SBJ: subjunctive, COND: conditional, INC: inceptive, PERF: perfect, EXP: expertive, DUR: durative, NEG: negative, HAB: habitual, PROG: progressive, STA: stative, INF: infinitive, IMP: imperative, FV: final vowel, S: ton super high tone: ṿ́, H: High tone: ́, M: Mid tone: ̄, L: Low tone: ̀, INV: inversive, INCH: inchoative, ALL: allative, REC: reciprocal, TRAN: transitive, APP: applicative, PAS: passive, ADV: adversative, BEN: benefactive, CAUS: causative.

unexplained[4]. The stative suffix has also a restricted distribution. It occurs only in cases where the verb has either CV or CVC shapes. As far as the perfect is concerned, the question is somewhat more complex regarding that the assumed suffix +a has a wider distribution. However, the number of exceptions is greater than the (probable) regular cases. For example, all the derived verbs (except the iterative) block the suffixation of +a. Furthermore, all the borrowed verbs are unchanged when they are used to construct the perfect. It follows that assuming +a as the perfect marker would raise some questions about how to account for productivity since all the productive cases would be exceptional cases. Concerning the infinitive, notice that its marker is a unspecified vowel which can randomly occur as one of the twelve vowels of the language in the case that the verb has a CV shape. In all other cases, infinitive marker is either i, e, a, or u. The quality of the vowel is unpredictable. It appears that whether the infinitive marker is the final vowel, it would be to idiosyncratic to be learned since the quality of this vowel is unpredictable.

In short, the perfect suffix is phonetically null. Borrowings and derived verbs then receive a natural account since they are productive cases. However the varying verb stem are a new problem under this assumption. By the way it is important to explain their occurrence. I will deal about this question in §3. As the perfect, the durative, negative, habitual, stative, and infinitive suffixes are also phonetically empty. Rather than a matter of inflectional suffixes, the stem variation is due to stem selection by morphology as will be argued in §2.2. Table 3 shows the last version of inflectional suffixes where +∅ materialises an empty string.

| +∅ | +∅ | +ɔ | +∅ | +de | +∅ | +∅ | +∅ | +mɔ́ | +∅ | +∅ | +o |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SBJ | COND | ING | PERF | EXP | DUR | NEG | HAB | PROG | STA | INF | IMP |

TABLE 3– *Inflectional suffixes* (last version)

The examples in (3) illustrate the use of some suffixes.

| | | | | |
|---|---|---|---|---|
| (3) | a. | bù | kūr-ē | ‘fold’ |
| | | 3.PL.SBJ | fold FV | |
| | b. | bù | kū–sī̀ā | ‘unfold’ |
| | | 3.PL.SBJ | fold INV | |
| | c. | bá | kúrù+mɔ́ | ‘They are folding…’ |
| | | 3.PL.IND | fold PROG | |

Phonetically, Baatɔnum has four punctual tones: Super high, High, Mid, and Low. Despite the great number of possible tone patterns, only are six are met on simple verb lexemes as illustrated in table 4.

[4] One could argue that this suffix occur only when the verbal has a final +a. Although this explanation seems plausible it isn’t satisfactory at all because the gaps are not motivated neither semantically nor phonologically.

| *Tone pattern* | *Lexeme* | *Glose* |
|---|---|---|
| H | géré | 'say' |
| M | dūūrē | 'plant' |
| HM | búrā | 'cut' |
| HL | tɔ́kè | 'bind' |
| SM | wɛ̃ɛ̄ | 'cocoon' |
| HLM | kpákɪ̀ā | 'rinse' |

TABLE 4– *Verb tone patterns*

## 1.2 The perfect

As we have seen above in §1.1, some pre verb elements are involved in the interpretation of TAMs categories and negation. The perfect form selects an indicative pronoun as its obligatory subject. Furthermore, the verb stem compared to another inflectional categories is (i) extended, (ii) tonally marked, (iii) tonal marked and extended, or (iv) unchanged. Table 5 illustrates the verb stems that are used to construct the perfect.

| # | *Lexeme* | *Glose* | *Perfect* |
|---|---|---|---|
| (i) | tō | 'signpost' | tōbā |
| (ii) | sô | 'beat' | sō |
| (iii) | kpê | 'finish' | kpā |
| (iv) | dɔ́kē | 'put' | dɔ́kē |

TABLE 5– *Some perfect forms*

The case (ii) is illustrated by three verbs : ***kɔ̂*** 'lose/throw', ***sô*** 'beat' et ***gô*** 'kill'. Obviously these cases undergo tonal inflection since the lexical tone is changed in an inflectional paradigm. However, these cases are suppletive inflection because they are totally unpredictable.

The case (iii) is illustrated only by the verb ***sɔ́rɪ̌*** 'pick'. But this lexeme also belongs to the type (i). Consequently there are two free varying forms ***sɔ́rà*** and ***sɔ̄rā*** in Baatɔnum lexicon for the perfect of ***sɔ́rɪ̌*** 'pick'. Case (iv) is the most productive. It concerns all borrowings and derived verbs (except the iterative). I will therefore consider this case as the regular perfect morphology. Examples (4)-(5) illustrate the regular perfect morphology respectively with derived verbs (see (4)) and loanwords (see(5)).

| | | | | |
|---|---|---|---|---|
| (4) | a. | bù | tūrū–mā | 'arrive' |
| | | 3.PL.SBJ | reach ALL | |
| | b. | bá | tūrū–mā | 'They arrived' |
| | | 3.PL.IND | reach ALL PERF | |
| (5) | a. | bù | tùrùnɛ̃ | 'turn' (loanword fr.) |
| | | 3.PL.SBJ | turn INF | |
| | b. | bá | tùrùnɛ̃ | 'They have turned' |
| | | 3.PL.IND | turn PERF | |

Another matter of complexity is the opacity of the verb base in the perfect form when the stem is variable. Table 6 illustrates this phenomenon.

| (6) | *Glose* | *Base-lexeme* | *Perfect* |
|---|---|---|---|
| a. | 'to be able to' | kp̰í | kp̰íá̰ |
| b. | 'dig' | gbé | gbá |
| c. | 'wait' | má̰ | má̰rá |
| d. | 'fry' | sɔ̰mɛ̰́ | sɔ̰ńw̰á̰ |
| e. | 'adore' | sâ̰ | sá̰w̰à̰ |
| f. | 'write' | yórè | yórùà |
| g. | 'do' | kō | kūā |
| h. | 'stand up' | sē | sēēwā |
| i. | 'climb' | yɔ̄ | yɔ̄ɔ̄wā |
| j. | 'plough' | yēwē | yēēwā |

TABLE 6– *Opacity of the verb base*

For expository purpose, I will suppose that the basic form is the elements under *Base-lexeme* column. (6a) is the simplest example because it just suffixes +a to the base. Examples (6b)-(6j) are problematic because verb bases undergo some changes. Before analysing these changes, I will review the previous analyses.

## 1.3 Literature review

Previous approaches of Baatɔnum verb morphology are divided into two main groups; the morpheme based account (Gouroubéra 2005), and the lexeme based account (Grossenbacher 1974 and Welmers 1952).

Gouroubéra (2005) have tempted to derive all inflectional and derivational verb forms from a single basic form in the spirit of Chomsky and Halle (1968). In such an approach the sound changes are systematically due to morphophonological alternations. Invariable verb forms are exceptional unless the suffix is phonetically null. Since Gouroubéra (2005) assumed a suffix +a for the perfect following Horn (1998), all the sound changes are triggered by this suffix. First of all, this analysis is incompatible with the phonetically empty hypothesis that I have assumed in §1.1. Recall that I am assuming here an empty suffix for the perfect. However this is not the only inadequacy of the morphophonological analysis. Most of the sound changes are indeed shown to lack synchronic motivation as well as they are irregular. Moreover even if we assume a phonetically empty suffix under the morphophological analysis, the sound changes would lack motivation contravening the supposed phonological character of morphophonological alternations in the tradition of Chomsky and Halle (1968). To illustrate the puzzle, consider the example in table 7 where the morphophonological processes affecting the final –e verbs are exemplified.

| (7) | *Glose* | *Base-lexeme* | *Perfect* |
|---|---|---|---|
| a. | 'avoid' | s-é | sér+á |
| b. | 'stand up' | s-ē | sēēw+ā |
| c. | 'dig' | gb-é | gb+á |
| d. | 'write' | yór-è | yórù+à |
| e. | 'plough' | yēw-ē | yēēw+ā |

TABLE 7– *Morphophonological processes affecting final –e verbs*

Observing the data in table 7, it is impossible to predict the morphophonological processes from the structure of the base lexeme. In (7a) and (b) for example, there is a

consonant inserted in the surface form. Supposing that the phonological representation can be enriched at some level of representation in order to account for this latent consonant, it is hard to predict its occurrence as *r* or *b*[5]. Apart from that, it is hard to justify why the vowel of the root is lengthened in (7b) and not in (7c), and (7d). Vice versa, it is hard to explain why the final vowel is deleted in (7c) and (7d), and not in (7b). Finally the most problematic case is (7d) where one can observe the e/u alternation which lacks synchronic motivation. It is now obvious that a morpheme based account of Baatɔnum perfect morphology is empirically inadequate. We will now see how it works with the lexeme based account.

Welmers (1952) proposes a lexeme based account of Baatɔnum verb morphology. The basic stem is the infinitive form (what he calls the 'consecutive'). To derive the perfect verb form, Welmers (1952) proposed a set of artificial morphophonological processes appropriated to five basic verb classes illustrated in table 8. While the first class verbs remain invariable, the second class verbs change the final vowel in *a*. The third class verbs add +*wa* to the infinitive verb form while the fourth class change the final vowel in *u* before adding +*a*. Finally the fourth class verbs change their HL tone pattern to M.

| (8) | *Glose* | *Base-Lexeme* | *Perfect* | *Class* |
|---|---|---|---|---|
| a. | 'break' | bú-ā | búā | 1 |
| b. | 'avoid' | s-é | sé+rá | ? |
| c. | 'danse' | y-â | yá+wà | 2 |
| d. | 'stand up' | s-ē | sēē+wā | ? |
| e. | 'dig' | gb-é | gb+á | 3 |
| f. | 'write' | yór-è | yórù+à | 4 |
| g. | 'plough' | yēw-ē | yēē+wā | ? |
| h. | 'beat' | s-ô | sō | 5 |
| i. | 'signpost' | t-ō | tō+bā | ? |
| j. | 'bear' | sɔ́b-é | sɔ́ɔ́+wá | ? |

TABLE 8– *Welmers' verb classes*

At first glance the classification in (8) is problematic since it leaves some verbs unclassified as indicated by the question marks in (8b), (8d), (8g), (8i), and (8j). Additional verb classes are needed. The lexeme based approach is better than the morpheme based approach because it treats more adequately both invariable and variable verb stems. However Welmers' classification is not exhaustive. In actual fact, it is hard to get an exhaustive classification because the number of classes increases as much as idiosyncratic verb behaviours are met without a significant empirical content sometimes. For example, to classify (8b), one would posit a sixth class which suffixes +*ra* to form the perfect. This class contains only four verbs as illustrated in table 9. To classify example (8i), a seventh class would be stipulated that adds +*ba* to the root. This class contains only one member as illustrated in table 9.

[5] *b* occurs in ***tōbā*** the perfect form of ***tō*** 'signpost' for example.

| *Glose* | *Base-lexeme* | *Perfect* | *Class* |
|---|---|---|---|
| 'avoid' | s-é | sé+rá | 6 |
| 'wait' | m-a̰ | ma̰+rá | 6 |
| 'give birth' | m-â̰ | ma̰+rà | 6 |
| 'drink' | n-ɔ̰ | nɔ̰+rá | 6 |
| 'signpost' | t-ō | tō+bā | 7 |

TABLE 9– *Class 6 and 7*

Recall that till now (8d), (8g), and (8j) are left unclassified. This is an additional argument against the verb classes. Grossenbacher (1974) also proposed verb classes with a variant of lexeme based account.

Grossenbacher (1974) assumed that every regular verb has four stem forms. These stems are used to construct both inflectional and derivational rule by means of constructional rules. Again here various morphophonological rules are used to derive the over forms from the basic one (form 1). The morphophonological rules are grouped according to verb classes. The verb forms are illustrated in table 10.

| *Class* | *Form 1* | *Form 2* | *Form 3* | *Form 4* | *Glose* |
|---|---|---|---|---|---|
| 1 | dēr̄i | dēr̄i | dēr̄i | dérî | 'let' |
| 2 | gāwā | gāwā | gāwā | gáwê | 'pull' |
| 3 | sókú | sókú | sóká | sókā́ | 'call' |
| 4 | dūūrē | dūūrū | dūūrā | dúúrê | 'plant' |
| 5 | yórè | yórù | yórùà | yórùà | 'write' |
| 6 | kēwē | kēē | kēēwā | kééwê | 'dry' |
| 7 | sɔ̰mɛ̰ | sɔ̰ń | sɔ̰ńwa̰ | sɔ̰ńwa̰ | 'fry' |

TABLE 10– *Verb stems according to Grossenbacher (1974)*

By using the verb classes approach, Grossenbacher (1974) have the same drawback with Welmers (1952). In this article I will assume a streamlined version of the lexeme based account proposed by Grossenbacher (1974) without the verb classes.

## 2. Analysis

The analysis will first focus on the stem space structure (§2.1). Then I will determine how the stem space is filled (§2.2). Finally an HPSG account of Baatɔnum perfect morphology will be proposed (§2.3).

### 2.1 The stem space

To account for Baatɔnum perfect morphology, it is argued that the morpheme based analysis is inappropriate in §1.3. I will therefore use the lexeme based account using the notion of MORPHOME following Aronoff (1994). According to Aronoff (1994), some morphological units lack semantic and morphosyntactic features. Thereby these stems are pure morphological objects. Following Bonami and Boyé (2002), verb stems can be considered as MORPHOMEs. Each verb comes equipped with given number of stems. Rather than deriving the verb base from a single basic forms, all the stems will be stored in the lexicon. The morphological rule will consist on selecting the appropriate stem involved on a given construction. This approach is motivated by the fact that morphophonological alternations lack synchronic phonological motivation in Baatɔnum perfect morphology. Moreover, these alternations are not regular. Notice that this approach is compatible with the lexeme based account

proposed by Welmers (1952) and Grossenbacher (1974). Anyway I consider that every pair of stem slot is motivated by a phonological distinction[6]. Hence nine stem slots are distinguished rather than four as suggested by Grossenbacher (1974). Table 11 illustrates the stems for dőkē 'put', gāwā 'pull', sókú 'call', dūūrē 'plant', kēwē 'dry' and sɔ̰mɛ̰́ 'fry'.

| *Lexeme* | *St.1* | *St.2* | *St.3* | *St.4* | *St.5* | *St.6* | *St.7* | *St.8* | *St.9* |
|---|---|---|---|---|---|---|---|---|---|
| dőkē | doke | doke | doke | doke | doke | doke | doke | doke | doke |
| gāwā | gaw | gawa | gaw | gawa | gawa | gawa | gawe | gawe | gawe |
| sókú | soku | soka | soku | soku | soku | soku | soku | soku | soka |
| dūūrē | duuru | duura | duuru | duure | duuru | duuru | duure | duura | duure |
| kēwē | kee | keewa | kee | kewe | kee | kee | kewe | keewa | keewe |
| sɔ̰mɛ̰́ | sɔ̰nw̰ | sɔ̰nwa̰ | sɔ̰nw̰ | sɔ̰mɛ̰ | sɔ̰n | sɔ̰n | sɔ̰mɛ̰ | sɔ̰nwa̰ | sɔ̰nwa̰ |

TABLE 11– *Some verb stems*

I will now determine the STEM SPACE, i.e. the way in which the different stems are used to construct the inflectional forms. Table 12 shows the stem space.

| *Stem* | *Inflectional form* |
|---|---|
| Stem 1 | imperative |
| Stem 2 | conditionnal, perfect |
| Stem 3 | inceptive |
| Stem 4 | subjunctive, infinitive |
| Stem 5 | expertive |
| Stem 6 | progressive |
| Stem 7 | habitual |
| Stem 8 | durative |
| Stem 9 | negative |

TABLE 12– *Stem space*

Considering table 11, it is obvious that the stem space is not filled uniformly. For example, the lexeme ***dőkē*** use regularly the same stem to fill all the stem slots. The lexemes ***sɔ̰mɛ̰́*** and ***kēwē*** respectively use four stems to fill their stem spaces. The four stems are distributed differently in every case. Thus the stem space filling strategy must be found.

## 2.2 Filling the stem space

It is assumed that Baatɔnum has nine verb stem slots. There is no verb which has a different stem for every slot. The most idiosyncratic verb has five distinct stems while regular verbs has only one stem. Since the stem space is filled differently even when sometimes verbs has the same number of stems, it is necessary to fix the various ways of filling the stem space. Baatɔnum has twenty-two ways of filling the stem space as shown in table 13. I now turn to the constraints governing the way that the stem space is filled out. I assume that one of the grammar requirements here is functions relating two consecutive stem slots following Giraud (2005) and Bonami and Boyé (2006). These functions are mutually exclusive morphophonological processes stated in (10).

[6] The phonological distinction considered here is only segmental. Tonal features will be treated separately to reduce the complexity of the stem distinction.

(10) a. Stem 1 is identical to stem 2 (regularity) ;
b. Stem 2 is constructed by adding +*a* to stem 1 (irregularity) ;
c. Stem 2 is fully different to stem 1 (suppletion).

Remark that the morphophonological rules in (10) concern the first two stem slots because we are dealing with the perfect. An exhaustive account of Baatɔnum inflectional and derivational morphological would have to determine the functions relating all the stem slots.

The perfect involves both syntax and morphology. Syntactically, the perfect verb stem selects an indicative pronoun. Morphologically, a stem selection operation takes place. An optimal description of Baatɔnum perfect must coordinate these two aspects. Furthermore the semantic aspect must normally be taken into account. Recall that the indicative pronoun is used to construct the perfect. Thus mood and aspect appear to interplay in Baatɔnum. Within the MRS framework it is possible to use scope-underspecified semantic representations to account for apparent mismatches between head NP and semantic composition of mood and aspect. This question is concerned with syntax-semantic interface and will be discussed in a forthcoming paper. In the present paper I will only deal with the morphology-syntax interface. HPSG is well-known to be a suitable framework to interface problems. In the next section I will propose an HPSG account of Baatɔnum perfect morphology.

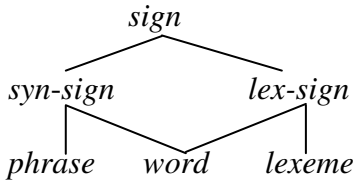
| *Examples* | *St.1* | *St.2* | *St.3* | *St.4* | *St.5* | *St.6* | *St.7* | *St.8* | *St.9* |
|---|---|---|---|---|---|---|---|---|---|
| dēr̄ì ‘let’ | A | A | A | A | A | A | A | A | A |
| géré ‘tell’ | A | C | A | B | A | A | B | C | C |
| gāwā ‘pull’ | A | B | A | B | B | B | C | C | C |
| sókú ‘call’ | A | B | A | A | A | A | A | B | B |
| kēwē ‘dry’ | A | C | A | B | A | A | B | C | D |
| sɔ̰́mɛ̰́ ‘fry’ | A | C | A | B | D | D | B | C | C |
| sē ‘stand up’ | A | C | A | B | D | D | B | C | D |
| tō ‘signpost’ | A | C | A | B | B | B | B | C | D |
| má ‘wait’ | A | C | A | B | B | B | B | C | C |
| dā ‘go’ | A | B | A | B | C | C | D | C | D |
| y̰ì ‘place’ | A | A | B | A | C | C | A | C | A |
| dū ‘enter’ | A | B | A | A | C | C | A | B | D |
| dɔ̰̄m̄ ‘bite’ | A | C | A | B | D | D | B | C | E |
| sɔ̰́ ‘walk’ | A | C | A | B | D | D | E | C | C |
| kɛ̰̄ ‘give’ | A | C | A | B | D | D | B | C | C |
| gbé ‘dig’ | A | B | A | A | C | C | A | D | A |
| sô ‘beat’ | A | C | A | B | D | D | B | D | A |
| tē ‘last’ | A | B | A | B | C | C | B | C | A |
| kpê ‘finish’ | A | C | A | B | D | D | A | E | C |
| kpɔ̰́ ‘be able to’ | A | C | A | B | D | D | A | C | C |
| sɛ̰́ ‘shell’ | A | C | A | B | D | D | B | E | B |
| wé ‘go back home’ | A | C | A | B | D | A | A | D | B |

TABLE 12– *Baatɔnum conjugation patterns*

## 2.3 HPSG modelisation

The basic unit of an HPSG grammar is the linguistic sign which can be a word, a phrase, a constraint involving phonological, semantical, syntactical or discursive information. With some feature structures, it is possible to organise some heterogeneous information in one representation. I assume the following signature.

(11)




a. *syn-sign* → [ PHON *phon*]

b. *phon* → $\begin{bmatrix} \text{SQL} & \langle segments \rangle \\ \text{TON} & \langle tones \rangle \\ \text{VOY} & \langle vowels \rangle \\ \text{CONS} & \langle consonants \rangle \end{bmatrix}$

c. *ton* ⇒ *lex-ton*∨ *gram-ton*

d. *lex-sign* → [M-DTRS *list(lexeme)*]

e. *phrase* → [DTRS *list(syn-sign)*]

f. *word* → [M-DTRS ⟨*(lexeme)*⟩]

g. *lexeme* → [STEMS *stem-space*]

h. *lexeme-v* → $\begin{bmatrix} \text{HEAD} & verb \\ \text{STEMS} & v\text{-}stem\text{-}space \end{bmatrix}$

i. *v-stem-space* → $\begin{bmatrix} \text{SLOT1} & phon \\ \text{SLOT2} & phon \\ \text{SLOT3} & phon \\ \ldots & \end{bmatrix}$

In (11a), I add the feature TON to *phon* (following Bird and Klein 1994) because I am describing a tone language. *ton* dominates *lex-ton* and *gram-ton* to capture the distinction between lexical tone and grammatical tone. *lex-ton* is a default value which maybe overridden when *gram-ton* is specified. It is the case for example with the suppletive inflection which changes HL to M. Moreover, I use the attribute STEMS with its corresponding value *stem-space* in (11g) following Bonami and Boyé (2006) to model the stem space of lexemes. I thereby assume that stem space is a data structure internal to every stem. *v-stem-space* is either *regular*, *irregular or suppletive* regarding the rules in (10). The constraints in (12a), (12b), and (12c) respectively materialise (10a), (10b), and (10c). The regular case is the default constraint.

(12) *v-stem-space* ⇒ *reg*∨*irreg*∨*suppl*

a. *reg* → [SLOT1 [1]; SLOT2 [1]]

b. *irreg* → [SLOT1 [1]; SLOT2 [1] ⊕a]

c. *suppl* → [SLOT1 [1]; SLOT2 [2]]

I assume an hierarchical lexicon in which lexical units are underspecified following Koenig and Jurafsky (1994) and Koenig (1999). Fully specified units are obtained by means of online typing. Inflected words can therefore be materialised by types that are constructed online. To illustrate these types the data in table 5 (repeated in table 11) will be used.

| # | *Lexeme* | *Glose* | *Perfect* |
|---|---|---|---|
| (i) | tō | 'signpost' | tōbā |
| (ii) | sô | 'beat' | sō |
| (iii) | kpê | 'finish' | kpā |
| (iv) | dőkē | 'put' | dőkē |

TABLE 11– *Some perfect forms*

Examples (i)-(iv) correspond to the following types that they instantiate.

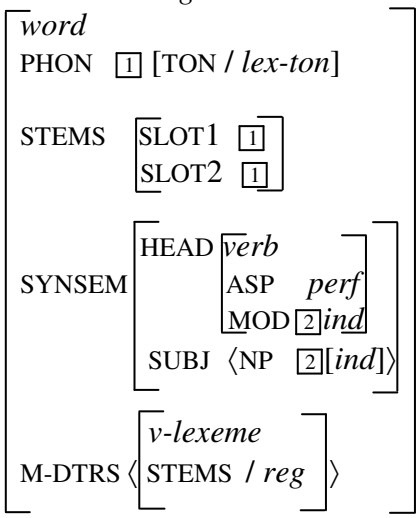
(13) type (i) : *v-lexeme*∧*suppl*∧*lex-ton* : tōbā
type (ii) : *v-lexeme*∧*reg*∧*gram-ton* : sō
type (iii) : *v-lexeme*∧*irreg*∧*gram-ton* : kpā
type (iv) : *v-lexeme*∧*reg*∧ *lex-ton* : dőkē

The perfect form of ***sɔ́rì*** 'pick' is ***sɔ́rà*** or ***sɔ̄rā*** as seen in §1.2. The two forms cohabit in Baatɔnum lexicon. Since online typing is assumed, these cases are easily explained as illustrated in (14).

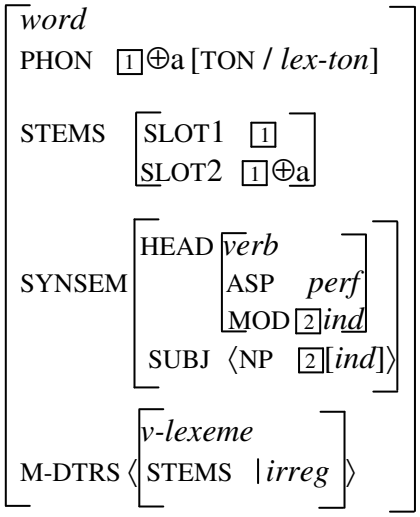
(14) a. *sɔ́rì*∧*irreg*∧*lex-ton* : sɔ́rà
b. *sɔ́rì*∧*irreg*∧*gram-ton* : sɔ̄rā

In (14a), *sɔri*∧*irreg* joins *lex-ton* by default. It follows that the lexical tone pattern of the verb remains. However in (14b), the default constraint is overridden since the lexeme inherits from *gram-ton*. It follows that the perfect form occurs with the suppletive tonal inflection. AVMs in (15a), (15b), and (15c) respectively materialise types *v-lexeme*∧*reg*∧*lex-ton*, *v-lexeme*∧*irreg*∧*lex-ton* and *v-lexeme*∧*suppl*∧*lex-ton*. *v-lexeme*∧*reg*∧*lex-ton* shows the constraint on regular verbs. *lexeme-v*∧*irreg*∧*lex-ton* and *lexeme-v*∧*suppl*∧*lex-ton* respectively account for cases where perfect stem is constructed by adding +a to stem 1, and cases where the perfect stem is totally different from the stem 1. On the over hand, AVMs in (15d) and (15e) represent types *lexeme-v*∧*reg*∧*gram-ton* (see 15d) and *lexeme-v*∧*irreg*∧*gram-ton* (see 15e) where verbs are shown to have a suppletive tonal inflection.

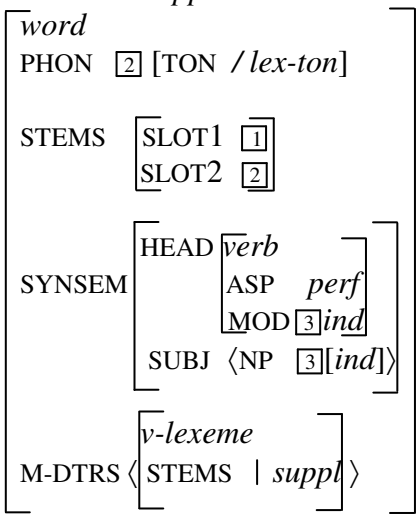
(15)a. *v-lexeme∧reg∧lex-ton* →



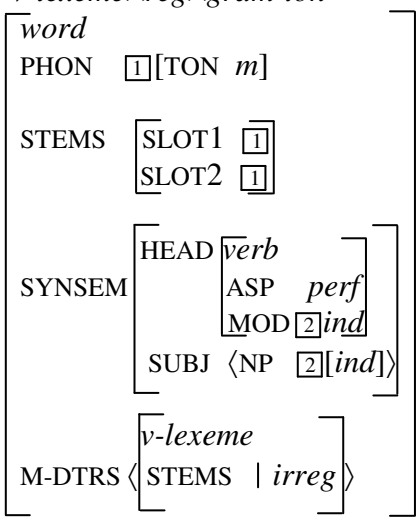

b. *v-lexeme∧irreg∧lex-ton* →



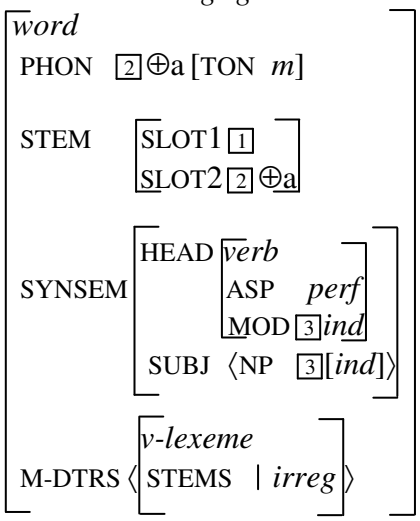

c. *v-lexeme∧suppl∧lex-ton* →



d. *v-lexeme∧reg∧gram-ton* →




e. *v-lexeme∧irreg∧gram-ton* →




## 3. Conclusion

In this paper I assumed that the perfect inflection is a phonetically empty suffix. A lexeme based account of Baatɔnum perfect morphology is proposed. It is shown that the perfect involves both syntax and morphology. By mean of a syntactic rule, the perfect verb stem selects an indicative pronoun while a stem selection operation governed by morphology takes place. Moreover the phenomenon is assumed to have a semantic import which is ignored here. On the morphological ground the stem space is modelled considering only two slots. An exhaustive analysis of the inflectional and derivational system will naturally use a larger stem slots.

## References


Aronoff, M. 1994. *Morphology by itself*. MIT Press, Cambridge.

Bird, S. & Klein, E. 1994. 'Phonological analysis in typed feature system', *Computational Linguistics 20: 55-90.*

Bonami, O. & Boyé, G. 2002. Suppletion and stem dependency in inflectional morphology. In Frank van Eynde., Hellan Lars, and Dorothee Beerman. (eds). *The Proceedings of the HPSG'01 Conference*. CSLI Publications, Stanford.

Bonami, O. & Boyé, G. 2006. Deriving inflectional irregularity. In Stefan Müller (ed). *The Proceedings of the HPSG'06 Conference*. CSLI Publications, Stanford.

Chomsky, N. & Halle, M. 1968. *The sound pattern of English*. Harper & Row.

Doneux, J.-L. 1965. Eléments pour une esquisse de la langue baatɔnum (bariba), 28p.

Guiraud, A. 2005. A detailed treatment of suppletion of french verbal morphology. Paper read at the Second International Workshop on Constraint-Based Grammar, University of Bremen.

Gouroubéra, S. 2005. Une approche morphophonologique du baatɔnum, mémoire de DEA, FLASH/UAC, Cotonou.

Grossenbacher, J.P. 1974. Abrégé de grammaire bariba. IPRAS, Parakou.

Koenig, J.P.1999. Lexical Relations. CSLI Publications, Stanford.

Koenig, J.P.& Jurafsky, D.1994. 'Type Underspecification and On-line type Construction in the Lexicon'. Proceedings of the 13th WCCFL. CSLI Publications, Stanford.

Horn, U. 1998. 'A propos de la morphologie verbale du baatɔnum', *Gur Papers/Cahiers Voltaïques 3 : 33-55.*

Soutar, 1970a. Bariba Grammar Summary, Polyc. 64p.

Toungara, D. 1996. Le système verbal du baatɔnum, mémoire de maîtrise, FLASH/UNB.

Welmers, W.E. 1952. 'Notes on the structure of bariba'. *Language 28, 1: 82-103*.