A Default Inference Rule Operating Internally to the Grammar Devices

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Abstract. Minimalist Grammars (MG) are viewed as a resource consuming system where syntactic operations are triggered when a positive form of a feature matches with its negative form. But a problem arises when a feature lacks a positive/negative value. For the latter case, we introduce a default inference rule in order to account for the underspecification of the feature in a lexical entry.

Keywords: minimalist grammars, feature underspecification, default logic.

1 Introduction

In Bantu syntax, the computational system only needs a noun class formal feature to proceed analysis. Noun classes are sets of words that trigger the same agreement schema. Ewondo (Bantu, A72a)[1] has 14 noun classes[2]. The choice

Table 1. Agreement Marker & Gender in Ewondo

Gender	Classes	Class morpheme	Agr marker on verb	Agr marker on adj
Gender I	1,2	ǹ- ∼ø- / bə-	á-(À) / bə́-	á-(À) / bə́-
Gender II	3,4	ǹ- / mì-	ó- / mí-	ó- / mí-
Gender III	5,6	à- / mə̀-	á- *ĺə́- *də́- / mə́-	á- *ĺə́- *də́- / mə́-
Gender IV	7,8	è- / bì-	é- / bí-	é- / bí-
Gender V	9,10	n- / n-	é-(À) / é-	é-(À) / é-
Gender VI	9,2	n- / bə-	é-(À) / bə́-	é-(À) / bə́-
Gender VII	9,6	n- / mə̀-	é-(À) / mə́-	é-(À) / mə́-
Gender VIII	11,5	ò- / à-	ó- / á- *ĺə́- *də́-	ó- / á- *ĺə́- *də́-
Gender IX	11,6	ò- / mə̀-	ó- / mə́-	ó- / mə́-
Gender X	19	vì-	ó-	ó-

[1] [Gu1] alphanumeric coding (of bantu languages) is mainly geographic. Nevertheless, the distribution (of languages) is done in zones A, B, ... whether the language has kept a tone model closed to Proto-bantu.

[2] More information on classes pairing can be found in [On1]. Two locatives noun classes are to be added to Table 1 , namely cl16 (`v-, à-`) and cl17 (`ò-`).

of a noun class prefix indicates whether the noun is viewed as a unit or a set of units. Except for locatives (cl16, cl17), even-numbered noun classes indicate `augmented (AUG)` and odd-numbered are for `minimal (MIN)`[3]. As it can be seen in Table 1, each class has a different class morpheme that triggers a different agreement morpheme feature; except for nouns of classes 9, 10 that share the same class feature.

(1) 1.

mɔ́ngɔ́	*áku*	*ám̀boo*
m-ɔ́ngɔ́	á-a-ku	á-m̀boo
1MIN-child	AGR1-past1-fall down	AGR1-lay flat

‘the child falled down and laid flat’

2.

bɔ́ngɔ́	*bə́ku*	*bə́m̀boo*
b-ɔ́ngɔ́	bə́-a-ku	bə́-m̀boo
2AUG-child	AGR2-past1-fall down	AGR2-lay flat

‘the children falled down and laid flat’

(2) 1.

ɲag	*yàdì*	*bílɔ̀g*
ɲag	yə̀-à-dì	bí-lɔ̀g
9MIN.cow	AGR9-Pres-eat	8AUG-grass

‘The cow grazes’

2.

ɲag	*yâdì*	*bílɔ̀g*
ɲag	yə́-à-dì	bí-lɔ̀g
10AUG.cow	AGR10-Pres-eat	8AUG-grass

‘The cows graze’

In (1), the agreement class feature of the head noun (`mɔ́ngɔ́`, `bɔ́ngɔ́`) spreads on the verbs. In (2) we have the same form of the noun for both the `minimal` and the `augmented`. In fact, when standing alone, one can't tell whether ɲag is `minimal (i.e class 9)` or `augmented (i.e class 10)`. It's rather the agreement it triggers that helps to distinguish one form to another. As already mentionned, Bantu agreement phenomenon is characterized by the spreading of class feature of the head noun all over its dependents including the verb. Structure building rules (`merge`, `move`) in MG are defined in a directional process with a feature checking system that is a mechanism of resource consumption i.e each `selector` feature must match a `selectee` and each `licensor` match a `licensee`. [On1] proposed to formalize bantu multiple agreement in MG by `Head Movement with Copying`, the idea being that a `selector` is not `end-consumed` as the items that select it still exist in the derivations. The aim of this paper is to see how to deal with the balancing of ambiguity versus underspecification in the feature (2) in a resource consumption system like MG. Underspecification has being addressed in type-based grammars [Cr1,Dn1], in Type-Logical Grammars [He1], but never in MG. Here, we propose to associate a `defeasible inference rule` (σ) to lexical items with underspecified class feature. σ is based on `Prototypical`

[3] Ewondo grammatical number has been redefined as Minimal (Min) and Augmented (Aug), thus we have one single feature [±aug] [On1]

`Reasoning` [Re1,An1]. Section 2 proposes three ways that languages can have (or not have) noun classes. Section 3 presents the indeterminacy of class feature of nouns of class 9/10 in Bantu syntax. In Sect. 4 we show how the building of syntactic operations works in MG, Sect. 5 provides a new solution that could help to account for underspecification in MG after showing the limits of the first proposal made in [On1]. The paper ends with a conclusion.

2 Inherent vs Flexible Gender Features

Given examples (3, 4, 5) that show agreement phenomenon encountered in French, English and Ewondo. Imagine one removes `maisons (houses)` from (3a), then if a French speaker is asked to give the masculine form of the adjective `belles` ($\texttt{beautiful}_{\texttt{FEM,PL}}$), he would say `beaux` ($\texttt{beautiful}_{\texttt{MASC,PL}}$) because gender is inherent in adjective in French. On the other hand in English (4), the adjective stays unchanged, gender (or number) feature is not inherent in adjective.

(3) 1. *toutes* *ces* *belles* *maisons*
all$_{\text{FEM,PL}}$ this$_{\text{FEM,PL}}$ beautiful$_{\text{FEM,PL}}$ house$_{\text{FEM,PL}}$
'All these beautiful houses'
2. *tous* *ces* *trois* *jours*
all$_{\text{MASC,PL}}$ this$_{\text{MASC,PL}}$ three$_{\text{MASC,PL}}$ day$_{\text{MASC,PL}}$
'All these three days'

(4) 1. *all* *the* *beautiful* *houses*
all$_{\varnothing}$ the$_{\varnothing}$ beautiful$_{\varnothing}$ house$_{\text{PL}}$
2. *the* *desperate* *housewives*
the$_{\varnothing}$ desperate$_{\varnothing}$ housewife$_{\text{PL}}$

For a Ewondo[4] speaker, if he is asked to give the gender class of a determinative[5], he will be unable to give one. He needs to know the syntactic context in which this determinative appears to tell what its class marker is.

(5) 1. *mə-mǒs* *mə́-tə̄* *mə́-sə* *mə́-lá*
6AUG-day AGR6-this AGR6-all AGR6-three
'All these three days'

[4] Unless specified, all the examples that aren't French or English are from Ewondo language

[5] The class marker allows to distinguish between substantives and determinatives. Substantives are the set of nouns that [Gr1, p. 7] called `inherent gender` because this category triggers agreement. The second one he called `derived gender` is made of words that agree with the first one. In Ewondo (as in most Bantu languages), there are two nominal categories that share the fact to have the same nominal prefix. We term this second one as "determinative"

2. *bi-soá* *bi-tə̄* *bi-sə* *bi-lá*
   8AUG-plate AGR8-this AGR8-all AGR8-three
   'All these three plates'

The following observations[6] can be made: (i) adjective in French is an unmarked form that potentially agrees with the noun; (ii) in Ewondo, we can't indicate the class marker of a determinative except it appears in a construction, that means we need the presence of a substantive that bears a specified noun class marker to tell what are the class markers of the others items. Determinatives don't have pre-specified class marker, they inherit the class marker of the head noun; (iii) adjective in English is invariable. French and Ewondo speakers differ in whether they are able to produce a particular inflected form of an adjective in isolation. This is an experimental finding, and can be explained in many ways. One possible explanation is simply that speakers of any gendered language, when faced with such a task, think of an appropriate context and report the form the adjective takes in that context. The different behaviour of the French and Ewondo speakers is a result of there being only two genders in French, and thus that it is much easier to think of an appropriate context.

3 The Problem

3.1 Ambiguity in the Feature

In Ewondo, nouns of classes 9, 10 are problematic if one wants to determine their respective noun class. In (6), the DPs subjects aren't different as can be found (`chicken vs chickens`) in English. It's rather the agreement class marker the noun triggers (`AGR9 yə̀` and `AGR10 yə́`) that differentiates `kúb` in (6a, b) [Ow1, p. 65] is `9MIN` and `10AUG` respectively.

(6) 1. *kúb* *yàkɔn.*
   kúb yə̀-à-kɔ*n*
   9MIN.chicken AGR9-Pres-be sick
   'The chicken is sick'

2. *kúb* *yâkɔn.*
   kúb yə́-à-kɔ*n*
   10AUG.chicken AGR10-Pres-be sick
   'The chickens are sick'

As in most Bantu languages, it's assumed their nominal class morphemes are originally homophones `n-` (see Table 1). It's also difficult to say whether a given noun has a root `/NCVC(V)/` or `/CVC(V)/` with a class morpheme `n-`. Linguists usually argue by analogy to others noun classes: if most nouns of classes 9, 10 begin with a nasal[7], and if there are less nouns in others classes with that

[6] My thanks to Greg Kobele for valuable comments after my aviva.

[7] and there is a high percentage of initials `[nD]` and `[nT]` (where `[D]` is a voiced occlusives and `[T]` is a non voiced occlusives).

structure, then people assume that roots can't generally begin with `NC`; therefore nouns in classes 9, 10 that always have a `NC` initial must actually have a prefix `/n-/`. An answer to this argument is the possibility to mark a contrast between roots with `NC` and `C` initials in noun classes 9, 10. In Ewondo, we have nouns with `[nD]` but also words with `[T]` and `[z]`; such thematic roots are ambiguous. Two explanations are possible : (i) there is a phonological deletion of `/n/` in front of voiceless consonants and fricatives, and (ii) there is a real contrast between `NC` and `C` initials in theses noun classes. In Ewondo, the prefix `n-` is deleted when it's followed by another nasal (7), an unvoiced consonant (8) or by a voiced consonant `/z/` (9):

(7) n+ŋàk → ŋag: cow

(8) n+tsit → tsíd: animal

(9) n+zə*k* → zəg: pineapple

In short, nouns of classes 9, 10 are morphologically invariable et neutral for class distinction. One may think there is no difference between `minimal` and `augmented` number.

3.2 Distinction between Class 9, 10 Nouns

As noted, for those nouns that don't change in `minimal/augmented` form, the distinction is made by the agreement they trigger (10, 11).

(10)
1. *kúb* | *é-nə̀* | *o-nɔ̌n*
   9MIN.chicken | AGR9-PRES.be | 11MIN-bird
   'The chicken is a bird'
2. *kúb* | *é-nə̂* | *a-nɔ̌n*
   10AUG.chicken | AGR10-PRES.be | 5AUG-bird
   'Chickens are birds'
3. **kúb* | *é-nə̌* | *a-nɔ̌n*
   10AUG.chicken | AGR10-PRES.be | 5AUG-bird
   'Chicken are birds'

(11)
1. *zəg* | *é-bədə̀* | *á* | *təbələ*
   9MIN.pineapple | AGR9-PRES.put down | on | 1MIN.table
   'The pineapple is on the table'
2. *zəg* | *é-bədə̂* | *á* | *təbələ*
   10AUG.pineapple | AGR10-PRES.put down | on | 1MIN.table
   'Pineapples are on the table'

In (10, 11), tone doesn't help to distinguish the two noun classes. Originally, the `augmented` form is obtained by adjoining a suprasegmental High tone `|´ |` to the noun of class 9. This floating High tone[8] attaches either to the noun or

[8] Regarding the architecture of tonal representations, floating tones (not associated) are usually represented in a circle : spreading high tone , spreading low tone .

to the verb. Nevertheless, it seems that the verb, each time it's present, bears the floating High tone. The association of the High tone is done from left to right. Nouns and verbs that bear a Low tone on the last syllable (10a) yield, when a High tone is added to them, a High-Low tone on the verb (10b). If the association is made from the right to the left, then we get a Low-High tone on the verb, thus the ungrammatical (10c). Let's take the subject and the verb in (10b), the High tone of `kúb (chickens)` spreads on the right :

(12)

In (12), as there is already a High tone on the verbal prefix (`é`), there is no difference.

(13)

And nothing stops this High tone to spread on its right up to the verb root yielding a High-Low tone (13). That's the way we get sentence (10b).

With nouns originally with a Low tone, the difference is made at phonological level with a raising pitch on the first syllable of the verb. This syllable should bear the Low or High tone to indicate whether the noun is minimal or augmented and also specify the class agreement feature. But, as the verb already has a High tone on its first syllable, the original tone of nouns of class 9, 10 spreads to the last vowel of the verb (11). Let's take an example with a noun bearing a High tone[9]

(14) *kúb* *é-nə̀*
9MIN.chicken AGR9-PRES.be
'The chicken is'

We have a High tone on `kúb (chicken)`, a Low tone of class 9 on the verbal prefix `è` and a Low tone on the verbal root `nə̀` that are shown below (15):

(15)

The floating High tone of `kúb (chicken)` attaches on the right yielding (16):

(16)

This floating High tone of `kúb (chicken)` pushes the Low tone of the verbal prefix to the right, and we get (17):

[9] It's important to note that tone isn't a distinctive feature as the word already has a high tone. The main point to look at is the (minimal) agreement on the verb comparing to (10b) that is an augmented form. That means the proposed analysis is the same for N with Low tone.

(17) The floating Low tone blocks the High tone of `kúb (chicken)` so that it can't spread up to the verb root.

And the Low tone goes on this verb root, as the latter already bears a Low tone, nothing changes. We can conclude that tonal distinction on the agreement feature can be useful to distinguish the `covert` class feature of nouns of class 9/10.

4 Minimalist Grammars

`MG` [St1] attempt to implement the so-called `minimalist` principles introduced by [Ch1]. A `MG` is a quadruplet `(V,Cat,Lex,F)`: `V = {P` $\cup$ `I}`, set of non syntactic features `(vocabulary)` where `P` represents the phonetic features and `I` the semantics features; `Cat = {base` $\cup$ `selector` $\cup$ `licensor` $\cup$ `licensee}`, finite set of non syntactic features ***(categories)*** which are partitioned into four kinds (`x : base` (**c, t, v, d, n, ...**), `=x : selector/probe`, `-x : licensee`, `+x : licensor` (feature that trigger `move`)); `Lex` = finite set of expressions built from `V` and `Cat (lexicon)`; `F = {merge` $\cup$ `move}` : set of generating functions. `Merge` and `Move` are built with trees where : (i) internal nodes are labelled with direction arrows (`<` or `>`) indicating where the head of the structure is, (ii) leaves are pairs $\langle \alpha, \beta \rangle$ with α = vocabulary item and β = set of features. `Merge` (or external merge) is a binary operation that takes two trees and puts them together. The tree whose first feature is `=x` merges with a tree whose category feature is `x` to built a new tree. Features `=x` and `x` are deleted after merging.

(18) $\texttt{merge}\ (\texttt{t}_1^{=x},\ \texttt{t}_2^{x}) = \overset{<}{\widehat{\mathrm{t}_1\ \mathrm{t}_2}}$ if t_1 is a lexical item

$\texttt{merge}\ (\texttt{t}_1^{=x},\ \texttt{t}_2^{x}) = \overset{>}{\widehat{\mathrm{t}_1\ \mathrm{t}_2}}$ if t_1 is not a lexical item

`Move` (or internal merge) is a unary operation that targets (some part of) an expression to remerge it higher in the structure. `Move` is applied to a subtree with a feature `-x`. Given a subtree with **`-x`** written $\texttt{t}_2^{-x}$ that appears in a tree $\texttt{t}_1^{+X}$, we write $\texttt{t}_1[\texttt{t}_2^{-x}]^{+X}$. $\texttt{t}_1^{+X}$ is the maximal projection of $\texttt{t}_1[\texttt{t}_2^{-x}]^{+X}$ i.e the largest subtree with `-x` as its head. After extraction, the subtree $\texttt{t}_2^{-x}$ merges as specifier of the head of the tree, features served for `Move` operation are removed from the tree. The `shortest move contraint (SMC)` that applies to `Move` requires there should be exactly one maximal projection $\texttt{t}_1[\texttt{t}_2^{-x}]^{+X}$ displaying a subtree $\texttt{t}_2^{-x}$. The original place of $\texttt{t}_2^{-x}$ is then filled by an empty tree ϵ i.e a single featureless node.

(19) $\texttt{move}\ (\texttt{t}_1[\texttt{t}_2^{-x}]^{+X}) = \overset{>}{\widehat{\mathrm{t}_2\ \mathrm{t}_1[\epsilon]}}$

There are few syntactic operations implemented in `MG` (Scrambling & Adjunction [FG1], Head Movement [St2], Copying [Ko1], Head Movement with Copying [On1]). In MG, `Merge` and `Move`, need a selecting feature matching a selected feature (both being of the same category) to drive derivations. Now, what's happened if the selecting feature is un(der)specified?

5 On Underspecification in Minimalist Grammars

5.1 Unspecified Class Feature

Given the examples below where nouns of classes 9, 10 are in subject position (20) and in object position (21), the analysis developed in [On1] for (20) is based on the theoretical claim that nouns of classes 9, 10 are not lexically specified for their class.

(20)	*ɲag*	*yə̀dì*	*bílɔ̀g*
	ɲag	yə̀-à-dì	bí-lɔ̀g
	9MIN.cow	AGR9-Pres-eat	8AUG-grass

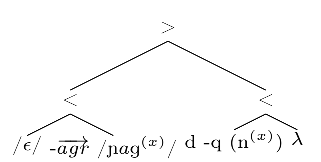
'The cow grazes'

(21)	*ńsɔmɔ*	*áwé*	*ɲag*
	ń-sɔmɔ	á-a-wé	ɲag
	1MIN-huntsman	AGR1-PAST1-kill	9MIN/10AUG.cow

'The huntsman has killed the cow/cows.'

These nouns enter the derivation with an uninstantiated variable `x` that will be valued through postsyntactic insertion of the class morpheme of the agreement feature $+\overrightarrow{agr}$ on TP. Variable `x` instantiation means to copy on the subject DP the value of the agreement feature on T head.

(22)



(22) is built in 3 steps:
(a) merge($\texttt{n}^{(x)}$`<= !cl -k` /ϵ/, $\texttt{n}^{(x)}$ $-\overrightarrow{agr}$ /ɲag/),
(b) merge($=>^{+}$`cl +k d -q` /ϵ/,`a`),
(c) move(`b`).

Postsyntactic insertion means the agreement class feature on the verb is substituting for the variable `x` yielding the corresponding noun class feature on the noun. As we said it's the agreement feature on the verb that give the information about the nominal class morpheme of the DP. The substitution process is made in two steps : (i) `covert movement` then (ii) `agree` (for detailed step-by-step justification see [On1]). If (20) is appropriately treated in [On1], the solution provided is still problematic for (21) where noun of classes 9, 10 are in object position. To solve this problem, let's try another approach. Following [Ro1], we distinguish three features: ϕ-features are specified class feature for inherent noun classes; θ-features are underspecified class feature for noun of

Table 2. Syntactic Class Features

Inherent noun classes		Neutral noun classes		Derived noun
cl1	cl2	cl9	cl10	flexible
cl3	cl4			
cl5	cl6			
cl7	cl8			
cl11				
cl16				
cl17				
cl19				

class 9/10; α-features are flexible and inherited class agreement feature found on derived nouns (i.e determinatives) and verbs. If we think of noun class feature as Attribute-Value feature system, we could say, noun of class 9, 10 has an Attribute specification `"n"` without a Value (i.e without a class number). That means, a word like `ɲag(cow)` is represented with the feature `n`θ. The difference being that a noun with a specified noun class (say `m-ɔ́ngɔ́: 1MIN-child`) will be represented with a specified class feature `n1`. α-features' transmission is done through `HMC`. The question now is how to formalize θ-feature in `MG`?

5.2 Default Inference Rule

A default rule will be used to model feature underspecification through prototypical reasoning, the latter is used when most instances of a concept have some property[10]. Default Logic [Re1,An1] is a nonmonotonic reasoning approach allowing to rely on incomplete information about problem. A default theory **T** is a pair $(\digamma, \Gamma)$ where $\digamma$ is a set of `FOL` sentences representing the background information, Γ represents the defeasible information (i.e a countable set of defaults rule).

Definition 1. *A default rule (say σ) is an inference rule of the form:*

$$\frac{\delta : \rho_1, \ldots, \rho_n}{\xi} \begin{cases} \delta & = prerequisite, pre(\sigma) \\ \rho_1, \ldots, \rho_n & = justifications, just(\sigma) or\ simply(\sigma) \\ \xi & = consequent\ of \sigma, cons(\sigma). \end{cases} \tag{23}$$

*interpreted as: given δ and as there is no information that $\neg\rho_i$, conclude ξ by default. A default rule is called **`normal`** if and only if it has the form:*

$$\frac{\delta : \xi}{\xi} \tag{24}$$

[10] That means for us the case when most instances of noun class feature have Attribute-Value property.

A semantics for Default Logic is provided through the notion of `extension` [Re1,AS1,An1]. An extension for a default theory $\mathbf{T}$ ($\mathbf{T} = (\digamma, \Gamma)$) is a set of `FOL` sentences $\mathbf{E}$ where: (a) $\digamma \subseteq \mathbf{E}$; (b) $\mathbf{E} = \Delta(\mathbf{E})$ where Δ denotes the deductive closure; (c) $\mathbf{E}$ should be closed under the application of defaults from Γ i.e if $\frac{\delta:\rho_1,\ldots,\rho_n}{\xi}$, $\delta \in \mathbf{E}$ and $\neg\rho_1 \notin \mathbf{E}, \ldots, \neg\rho_n \notin \mathbf{E}$ then $\xi \in \mathbf{E}$.

Definition 2. *For $\mathbf{T} = (\digamma, \Gamma)$, let Π = $(\sigma_0, \sigma_1, \ldots)$ be a finite or infinite sequence of default rules from Γ without multiple occurrences. Π is viewed as possible order in which default rules from Γ are applied, so a default rule doesn't need to be applied more than once in such a reasoning. The initial segment of Π with length* **k** *is denoted Π* **[k]***. Sets of first-order formulae,* **In(Π)** *and* **Out(Π)** *are associated to such sequence as Π: (a)* **In(Π)** = $\Delta(\digamma \cup \{cons(\sigma) | \sigma$ **occurs in** $\Pi\})$, **In(Π)** *collects the information gained by the application of the default in Π and represents the* **current knowledge base** *after the default in Π have been applied; (b)* **Out(Π)** = $\{\neg\rho | \rho \in just(\sigma)$ **for some** σ **occuring in** $\Pi\}$, **Out(Π)** *collects formulae that should not turn out to be true i.e that should not become part of the current knowledge base even after subsequent application of the other default rules.*

Definition 3. *Π is called a* **process** *of $\mathbf{T}$ iff σ_k is applicable to $In(\Pi[k])$, for every* **k** *such that σ_k occurs in Π.*

Definition 4. *For a given process Π of $\mathbf{T}$: (a) Π is a* **successful process** *iff $In(\Pi) \cap Out(\Pi) = \emptyset$, otherwise it is a* **failed process**; *(b) Π is a* **closed process** *iff every $\sigma \in \Gamma$ that is applicable to $In(\Pi)$ already occurs in Π. Closed processes correspond to the desired property of an extension $\mathbf{E}$ being closed under application of default rules from Γ.*

Definition 5. *For the application of a default rule, a* **consistency condition** *should be satisfied.*

$$\sigma = \frac{\delta : \rho_1, \ldots, \rho_n}{\xi} \tag{25}$$

is **applicable** *to a deductively closed set of formulae $\mathbf{E}$ iff $\sigma \in \mathbf{E}$ and $\neg\rho_1 \notin \mathbf{E}, \ldots, \neg\rho_n \notin \mathbf{E}$.*

Proposition 1. *The rule of thumb when treating nouns of class 9, 10 is to say these nouns are of class 10 unless stated by the grammarian they are of class 9[11]. If the latter is done, the default rule (i.e the rule of thumb) already mentionned isn't rejected, it's simply no more applicable as the missing information is now known.In a classical logic setting[12], we need to say what is the Value of Attribute* **n** *for classes 9, 10 nouns. As we don't know, no decision could be taken in such a system. But in default reasoning, the previous rule of thumb can be applied.*

[11] That means, only the `augmented` is grammatically marked, `minimal` will have a zero grammatical marker that is realised as a low tone by default. In fact, that's the strategy generally used in natural language that the `minimal` has a zero morpheme.

[12] As well as in Stablerian MG

Proof. We write Attribute with indices to differentiate between $\mathtt{n}_1$ (that stands for class 10 nouns) and $\mathtt{n}_0$ (that stands for class 9 nouns). So, for $\mathbf{T} = (\digamma, \Gamma)$, let $\digamma = \{n_1, n_0\}$ and $\Gamma = \left\{\frac{n_1:\neg 9}{10}, \frac{n_0:\neg 10}{9}\right\}$. The default theory $\mathbf{T}$ is represented as : $\mathbf{T} = \left(\{n_1, n_0\}, \left\{\frac{n_1:\neg 9}{10}, \frac{n_0:\neg 10}{9}\right\}\right)$. Let also assume that $\sigma_1 = \frac{n_1:\neg 9}{10}$, $\sigma_0 = \frac{n_0:\neg 10}{9}$ and $\Pi = (\sigma_1, \sigma_0)$. As Γ contains only (a finite number of) two default rules, closedness doesn't matter. We apply default rules as long as they are `applicable`, and then we get a closed process. So, we apply the first default σ_1 and check default σ_0 with respect to the knowledge collected after the application of σ_1. For $\Pi[\sigma_1]$ we have: $\mathrm{In}(\Pi[\sigma_1]) = \Delta(\{n_1, n_0, 10\})$, $\mathrm{Out}(\Pi[\sigma_1]) = \{9\}$, $\mathrm{In}(\Pi[\sigma_1]) \cap \mathrm{Out}(\Pi[\sigma_1]) = \emptyset$, so, we say $\Pi[\sigma_1]$ is closed and successful process.For $\Pi[\sigma_0]$ we have: $\mathrm{In}(\Pi[\sigma_0]) = \Delta(\{n_1, n_0, 9\})$, $\mathrm{Out}(\Pi[\sigma_0]) = \{10\}$. In fact σ_0 can't be applied as $\mathtt{10} \in \Delta(\{n_1, n_0, 10\})$ which is our current knowledge base before we apply σ_0. We know $\mathrm{In}(\Pi[k+1]) = \Delta(\Pi[k]) \cup \Delta(\Pi[k+1])$ and $\mathrm{Out}(\Pi[k+1]) = \mathrm{Out}(\Pi[k]) \cup \mathrm{Out}(\Pi[k+1])$ so $\mathrm{In}(\Pi[\sigma_0]) = \Delta(\{n_1, n_0, 10, 9\})$, $\mathrm{Out}(\Pi[\sigma_0]) = \{10, 9\}$, $\mathrm{In}(\Pi[\sigma_0]) \cap \mathrm{Out}(\Pi[\sigma_0]) = \{10, 9\}$, thus, we say $\Pi[\sigma_0]$ is failed process.We could have stopped the proof earlier as application of σ_1 blocks application of σ_0 and vice versa, so there are no more extension of $\mathbf{T}$. From the application of the first default rule σ_1, we know Attribute `n` has Value `10`, so it is not consistent to assume `9`. Thus $\Delta(\{n_1, n_0, 10\})$ is the only extension of $\mathbf{T}$. □

We associate a defeasible inference rule σ to lexical items with feature ambiguity. A default rule on an underspecified Attribute `n` is marked using an arrow $\uparrow^{\sigma}$ indicating to map Attribute `n` to the result of σ. Once the Value of `n` is calculated, then the MG derivation can proceed (and not the inverse). The idea being that the default rule blocks the derivation. So the derivation tree for a word like ɲ*a*g (cow) is:

(26)

$$\begin{array}{ccc} & < & \\ [n \uparrow^{\sigma}] \Leftarrow !\mathrm{cl}\ \text{-k} & /\epsilon/\ \mathrm{nx} & /\ \text{ɲ}ag/ \end{array}$$

where `x` is an anonymous variable that match with any value collected after the application of $[n \uparrow^{\sigma}]$.

MG are by definition encapsulated, which means that they make reference only to their own internalised system, and not to any external formal system, such as a logic for general reasoning. This is intrinsic to the claim of the language faculty being prior, feeding into more general reasoning devices but separate from them. If the current proposal is in line with Stabler's formalization, then we think MG clearly differentiate a Stabler form of minimalism with others. That might mean that the notion of encapsulation may be rather different for a Stabler form of grammar than others.

6 Conclusion

In this paper we attempt to introduce a rule in a Stablerian MG that could help to account for feature underspecification in a resource consuming system.

The proposal rests on default reasoning that allows to deal with incomplete information about a problem.

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