Is syntax really phonology-free?*

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1   Introduction

It is an assumption of most models of syntax that phonological features are not present during syntactic derivations, thus cannot influence syntactic structure (cf. Pullum and Zwicky 1986, 1988). The Minimalist Program and its predecessors assume that grammar is modeled as in (1) (Chomsky, 1993), where syntactic operations apply entirely before phonological ones. A similar model is assumed by advocates of Distributed Morphology, where morphological operations (including insertion of all phonological information associated with the relevant morphosyntactic features) take place between Syntax and Phonology (Halle and Marantz, 1994; Embick and Noyer, 2001; Harley and Noyer, 1999).

(1)   **The Y-model of grammar**
         Syntax

Phonological Form   Logical Form
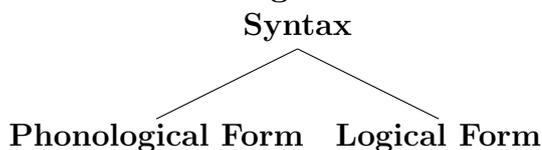
One phenomenon that challenges the assumption of phonology-free syntax is *phonologically determined agreement.* Here I use the term phonologically determined agreement to refer to a system where agreement (between a verb and its arguments or a noun and its modifiers) is determined by the phonological form of the noun controlling agreement, rather than by its semantic or syntactic features. Such a system exists in Kru languages, including Guébie, an undescribed Kru language (Niger-Congo) spoken in Côte d'Ivoire, which I describe based on original data here. Guébie shows a typologically remarkable phonologically determined agreement system where nominal concord is determined not by semantic class but by the phonological form of the agreement-controlling noun.

The main goal of this paper is to determine whether phonologically determined agreement systems like the one in Guébie can be accounted for without requiring syntax to reference phonological features. If a satisfactory analysis of this type is found, perhaps we can maintain our assumption that syntax is never sensitive to phonological information.

I begin in section 2 by providing a typology of noun class systems, introducing a scale where one extreme includes entirely semantically determined noun class agreement, and the other extreme includes entirely phonologically determined systems. In section 3 I provide background on the Guébie language, along with an exposition of Guébie

phonologically determined agreement data. This is followed in section 4 with an analysis of the Guébie data that does not require phonological features to be present in the syntax. The proposed analysis involves interaction between morphology, syntax, and phonology, and proposes a novel approach to ellipsis at PF. Section 5 tests the predictions of the proposed analysis by extending the model to other languages that display similar phonologically determined agreement phenomena. These include other Kru languages, as well as Bainuk (Atlantic), and Abuq (Arapesh). In section 6 I discuss the implications of the data presented throughout the paper, asking whether phonologically determined agreement systems raise sufficient doubts about our assumption that syntax is phonology-free. I conclude in section 7.

2 A typology of noun class agreement

The term *agreement* is used here as a general cover term to refer to the phenomena of dependents agreeing in some feature with heads (subject-verb agreement, noun-modifier agreement). The specific type of agreement most relevant to this paper is that between nouns and their modifiers. This is sometimes called *nominal concord* (Norris, 2014), or, when the agreement marker on the noun is identical to the agreement marker on its modifiers, *alliterative concord* (Dobrin, 1995). Nominal modifiers can agree with the agreement-controlling noun in person and number features, but also in *gender* or *noun class*. Here I use the term noun class to encompass both gender and noun class systems described in the literature.

Corbett (1991) provides a typology of noun class systems, demonstrating that there are two ways of assigning nouns to a particular noun class: 1) based on semantic features of the noun and 2) based on phonological or morphological form of the noun. I discuss examples of both types in the remainder of this section, and I propose a typological scale of noun class systems.

2.1 Semantically determined noun class assignment

The first type of noun class system considered here is one that is entirely predictable based on semantics. An example of such a language is Diyari (Australia), which makes two noun class distinctions: feminine animates versus everything else (p. 11). For any referent whose sex is differentiated, the feminine entity falls into the feminine class, while all masculine entities and non-sex-differentiated items fall into the remaining class.

Similarly, Tamil has three classes: masculine, feminine, and neuter. All words for masculine entities, including deities, fall into the masculine category, all feminine entities in the feminine category, and all non-gendered items into the neuter category. There are very few, if any exceptions to this rule (Asher 1985:136-137, Corbett 1991:8-9).

In both Tamil and Diyari, the semantic gender of a noun is enough to determine its noun class, and its noun class agreement markers are enough to determine the semantic gender.

While there are many purely semantically determined noun class systems like the ones in Diyari and Tamil, there are also systems that are mostly semantically determined but with "leaks" (Corbett 1991:15). In Dyirbal, for example, there are four noun classes as listed in (2).

(2) **Dyirbal noun classes** (adapted from Dixon (1972); Schmidt (1985))
    Class 1   male humans, non-human animates
    Class 2   female humans, water, fire, fighting
    Class 3   non-flesh foods
    Class 4   residue

While the above semantic criteria account for most noun class assignments in Dyirbal, there are exceptions. For instance, non-human objects associated with males or females via mythology fall into class 1 or 2, respectively. We also find other examples of 'concept association' such as terms for 'fishing line' and 'fish spear' taking class 1 agreement due to their association with fish.

Semantic systems with exceptions raise the question of how a speaker learns the class of a given noun. Must all noun class assignments be memorized? Dixon (1972) says that children learning Dyirbal do not have to learn the gender of each noun individually, and loan words are assigned to the same class across speakers. Thus, the semantic criteria in (2) must be salient enough for learners to avoid the memorization strategy.

Semantic criteria determining noun class range from insects to names of languages; however, Corbett finds that the most common criteria are, unsurprisingly, male versus female, human versus non-human, and animate versus inanimate (p. 30). Because masculine, feminine, human, and animate are all quite salient features across cultures, it is unsurprising that noun class systems are often divided in this way.

2.2 Morphophonologically determined noun class assignment

While there are numerous fully and partially semantically determined noun class systems, Corbett finds no examples of languages whose noun class assignment is based *solely* on phonological or morphological form. However, many languages base noun class assignment on both semantic *and* phonological criteria.

Qafar, a Cushitic language, also called Afar, has two morphological genders. Male entities fall into the masculine category and females into the feminine category, but all non-sex-differentiated items also fall into one of these two groups. Which group they fall into is determined by their phonological form (Parker et al., 1985). Specifically, if a noun ends in an accented vowel, that noun appears in the feminine class. All other nouns, those ending in consonants or with the accent on the penultimate syllable, fall into the masculine class. While there are very few exceptions to this phonological generalization of class assignment, when the semantic and phonological criteria are at odds, the semantics takes precedence. The word *abbá*, 'father', looks phonologically like it should appear in the feminine class, but due to its masculine semantics, it takes masculine agreement. With only phonological criteria, we can predict the correct class 95% of the time in Qafar (Corbett 1991:52, citing personal communication with RJ Hayward); however, we still need semantic criteria for things like 'father'.

In Qafar and similar systems, where an edge-aligned segment or suprasegmental corresponds to a particular class, we can ask the following question: Does class determine the form of the noun, or does form determine class assignment? Because speakers in Qafar and other languages consistently assign loan words to a particular class based on form, we must assume that as a minimum form determines noun class. This does not rule out the possibility that the relevant formal property, here final versus non-final accent, is or was historically determined by the noun class.

Another system with both semantic and phonological criteria at work is Yimas (Lower Sepik, Papua New Guinea) (Foley 1991:119-162, Corbett 1991:57, Aronoff 1994:114). In Yimas there are eleven noun classes, four of which are partially semantically determined, and all of which are at least partially determined by morphophonological form, except perhaps class five, which is the class for the residue, those nouns that do not fit into the other classes. The semantic and morphophonological assignment rules for Yimas are shown in (3).

(3) **Yimas noun class assignment**

Gender	Semantics	Morphophonology
1	non-female human	/-rm/
2	female human	/-maŋ, -mprum/
3	important animals	/-ntrm/
4	important plants	/-um/
5	residue	residue
6	–	/-ŋk/
7	–	/-mp/
8	–	/-i/
9	–	/-aw/
10	–	/-uk/
11	–	/-uŋk/

While classes 1, 2, and 3 are primarily semantically determined in Yimas, the others, 4-11, are primarily morphophonologically determined. However, with the knowledge of both semantics and form, a speaker would know which class to assign a given noun.

For another example of a language with both semantics and form governing noun class assignment, we turn to Wolof (Atlantic) (Mc Laughlin, 1997). Noun class agreement in Wolof marks both number and class. There are eight singular classes and two plural classes, listed in (4).

(4) **Wolof noun classes** (adapted from Mc Laughlin (1997))

Singular	Plural
k	ñ
b	y
g	
j	
s	
m	
l	
w	

The singular class /k/ and plural class /ñ/ are restricted to a few nouns, including the word 'person', and depending on the speaker also other human nouns. Class /y/ is the plural class for all other nouns.

Diminutives take /s/ class agreement, however there are many non-diminutive nouns in the /s/ class as well. Many human words, including most relatives, are in the /j/ class. The /g/ class contains trees, and the /b/ class contains the fruits of those trees. The above semantic noun class assignments are true for loan words as well as native ones: *banaana gi* 'banana tree', *banaana bi* 'banana fruit'.

These semantic criteria determine the class of only a small number of lexical items in Wolof. Thus, phonological criteria carry much of the burden in noun class assignment (Rambaud, 1898; Delafosse, 1927). Since at least the 1970s, Wolof class assignment has been shifting even more toward phonologically determined and away from semantically determined noun class assignment (Irvine, 1978).

Nouns that begin with the same consonant as a class marker often fall into that class (ex: _muus mi_, 'this cat'). Most nouns that begin with coronal consonants fall into class /l/. All of the /g, j, m, s, l, w/ classes show strong phonologically determined agreement, though the /k/ class is too small to show any phonological tendencies, and the /b/ class is too large.

Class /b/ is the class of most loan words, and because Wolof has borrowed and continues to borrow numerous words from French, class /b/ is large and growing. In varieties of Urban Wolof, class /b/ is becoming generalized across the lexicon to be the only remaining noun class marker. However, rural Wolof speakers continue to use all ten classes, and even to extend phonological class-assigning generalizations to loan words: _galaas gi_, 'this ice' from French _glace_.

For the s-class in particular, Pozdniakov and Robert 2015:36 find that only 15 of the 51 s-class lexical items in Diouf (2003)'s Wolof dictionary do not begin with /s-/. That is, phonological form accounts for 70% of nouns in the s-class.

To summarize, in Wolof we see that a small portion of the lexicon is assigned to a noun class based on semantic features, while the remaining words are assigned phonologically.

Many Indo-European languages like Spanish, French, German, and Russian use both semantic and phonological criteria to determine noun class assignment. In Spanish feminine animates take feminine agreement /-a, la/, masculine animates take masculine agreement /-o, el/, and for other nouns the final vowel of the noun /-a, -o/ determines the agreement marking. For nouns ending in consonants, often the final suffix (if there is one) determines the class. Of course, there are a few exceptions to the phonological and morphological generalizations: _el mapa, *la mapa_, 'the map'.

In Russian, there are three singular noun classes (or genders): masculine, feminine, and neuter. While semantically masculine and feminine nouns predictably fall into the masculine and feminine classes, repsectively, the class of all non-sex-differentiated nouns is determined by their morphological declension type. In Russian, just as in Qafar, when the semantics and morphology are at odds, the semantic criteria take precedence (Corbett 1991:34-35 , Aronoff 1994:72-73).

2.3   Proposing a typology of noun classes

We have seen that in many languages noun class assignment is purely determined by semantic features of each noun (Diyari). In others, semantic features play a large role, but there are principled exceptions (Dyirbal). In still other languages, morphophonological form determines the class of some, or even most nouns in the language, while semantic features account for those nouns that do not follow the phonological criteria (Qafar). What we have not seen is a language whose noun class system is _purely_ determined by morphophonological form. Whether such a system exists is discussed later in this section and further in section 6.

I propose a scale of noun class systems, ranging from entirely phonologically determined to entirely semantically determined. Languages like Diyari fall on the right, the semantic extreme side, Wolof and Yimas are closer to the middle, and Qafar, where

phonological criteria determine the class of 95% of the lexicon, is almost entirely to the left.

(5) **A scalar typology of noun classes**

$$Qafar \qquad Wolof \qquad Yimas \qquad Dyirbal \qquad Diyari$$

|—————|—————|—————|—————|

Form-based   **Meaning-based**

The place of languages on the above scale has been determined impressionistically; however, one could imagine a statistically determined scale if numbers were available for each language about what percent of nouns are assigned to classes semantically versus phonologically.

While we have examples of languages that fall on the semantic-extreme side of this typology, there has not been a language attested to have an entirely phonologically determined system. This raises an interesting question: Would we expect to find such a language? What would a purely phonologically determined system look like?

Let us imagine a language with two noun class agreement markers, where the number of syllables in a noun determines which agreement marker is used. For example: a noun with an odd number of syllables falls into Noun Class 1 and a noun with an even number of syllables falls into Noun Class 2. A system with this distribution and no exceptions would fall onto the phonologically extreme edge of the scale in (5). Alternatively, one could imagine a system where the initial or final segment of a noun determined its noun class, with no exceptions. In the latter example, it would be possible to analyze the final segment of the noun as a morpheme itself, perhaps a noun-class marker on the noun. However, if there were significant evidence to show that the final segment of the noun was not itself a noun class marker, this would be an example of an extremely phonologically determined system.

If we did find an entirely phonologically determined system, it would be an example of phonological form determining morphosyntactic agreement, which is not predicted based on a model of phonology-free syntax. While I agree that no such system has yet been attested, many do come close. In the following section I describe the nearly completely phonologically determined agreement system of Guébie, a Kru language spoken in Côte d'Ivoire. I proceed in section 4 with an analysis that accounts for the Guébie system and predicts the existence of a fully phonologically determined noun class system. I return to the typology of noun classes in section 6, claiming that in fact any noun class system that is even partially phonologically determined poses potential challenges for a strict view of phonology-free syntax.

3   Guébie phonologically determined agreement

3.1   Language background

Guébie is a Kru language spoken by approximately 7000 people in seven villages in southwest Côte d'Ivoire. It is part of the Dida sub-group, closely related to Vata, which is described by Koopman (1984). The people in the seven Guébie villages are subsistence farmers, growing rice and cassava for their families and occasionally growing cacao to sell for profit. Until the late 1990s, the Guébie-speaking villages were isolated with little access to the nearest city. However, in the late 1990s, a road was created from Gnagbodougnoa, the largest Guébie-speaking village, to Gagnoa, the nearest city. Gagnoa, a

city of more than 200,000 people, is only 31 kilometers from Gnagbodougnoa, and now Guébie speakers have easy access and make regular trips there. The indigenous language of Gagnoa is Bété, a Kru language not mutually intelligible with Guébie. However, French is the most widely spoken language in the city.

Since having access to Gagnoa, Guébie speakers have begun speaking more French and less Guébie. French is the language taught in schools, used in government, and it is the lingua franca of all urban areas in the country. It is becoming the norm for children in Guébie villages to learn French before Guébie, thus the language is in critical condition.

The data here come from original work with one Guébie speaker in Berkeley, California and five others in Gnagbodougnoa, Côte d'Ivoire from September 2013 through November 2015. The majority of the data comes from two speakers, a 28-year-old male and a 76-year-old male. Three other male speakers ages 35-52 and two female speakers ages 19 and 30 were also consulted. Data was collected in the form of text and elicitation.

3.2   Phonologically determined agreement

The basic word order for Guébie alternates between S AUX O V and SVO. When there is no overt auxiliary, the verb moves to T (Author), as in Vata, a neighboring Kru language (Koopman, 1984). Like other Kru languages (Marchese, 1979), Guébie is highly tonal, with four distinct lexical tone heights and a number of contour tones (Gnahore, 2006). Tone is marked throughout this paper with numbers 1-4, where 4 is high. Syllables are usually CV and maximally CLV, where L is a liquid. Words other than pronouns must be at least CV. Pronouns take the form of a single vowel. Subject pronouns are free words, but object pronouns are part of the phonological word of the verb, surfacing as enclitics on the element in T (the verb or auxiliary).

This section details the phonologically determined agreement system of Guébie, demonstrating that pronouns and adjectives agree with nouns not in semantic class but in phonological features.

3.3   Phonological agreement between pronouns and nouns

Human pronouns in Guébie always take set forms. Specifically, third person pronouns take the form $/ɔ^3/$, singular, and $/wa^3/$, plural. Non-human third person pronouns agree with their nominal antecedent not in semantic features (person, number), but in *phonological features*, where the final vowel of the noun stem determines the vowel of the pronoun.

There are ten vowels in Guébie, and all words end in a vowel. To mark plurality on nouns, there are two possible plural suffixes, /-i/ and /-a/, and it is not predictable which noun will take which suffix. The final vowel of a noun stem, which is the plural suffix when present, determines the vowel of the pronoun used to replace that noun, as well as the possessive pronoun, according to the chart in (6).

(6)   **Mapping of Guébie stem-final vowels to pronoun vowels**

Final vowel		3.SG pronoun vowel	Plural suffix		3.PL pronoun vowel
i, ɪ, e, ɛ	→	e	-i	→	i
ə, a	→	ə	-a	→	wa
u, ʊ, o, ɔ	→	u			

Above is a mapping of non-human pronouns. The complete personal pronoun chart is given in (7). All pronouns in (7) are shown in their nominative (subject pronoun) forms. Segmentally, object pronouns are identical to subject ones, though tonally object pronouns are each one step lower on the 4-tone scale than the corresponding subject pronoun. There is an additional set of pronouns used solely in emphatic or focused contexts, given in (8). Just like nominative and accusative pronouns, non-human emphatic pronouns are phonologically determined by the final vowel of the noun.

(7)   **Human and non-human subject pronouns**

	Human			**Non-human**	
	Singular	**Plural**		**Singular**	**Plural**
1st	e^4	a^3	**1st**	–	–
2nd	e^2	a^2	**2nd**	–	–
3rd	$ɔ^3$	wa^3	**3rd**	$e^3,ə^3,u^3$	i^3,wa^3

(8)   **Emphatic pronouns**

	Human			**Non-human**	
	Singular	**Plural**		**Singular**	**Plural**
1st	$mɔ^3$	$aɲɛ^{3.2}$	**1st**	–	–
2nd	$mɔmɛ^{3.2}$	$aɲɛ^{2.2}$	**2nd**	–	–
3rd	$ɔɓa^{3.2}$	$waɓa^{3.2}$	**3rd**	$ɛɓa^{3.2},aɓa^{3.2},ʊɓa^{3.2}$	$ɪɓa^{3.2},waɓa^{3.2}$

Possessive pronouns, which surface immediately before the possessed noun, are shown in (9), where for non-human possessors, the possessive marker is phonologically determined.

(9)   **Possessive pronouns**

	Human			**Non-human**	
	Singular	**Plural**		**Singular**	**Plural**
1st	na^4	$anɛ^3$	**1st**	–	–
2nd	na^2	$anɛ^2$	**2nd**	–	–
3rd	$ɔnɛ^3$	$wanɛ^3$	**3rd**	$ene^3,əne^3,une^3$	$ine^3,wane^3$

The forms in (9) are used for alienably possessed nouns: /na^4 ɓitə$^{2.3}$/ 'my house'. A separate set of possessive pronouns are used for inalienably possessed nouns, mostly kinship terms. The inalienable pronouns are identical to the personal pronouns in (7) with one exception; the first person singular inalienable pronoun is /a^4/ instead of /e^4/: /a^4 no^4/ 'my mother'. The inalienable pronouns are of less interest to us because they are quite infrequently used with non-human pronouns. It is quite rare that a non-human noun

(one whose agreement is phonologically determined) is the possessor in of an inalienable noun in Guébie.

Human pronouns take set forms, while non-human ones are always phonologically determined by their antecedents. As far as I know, this is exceptionless. Unlike Godié (Marchese, 1986a), a neighboring Eastern Kru language, there is no default pronoun. The choice of non-human pronoun in Guébie must always agree phonologically with the contextually relevant noun.

In (10) I show examples of this phonologically predictable agreement, where the noun in the left column determines the form of the object pronoun in the center column and the subject pronoun in the rightmost column. The final vowel determining agreement and the pronoun vowels are underlined.

(10) **Phonological agreement of pronouns with antecedents**

Noun	Gloss	Object	Gloss	Subject	Gloss
a. ɟi$\underline{e}^{2.2}$	'a prison'	e-^{4} ni-^{4} $\underline{e}^2$ ji^3	'I see it (prison)'	$\underline{e}$-^{3} kadɛ$^{3.2}$	'It (prison) is big.'
b. kʷal$\underline{a}^{4.2}$	'a farm'	e-^{4} ni-^{4} $\underline{ə}^2$ ji^3	'I saw it (farm)	$\underline{ə}$-^{3} kadɛ$^{3.2}$	'It (farm) is big.'
c. t$\underline{o}^3$	'battle'	e-^{4} ni-^{4} $\underline{u}^2$ ji^3	'I saw it (battle)'	$\underline{u}$-^{3} kadɛ$^{3.2}$	'It (battle) is big.'

As above, the antecedent does not have to be in the same utterance, nor nearby in the discourse for this agreement to hold.

Examples of words that fall into each class are given below. Note that there is no semantic distinction between the groups. For example, there are body parts, animals, large things, and small things in all of the categories. The word for a small spider falls into the /e/ category and the word for a big spider falls into the /ə/ category, though neither of these classes is limited to small or large things. 'Bee' and 'honey' – which is derived from 'bee' – are in the /e/ category, but 'beehive', also derived from 'bee', is in the /ə/ category.

(11) **Words that take the front vowel pronoun, /e/**

kʷəli$^{2.4}$	'face'	dʒɔkʷɪ$^{2.3}$	'bird species'
ŋəte$^{3.1}$	'yam'	gbele$^{3.2}$	'cola nut'
nove$^{2.3}$	'bee'	nove$^{2.4}$-kpe^2	'honey'
dʒe^2	'leopard'	tɛlɛ$^{3.2}$	'snake'
dʒakʷɛlɛ$^{2.3.2}$	'small spider'	pɔpɛ$^{2.3}$	'leaf'

(12) **Words that take the central vowel pronoun, /ə/**

ɠama$^{2.2}$	'big spider'	ma^1	'butt'
takʷa$^{3.2}$	'basket'	nove$^{2.4}$-ɠuɓə$^{3.1}$	'bee hive'
dʒaɓə$^{3.1}$	'coconut'	dʒukpə$^{3.1}$	'bracelet'
ɓitə$^{2.3}$	'house'	uɓə$^{3.1}$	'head'

(13) **Words that take the back vowel pronoun, /u/**

nukpu$^{4.4}$	'quill (pen)'	kasu$^{3.2}$	'fire'
sabu$^{3.2}$	'night'	nɔpɔpʊ$^{2.4.3}$	'palmwine'
sio$^{2.2}$	'snail'	gbo^2	'dispute'
go^3	'abdomen'	takpɔ$^{2.3}$	'cheek'

The phonological assignment of nouns to noun classes is not only predictable for Guébie lexical items, but also for loan words (14) and nonce words (15).

9

(14) **Phonological agreement in loan words from English/French**

    a.   sukul**u**$^{1.1.3}$ kɔda.$^{3.21}$ e-^{4} ni-^{4} **u**^{2} ji^3
        school   exist.   I   see.PFV 3SG.ACC see

        'There is a school. I saw it (the school).'

    b.   baraʒ**ɛ**$^{2.3.2}$ kɔda.$^{3.21}$ e-^{4} ni-^{4} **e**^{2} ji^3
        dam   exist.   I   see.PFV 3SG.ACC see

        'There is a dam. I saw it (the dam)'

(15) **Phonological agreement in nonce words**

    a.   fo^2 kɔda.$^{3.21}$ e-^{4} ni-^{4} **u**^{2} ji^3
        Nonce-word exist.   I   see.PFV 3SG.ACC see

        'There is a NONCEWORD. I saw it (the NONCEWORD).'

    b.   gbele$^{4.3}$ kɔda.$^{3.21}$ e-^{4} ni-^{4} **e**^{2} ji^3
        Nonce-word exist.   I   see.PFV 3SG.ACC see

        'There is a NONCEWORD. I saw it (the NONCEWORD).'

When a Guébie speaker asks about an unknown object, like "What is it?", he/she uses the front-vowel pronoun, /e/ which is the same pronoun used to replace the word /ɓe^3/, 'thing'. Thus, this is not a default pronoun, but rather the speaker is asking something like, "What is that thing?"

(16) **No default pronoun in Guébie**

    a.   (ɓe^3)   e^3 le^2 na^2
        (thing) 3SG.NOM be.IPFV Q

        'What is it/that?'

    b.   (li^3)   i^3 le^2 na^2
        (things) 3PL.NOM be.IPFV Q

        'What are they/those?'

The choice of nominative pronoun in (16) is determined by the final vowel of the words for 'thing, things'. This shows the lack of a default pronoun and the full phonological predictability of the Guébie system.

There are examples of animals, liquids, large and small objects, round objects, nature, animates, and inanimates in each of the three non-human classes in Guébie, which shows that Guébie noun class assignment is not semantically coherent. However, it is likely that this system stems from a semantically determined Proto-Kru noun class system (Marchese Zogbo, 2012). Some Kru languages show tendencies for like-things to have the same final vowel, such as Godié (Marchese, 1986b), though others, like Guébie, Tepo (Dawson, 1975), and Krahn (Bing, 1987), show no semantic coherence of classes and are phonologically predictable. It seems that in Guébie, Tepo, and Krahn, at least, the Proto-Kru semantic noun class system has been reanalyzed as a phonologically determined agreement system.

3.4 Phonological agreement between nouns and modifiers

The same agreement pattern found in noun/pronoun agreement in Guébie also holds between nouns and the final vowel of adjectives that directly modify them (17).

(17) **Noun-modifier phonological agreement**

    a. bit$\underline{\partial}^{2.3}$ lel$\underline{\partial}^{1.2}$ ɟɛl$\underline{a}^{1.1}$ b. f$\underline{u}^{3}$ lel$\underline{o}^{1.2}$ ɟɛl$\underline{\mathwordbox{}}^{1.1}$
        house new red   sponge new red
        'A new red house'   'A new red sponge'

Word-internal ATR harmony influences the quality of the final vowel of the adjectives; however the backness and rounding values of the final vowel are determined by the final vowel of the noun. That is, the difference between the final /ə/ on 'house' and 'new' versus the final /a/ on 'red' in (17a) is due to ATR harmony with the root.

Adjectives surface after nouns and before numerals within a noun phrase. There are only six adjectives that can directly modify nouns in Guébie, while other modifiers are predicative, surfacing with verbal morphology. Those adjectives that can surface within a noun phrase include 'big, small, new, red, black, white'. All six of these adjectives can also surface predicatively; but it is only these six adjectives that can directly modify nouns within a noun phrase.

I return to noun-modifier agreement in more detail in Section 5.2.

4 An interface model of phonologically determined agreement

4.1 Considering possible analyses

Based on the facts in section 3, one might consider pursuing a purely phonological analysis in accounting for the Guébie data. This could take the form of an Agreement-By-Correspondence (ABC) (Rose and Walker, 2004) analysis stipulating that the pronoun and its antecedent are in correspondence and requiring phonological identity between the two. However, because Guébie nominal agreement is non-local, and the head noun need not be in the same utterance or even in the same discourse for agreement to hold, a purely phonological analysis will not suffice (Author).

Agreement by Correspondence requires agreeing elements to be overt and within the same local domain so that one element can copy features from the other. Because agreement between a noun and pronoun is required in Guébie even when the noun is not present (18), Agreement by Correspondence is not enough, at least on its own, to account for the phonological agreement of pronouns with nouns in Guébie. The example in (18) shows that even when a noun is not pronounced in the discourse, it can still control agreement of a pronoun referring to it.

(18) **Agreement without an overt noun**

- *Context: There are eggplants (trobiə$^{3.2.2}$) on the table. You and your wife are sitting next to the table talking about going to the market, when all of a sudden the eggplants start to roll off the table.*

11

- *Response:*

  ə³   ka³   briɟo²·³
  3SG.NOM PROS fall

  'It is going to fall!'

In the context above, the word 'eggplant', /trobiə³·²·²/ had not been uttered aloud, however, the pronoun must surface with the agreeing vowel [ə³] and not another third person singular pronoun vowel *[e, u, ɔ]. A purely phonological approach cannot account for agreement between a pronoun and a noun absent in the discourse.

Alternatively, a purely syntactic account could take one of three forms:

1. Phonological features are present in the syntax and available for copying during morphosyntactic agreement processes.

2. Final vowels on nouns, and their agreeing pronoun vowels, are simply arbitrary noun classes that coincidentally surface as entirely phonologically predictable.

3. Phonological agreement is the result of multiple copy spellout of the noun. This is proposed by Dimitriadis (1997) for Bainuk (Atlantic) and Abuq (Arapesh).

I consider option one above a last-resort strategy, because it requires defying accepted theoretical claims that syntax does not have access to phonological information (Pullum and Zwicky, 1986, 1988). This particular objection is an architectural one. A model of grammar which disallows syntactic sensitivity to phonological features, like the Y-model, is more restrictive than one which allows phonology to affect syntactic operations.

Option two above is entirely arbitrary, where all lexical items are indexed for noun class, and the fact that the phonological form of the pronoun is predictable given the form of the noun is just a coincidence. While this analysis is feasible, it assumes that all noun class assignments are memorized rather than fully productive. Additionally, this analysis predicts exceptions to the phonological predictability of the Guébie agreement system, and it might also predict a default noun class for loan words or certain semantic categories. Because we find no exceptions and all pronoun agreement is predictable based on the phonological features of the noun, this analysis is unsatisfying. It fails to capture the generalization that all noun-pronoun agreement is phonologically predictable. A better analysis would predict this agreement, rather than claim it is coincidental.

I set aside Option 3 above because it is uneconomical compared to alternative analyses. A Guébie noun phrase like (17) would require three copies of the noun to be present in the syntactic structure, where one of them is fully pronounced and the other two are partially pronounced. There is no supporting evidence, syntactic or morphophonological, for such redundancy in Guébie.

Here I propose a novel model of phonologically determined agreement which relies on specific interactions between morphology and its interfaces. Unlike the above analyses, the model proposed here predicts the phonological determinedness of the Guébie system, and it does not require that syntax be sensitive to phonological features. In addition to accounting for phonologically determined agreement in a manner coherent with extant current linguistic theories, this model also involves explicitly details how ellipsis occurs at PF.

The proposed analysis assumes a Distributed Morphology style model of grammar, where syntax precedes morphological operations which precede phonology (Halle and Marantz, 1994).

As a brief summary, I claim that in noun phrases involving phonologically determined agreement in Guébie, the agreement-controlling noun must be present. This is the structure of full noun phrases, but also of pronoun D-heads, where nouns may or may not actually pronounced but either way pronouns agree with them. During the morphological component, an Agr(eement) node is inserted on the pronoun, and features of the noun are copied to it. The phonology, which applies at phase boundaries, has access to the morphosyntactic features of heads within that phase, and phonological constraints ensure phonological identity between those heads in the DP which agree in specific features. Ellipsis of the noun optionally occurs at PF, licensed by overt phonological agreement between the noun and the pronoun. The proposed analysis is outlined by the diagram in (19) and is detailed in the remainder of this section.

(19) **Diagram of the proposed analysis**
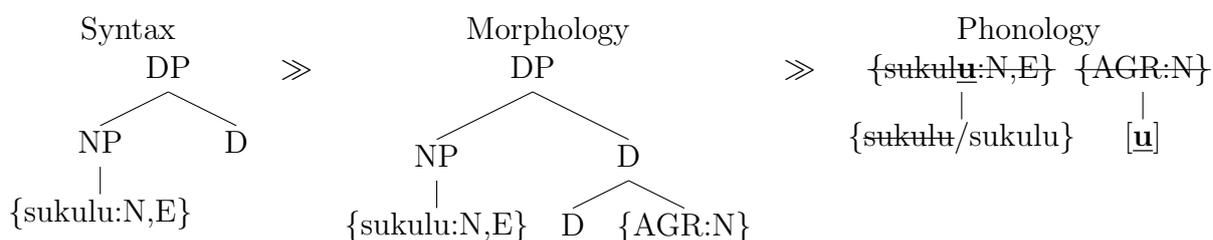
4.2 The syntactic structure

Each instance of phonologically determined agreement, or nominal concord, in Guébie, requires that the agreement-controlling noun be present in the DP in which agreement takes place, at least at the syntactic level. We know that pronouns and adjectives agree with nouns in Guébie. I focus here on deriving pronoun agreement and turn to adjectives in section 5.2.

Personal pronouns in Guébie are in complementary distribution with the definite marker, /-a/, (20e). This is evidence that pronouns are D-heads. This is consistent with analyses that liken the structure of third-person pronouns to that of definite markers (Postal, 1966; Elbourne, 2005; Arkoh and Matthewson, 2013). Like the definite marker, pronouns can occur with an overt noun, similar to the 'we linguists' construction in English, (20c), except that in Guébie it is not restricted to first and second persons. This Noun-Pronoun construction is distinct from topic, focus, and definiteness in Guébie, though I leave its exact semantic interpretation for future work.

As expected, pronouns can also surface with a covert agreement-controlling noun, which I analyze as pronouns licensing ellipsis of their nominal complement, (20d).

(20) **Distribution of definite markers and pronouns**

a. sukulu$^{1.1.3}$ 'school'   d. u^3 'it' (the school)
b. sukulu-a$^{1.1.3.3}$ 'the school'   e. *sukulu-a$^{1.1.3.3}$ u^3 'it the school'
c. sukulu$^{1.1.3}$ u^3 'it school'   f. *wa   'the (one/school)'

A DP containing a pronoun can surface either as [[Noun] Pronoun] or [[~~Noun~~] Pronoun]. Either way, I claim that the syntactic structure is as shown in (21). This follows from Elbourne (2001)'s analysis of e-type pronouns, which says that the nominal antecedent of a pronoun is always present in the syntax as complement to the pronoun D-head.

(21) **Syntax of pronoun DPs in Guébie**

```
              DP
            /    \
          NP      D
          |
      {sukulu:N,E}
```
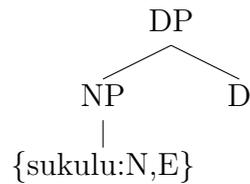
The features on the noun in (21) are N for 'noun' and E for 'ellipsis'. Both are explained further in the following sections.

The structre in (21) is identitcal to the structure of a definite DP. This follows Postal (1966); Elbourne (2005); Arkoh and Matthewson (2013) in unifying the structure of determiners and third-person pronouns.

4.3 The morphological structure

In the proposed model, morphology and phonology apply cyclically to syntactic structures by phase (Marvin, 2002), and each DP is a phase (Svenonius, 2004). Thus, morphology takes the structure in (21) as an input. Via regular Distributed Morphology agreement mechanisms, an AGR-node is inserted on D, and the N feature is copied to it from the noun (cf. Halle and Marantz 1994). Node insertion in Distributed Morphology occurs only when the relevant morphological features have no bearing on semantics. That is, only those terminal nodes which affect the truth value of the sentence are present in the syntax, and others are inserted during the morphological module of grammar. See Norris (2014) for a previous analysis of nominal concord where AGR-nodes are inserted in the morphological component.

This insertion of an AGR-node on D is where the derivation of definite markers and pronouns differ. The definite marker does not undergo agreement with the noun in Guébie; only the features of the pronoun D-head trigger the insertion of an AGR-node. Morphological agreement proceeds as shown in (22).

(22) **Morphological agreement**

```
                 DP
               /    \
             NP       D
             |       /  \
       {sukulu:N,E}  D   {AGR:N}
```
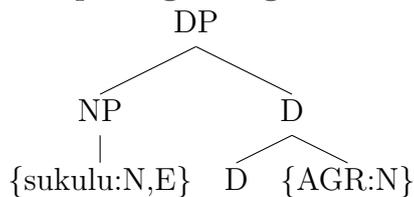
After AGR-nodes are inserted, the morphological structure in (22) is linearized via Distributed Morphology Linearization mechanisms (as laid out by Embick 2010). Note that in the proposed analysis, the morphological features associated with terminal nodes are preserved through morphology, including Linearization, and are available to the phonology.

4.4 The phonology

Here I adapt a constraint-based approach, combining Agreement-by-Correspondence (Rose and Walker 2004) with paradigm output-output faithfulness (Burzio, 1994; Benua, 1997; Kager et al., 1999). While a derivational or rule-based approach to this phonological system could yield the same results, I discuss in section 4.5 why a constraint-based approach is preferable for our purposes.

While I choose to show an analysis evaluated in parallel, a constraint-based approach using strata, like Stratal OT (Kiparsky, 2000, 2008; Bermúdez-Otero, 1999) would work equally as well as the parallel approach provided here. Since my point here is not to choose between a parallel and stratal phonology, but rather to show that a model of grammar where phonology follows morphosyntax can account for phonologically determined agreement, I set aside the differences between a stratal and parallel approach and use a parallel one for simplicity.

To arrive at the correct output [sukulu u] or [s̶u̶k̶u̶l̶u̶ u] based on the linearized input in (23), we need a constraint ensuring identity between the final vowel of the noun and the vowel of the pronoun. This is accomplished with ANCHOR-R, which anchors agreement to the right edge of a word, (24)

(23) **Morphosyntactic input to phonology**
{sukulu:N,E} {D:AGR:N}

(24) **Anchor-R** (McCarthy and Prince, 1993)
Segments at the right edge of agreeing heads correspond.

This constraint is only active if the heads in question agree in some morphosyntactic feature. If they do agree morphosyntactically, segments at the right edge of each head will correspond. We also need a constraint ensuring that heads in correspondence are phonologically identical. I propose an output-output identity constraint IDENT-OO(N) which says that heads that agree in the feature N must be phonologically identical.

(25) **Ident-OO(N)** (Benua, 1997)
Heads that Agree in N must be phonologically identical.

The combination of these two constraints has the result that two heads agreeing in N within the same spellout phase will be phonologically identical, starting from the right edge of the word. However, if left unconstrained, this combination will result in the unattested optimal output [sukulu sukulu], where the pronoun is identical to the entire phonological form of the noun. This can be avoided with a *STRUC constraint, which penalizes extra structure (segments).

(26) ***Struc(ture)** (Prince and Smolensky, 1993)
Assign one violation for each output segment.

The tableau below shows that the presence of IDENT-OO(N) rules out a pronoun vowel that does not agree phonologically with the noun (27d). ANCHOR-R rules out a pronoun that is phonologically identical to the left edge of the noun (27c). *STRUC is necessary to rule out a pronoun that copies the entire phonological form of the noun, or even anything more than a single segment (27b). The justification for the ranking in (27) follows.

(27) **Ident-OO(N), Anchor-R ≫ *Struc**

{sukulu:N,E} {D:N}	ID-OO(N)	ANCHOR-R	*STRUC
☞a. sukulu u			7
b. sukulu sukulu			12!
c. sukulu s		*!	7
d. sukulu e	*!		7

The combination of the correspondence constraint ANCHOR-R and the indentity constraint IDENT-OO follows from the assumptions of Agreement-by-Correspondence (Hansson, 2001; Rose and Walker, 2004).

While the tableau in (27) rules out a number of unwanted candidates, without an additional constraint, the candidate [sukulu] with a null pronoun would beat the optimal candidate. We must ensure that the pronoun surfaces overtly, despite its lack of phonological feature information in the input. This can be assured with a REALIZEMORPHEME constraint, which penalizes an output candidate that does not overtly realize an input morpheme, (28).

(28) **RealizeMorph(eme)** (Kurisu, 2001)
Assign one violation for each input morpheme that is not phonologically realized in the output.

This constraint must be ranked above *STRUC. A highly ranked *STRUC would prefer a candidate with fewer output segments to one with a pronounced pronoun, resulting in the opposite outcome in (29).

(29) **Ident-OO(N), Anchor-R, RealizeMorph ≫ *Struc**

{sukulu:N,E} {D:N}	ID-OO(N)	ANCHOR-R	REALIZEMORPH	*STRUC
☞a. sukulu u				7
b. sukulu			*!	6

While the constraints in (29) explain why we get a surface pronoun that is a single segment and agrees with the final segment of the noun, they do not explain why the features of the final vowel of the output noun are identical to the input features. That is, why don't we have an optimal output candidate [sukule e]? This is solved with a highly ranked IDENT:IO constraint.

(30) **Ident-IO** (Prince and Smolensky, 1993)
Assign one violation for each output segment whose features differ from the corresponding input segment.

Similarly, we want to avoid deleting input segments in a candidate like [suku u]. While this would satisfy *STRUC, Guébie never uses deletion of input segments as a repair to satisfy other constraints. Thus, we need a constraint like MAX.

(31) **Max** (McCarthy and Prince, 1993)
Assign one violation for every input segment that lacks a corresponding output segment.

Additional constraints such as PERIPHVOWEL preferring peripheral vowels and *i dispreferring the output segment [i] in Guébie account for the reduced number of pronoun vowels [3] compared to the full Guébie vowel inventory [10]. As this is secondary to the point of this section, I leave these constraints out of the tableau below.

Ranked as in (32), the above constraints lead to the correct output of a [[Noun] Pronoun] structure, where both the noun and the pronoun are overt. These constraints ensure that the pronoun agrees phonologically with the final vowel of the noun in question.

(32) **Ranking:** IDENT-OO(N), ANCHOR-R, IDENT-IO, MAX, REALIZEMORPH ≫ *STRUC

For those cases where a pronoun surfaces without a nominal complement I posit that the noun is present in the syntax but is elided at PF, [s̶u̶k̶u̶l̶u̶ u] (cf. Merchant 2001; Lasnik 2007). Constituents that can optionally be elided are marked with a feature E in the syntax (Merchant, 2001), and here I propose a new model of ellipsis where the phonology has access to the E feature of the noun, just as it has access to other morphosyntactic features. The option of eliding the noun is then determined via constraints.

The constraint in (33) is an output-output paradigm correspondence constraint, which ensures that the phrase (or syntactic phase) containing the elided element is as similar to the optimal non-elided output as possible. For example, the elided form [s̶u̶k̶u̶l̶u̶ u] must be faithful to the non-elided [sukulu u].

(33)   **Faith-NoElide**
       For each form in an ellipsis paradigm, assign one violation for each output segment whose features differ from corresponding output segments across the paradigm.

In an output-output paradigm correspondence model such as this, candidates consist of paradigms, which are evaluated together as a unit. We see that in Guébie, when DPs containing elided and non-elided nouns are evaluated together in a paradigm, the undominated constraint (33) together with those constraints in (32) gives the correct output. That ellipsis can be sensitive to unpronounced material is well known (Merchant 2015:16), and here I propose a model to account for that fact.

(34)   **A constraint-based approach to ellipsis**

{sukulu:N,E} {D:N}	Faith-NoE	Id-IO	Id-OO(N)	Anchor	Realize	Max	*Struc
☞a. sukulu u, u					*	6	8
b. sukulu u, Ø					**!	6	7
c. sukulu s, s				*!	*	6	8
d. sukulu e, e			*!		*	6	8
e. sukule e, e		*!			*	6	8
f. sukulu u, e	*!				*	6	8

This analysis forces phonological agreement and provides the option of ellipsis at PF simultaneously via constraints. Note that this analysis predicts the optionality of ellipsis at PF. A terminal node which has a morphosyntactic E features (which is available to the phonology), can optionally be elided via an ellipsis paradigm at PF, as in (34).

The resulting model is as shown in (35), where the noun with an E feature is present in the syntax as complement to the pronoun D-head. An AGR-node is inserted on the D-head during morphology, and linearization takes place. The phonology has access to the linearized terminal nodes and their features, and it ensures phonological identity between nodes that agree in morphosyntactic features. Optionally, the noun with an E-feature is elided, but the elided DP must be as similar to the non-elided one as possible, resulting in agreement between noun and pronoun, even when the noun is not pronounced.

(35)   **An interface model of Guébie pronoun DP agreement**

17
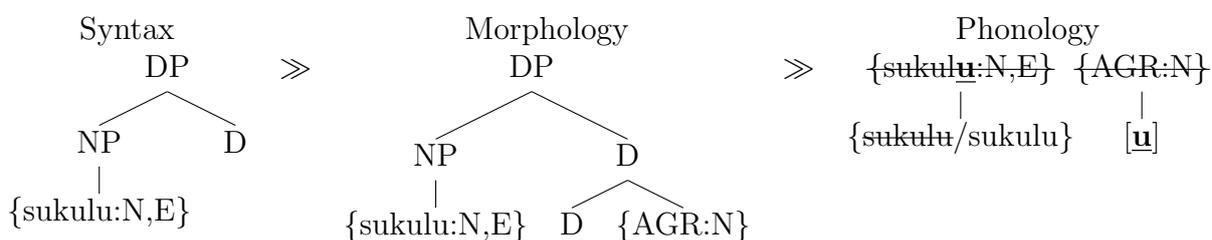
4.5 Typological predictions

The constraints presented in section 4.4, together with the proposed syntactic and morphological structure of the DP, account for the Guébie noun/pronoun phonological agreement data in section 3. The same analysis explains the phonological agreement in nominative, accusative, emphatic, and possessive pronouns in Guébie; all involve a pronoun D head with an optionally elided nominal complement. We will see that the proposed analysis not only also accounts for the human pronouns and noun/adjective agreement in Guébie, but it also accurately predicts the types of existing phonologically determined agreement systems cross-linguistically.

The analysis in section 4.2 relies on the fact that DP is a syntactic phase, and that morphology and phonology apply cyclically by phase. It predicts that any two elements within the same syntactic phase could show phonological agreement, as long as those two elements share some morphosyntactic feature. Recall that I claim morphosyntactic features are available to phonology. While I do not address it further here, I do not rule out phonologically determined subject or object agreement on a verb, as long as the agreement controlling element is inside the same syntactic phase as the verb itself.

Additionally, due to the nature of correspondence and identity constraints, the phonologically corresponding segments in the morphosyntactically agreeing elements must be either edge-based or surface in some prominent position in a word. The ANCHOR-R constraint in Guébie ensures correspondence at the right-edge of the noun and pronouns. However, we could imagine a system where ANCHOR-L is at play instead, requiring that corresponding segments be anchored to the left edge of the agreeing elements.

Perhaps a more specific statement of the prediction above, only an edge-aligned or prominent segment (or, perhaps, suprasegmental) can control phonological agreement. We saw in section 4.4 that IDENT-OO(N) ensures that the final segment of two elements with N features are identical. This means that in Guébie, the final vowel of the noun will control agreement. Rather than a final vowel, we could imagine a system where the agreement controlling segment is a consonant or suprasegmental.

The above predictions are summarized in (36).

(36) **Predictions of the model**

    A. Only elements within the same syntactic phase can surface in phonological agreement.

    B. Phonologically corresponding segments will be edge-based or surface within some prominent position in a word.

    C. Any edge-aligned or prominent segment or suprasegmental can control agreement.

In section 5.1 I show that the model holds for human pronouns and in section 5.2 for noun/adjective agreement in Guébie. In sections 5.3-5.5 I turn to other attested phonologically determined agreement systems. Very few languages outside of Kru have been described as having such systems; however, in those few other languages with phonologically determined agreement, we see the above predictions born out.

5   Extending the model to other cases of phonologically determined agreement

5.1   Guébie human pronouns

Recall that human pronouns in Guébie do not follow the phonological agreement pattern that all other nouns follow. Instead, they predictably take the forms /ɔ/, singular, and /wa/, plural. I repeat the pronoun chart for Guébie from (7) in (37) below.

(37)   **Human and non-human subject pronouns**

	Human			Non-human	
	Singular	**Plural**		**Singular**	**Plural**
1st	e^4	a^3	**1st**	–	–
2nd	e^2	a^2	**2nd**	–	–
3rd	ɔ^3	wa^3	**3rd**	e^3,ə^3,u^3	i^3,wa^3

The model described in section (4) needs to be modified only slightly to account for human pronouns in Guébie. We saw that nouns are present in the syntax as complement to pronouns, and their features are copied to the pronoun via a morphological AGR node. I claim here that human nouns not only have a [Noun] feature which is copied to the pronoun, they also have a [Person] feature (Richards, 2008; Van der Wal, 2015). This is summarized in (38) and exemplified for *ŋudi* 'man' in (39).

(38)   **Pronoun features and realization**

Human	Nonhuman
[+person]	[-person]
/ɔ, wa/	/e, ə, u, i, wa/
semantically determined	phonologically determined

(39)   **Syntactic representation of human pronouns**

$$
\begin{array}{c}
\text{DP} \\
\diagup \quad \diagdown \\
\text{NP} \qquad \text{D} \\
| \\
\{\text{ŋudi:N;Person:3;Sg;E}\}
\end{array}
$$
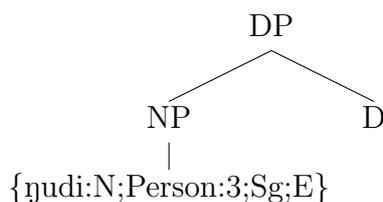
When features are copied from a human noun to the AGR node on the pronoun D, [Person] and [Number] features are copied along with the [Noun] feature.

(40)   **Morphological agreement between human nouns and pronouns**

$$
\begin{array}{c}
\text{DP} \\
\diagup \quad \diagdown \\
\text{NP} \qquad\qquad \text{D} \\
| \qquad\qquad \diagup \quad \diagdown \\
\{\text{ŋudi:N;3;Sg;E}\} \quad \text{D} \quad \{\text{AGR:N;3;Sg}\}
\end{array}
$$
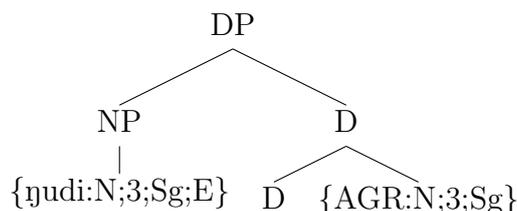
Then, during Vocabulary Insertion, this particular bundle of features is spelled out as [ɔ], as in (37). That is, the 3rd singular human vocabulary item /ɔ/ has the spellout conditions: [+3sg +N, ___]. This differs from all non-human nouns which are not marked for person or number features in the syntax.

(41) **Phonological representation of human pronouns**

<div align="center">

{ŋ̶u̶d̶i̶:N;**Pers:3,Sg**;E̶}   {AGR:N;Pers:3,Sg}

| |

{ŋ̶u̶d̶i̶/ŋudi}   [ɔ]

</div>

We see that if certain semantic features of the noun (person, number) are copied to the pronoun D via morphological agreement mechanisms and spelled out by a vocabulary item with specified phonological features ([PERS:3SG → [ɔ]), that vocabulary item is not subject to phonological identity. Instead, we can imagine a highly ranked constraint ensuring faithfulness to the phonological content inserted during Vocabulary Insertion. This IDENT-IO constraint must be ranked higher than the IDENT-OO constraints requiring phonological agreement between agreeing elements in the DP.

It seems, then, that phonological identity between the pronoun and agreement-controlling noun is a last resort agreement strategy in Guébie. Specifically, phonological identity holds only in those cases where there is no relevant vocabulary item with specified phonological content to insert. This fact follows from Corbett (1991)'s generalization that when semantic and phonological criteria for determining noun class are at odds, semantics takes precedence.

5.2 Guébie adjectives

Adjectives in Guébie agree in final vowel with the noun that they modify.

(42) **Noun-modifier phonological agreement**

  a. bit**ə**[2.3] lel**ə**[1.2] ɟɛl**a**[1.1] b. f**u**[3] lel**o**[1.2] ɟɛl**ɔ**[1.1]
    house new red   sponge new red
    'A new red house'   'A new red sponge'

We can derive this agreement in the same way as noun-pronoun agreement. Syntactically, nouns and the adjectives that directly modify them are present in the same syntactic phase (DP). Then an AGR node is inserted on the adjective by the morphology. Features of the noun are copied to the adjective so that the adjective and noun are in morphosyntactic agreement. The phonology ensures that agreeing heads (the noun and its adjectival modifiers) are phonologically similar via the constraints discussed in section 4.

Further evidence that noun/adjective agreement works the same way as noun/pronoun agreement comes from ellipsis. In the same way that pronouns license ellipsis of their nominal complement (20d), adjectives that agree with the head noun license ellipsis of that noun, (43).

(43) **Overt agreement on adjectives licenses ellipsis of the noun**

  a. lel**ə**[1.2] ɟɛl**a**[1.1]   b. lel**o**[1.2] ɟɛl**ɔ**[1.1]
    new red   new red
    'A new red one' (house) 'A new red one' (sponge)

Just like optional nominal ellipsis in [[Noun] Pronoun] constructions, [Noun [Adjective]] candidates are evaluated in paradigms, with two forms in each paradigm: one where the noun is elided and one where it is overt. A FAITH-NOELIDE constraint ensures output-output paradigm faithfulness so that the adjective agrees phonologically with the noun even when the noun is elided. The relevant constraint ranking is identical to the one shown for noun/pronoun agreement in in (34).

Though they are few, other languages have also been described to have phonologically determined agreement systems. These include other Kru languages, Bainuk (Atlantic), and Abuq (Arapesh). Like Guébie, phonological agreement in each of these other languages is productive, predictable, and non-local. These are discussed in the remainder of this section.

5.3 Kru languages

A similar phonologically determined agreement system to Guébie is present in other Kru languages. These include but are not limited to Krahn, a Western Kru language (Bing, 1987); Godié, an Eastern Kru language (Marchese, 1986b, 1988); Vata, an Eastern Kru language (Kaye, 1981; Marchese, 1979; Corbett, 1991).

5.3.1 Krahn

Bing (1987) describes an agreement pattern in Gbɔbo, a dialect of Krahn (Western Kru) spoken in Liberia and Côte d'Ivoire, that is quite similar to the Guébie pattern. There are nine vowels in the Krahn system, and there are four possible third-person singular pronouns vowels: one for humans and three phonologically determined ones for non-humans. Non-human nouns that end in front vowels take the front vowel pronoun ɛ, those that end in non-high back vowels take the pronoun vowel ɔ, and those that end in high back vowels take the pronoun vowel ʊ.

(44) **Krahn phonological agreement**

Noun	Gloss	Pronoun
ɟi	'leopard'	ɛ
ni	'water'	ɛ
kasee	'cassette'	ɛ
gba	'dam'	ɔ
sɔɔ	'basket'	ɔ
pu	'gun'	ʊ
tau	'basket'	ʊ
dʊ	'honey'	ʊ

Since the Krahn system is so similar to the Guébie one, it requires no extra theoretical tools to account for the data. The proposed model would apply to Krahn just as it does to Guébie, ensuring phonological agreement between the final vowel of the noun and pronoun unless the noun is human, in which case the semantic features win out. The only significant difference is that Bing does not mention any category of element other than pronouns that agrees with the noun in Krahn. If adjectives do not agree phonologically with the nouns they modify, we can assume that adjectives in Krahn do not agree *morphologically* in features with nouns; thus, no phonological identity is required to hold between them.

5.3.2 Godié

Godié is an Eastern Kru language spoken in Côte d'Ivoire. Just like Guébie and Krahn, there are four possible pronoun vowels in Godié: one human vowel and three phonologically determined vowels. However, Godié agreement processes target not only pronouns, but also definite clitics, demonstratives, and adjectives (Marchese, 1986b, 1988).

In the Godié example below, the human word 'man' triggers the agreement vowel [ɔ] on the adjective and demonstrative following it. The final front vowel of the word 'animal' triggers the front agreement vowel [ɛ] on the adjective [kəd-ɛ] that describes the word 'animal.'

(45) **Godié pronoun agreement**

ɲʊkpɔ̠ kəd-ɔ̠ nɔ̠ nii mlɛ kəd-**ɛ**
man big this saw animal big

'This big man saw the big animal.'

Since demontratives, definite clitics, pronouns, and adjectives are all within the DP domain, all of them should be equally likely to agree with the noun. I have proposed that the phonology applies by phase, and that DP is a phase, so the phonological analysis applies to any two elements within a DP phase as long as they are in morphosyntactic agreement. Thus, the difference between the Godié agreement system and the Guébie system is that in Godié demonstratives and definite markers are in morphosyntactic agreement with the noun, while in Guébie they are not. Guébie lacks demonstratives entirely but has a definite clitic /-a/ which surfaces on the noun. Further research is need to determine whether there are any true syntactic difference between Guéibe and Godié definite markers which shows that they are in agreement with the noun in Godié but not Guébie. What matters for this analysis, though, is that demonstratives and definite markers in Godié agree *morphologically* with the head noun.

5.3.3 Vata

Vata is an Eastern Kru language spoken in south-central Côte d'Ivoire (Kaye, 1981). The Vata system differs slightly from the phonological agreement systems of other Kru languages discussed thus far. There are ten contrastive vowels in Vata, at five places of articulation with an ATR contrast, /i, ɪ, e, ɛ, u, ɯ, o, ɔ, ə, a/. Rather than three possible non-human pronoun vowels like Guébie, Krahn, and Godié, Vata has five non-human pronoun vowels: one for each of the five degrees of height/backness, underspecified for ATR value, /ɪ, ɛ, ɯ, ɔ, a/.

Agreement holds between a noun and a personal pronoun in Vata, as well as between a noun and a relative pronoun, as shown in (46).

(46) **Pronouns in Vata**

Nouns	Glosses	Pronoun-be.big	Relative Pronoun
lɪ, di	'songs, villages'	ɪ-ɣli	mɪmɪ
cɪcɛ, ɓle	'eagle, cow'	ɛ-ɣli	mɛmɛ
gɔlɯ, du	'progue, village'	ɯ-ɣli	mɯmɯ
lagɔ, deto	'god, spider'	ɔ-ɣli	mɔmɔ
jla, slə	'lion, home'	a-ɣli	mama

I have chosen one noun ending in a +ATR and one ending in a -ATR vowel for each of the five height/backness distinctions in (46). The pronoun and relative pronoun themselves remain -ATR even when the noun ends in a +ATR value. Only the backness, height, and rounding of the vowel is determined by the final vowel of the noun.

Extending the analysis from section 4 to Vata agreement, we would only need to rerank certain constraints to get the right output. In Guébie, there is a ten-vowel system in the language which is reduced to three possible agreeing vowels for non-human pronouns. I mentioned in section 4 that in order to account for the reduced number of possible pronoun vowels in Guébie, [e, ə, u] as opposed to the full ten [i, ɪ, e, ɛ, ə, a, u, ʊ, o, ɔ], we would need constraints like PERIPHERALVOWEL which prefers the peripheral vowels /i, ə, u/, and *i to prefer /e/ to /i/. In Guébie these constraints must be highly ranked, only crucially out-ranked by IDENT-IO. However, in Vata, the same constraints must be very low-ranked, because they play no role in the Vata agreement system. In Vata, for every distinct final vowel on nouns, there is a corresponding pronoun vowel that has the same height, backness, and rounding features. Only the ATR features of the pronoun are pre-specified on the pronoun vowel in Vata. Thus, by simply ensuring that IDENT-OO outranks PERIPHERALVOWEL and other such vowel markendess constraints, we get the correct output for Vata without otherwise changing the analysis for Guébie presented in section 4.

It is worth noting that the kind of minor typological variation we see between Guébie and Vata is predicted by a constraint-based analysis like the one presented here, but is less obviously expected in a rule-based phonology or a purely syntactic approach to phonologically determined agreement.

5.3.4   Summary of Kru phonological agreement

Krahn and Godié, like Guébie, have three possible forms for non-human third-person singular pronouns. The optimal form is the one that agrees with the noun phonologically. In Vata, there are five possible vowels for non-human third-person singular pronouns, where height and backness, as opposed to just backness of the pronoun vowel is determined by the final vowel of the noun.

(47)   **Phonological agreement across Kru**

	Guébie	**Krahn**	**Godié**	**Vata**
Number of Agreeing Vowels	3	3	3	5
(Non-human) Pronoun-Noun	Yes	Yes	Yes	Yes
Possessive-Noun	Yes	Yes	Yes	Yes
Adjective-Noun	Yes	No	Yes	No
Demonstrative-Noun	N/A	No	Yes	No
Definite-Noun	No	No	Yes	No
Relative Pronoun-Noun	No	No	No	Yes

The phonologically determined agreement systems in Krahn, Godié, and Vata all closely resemble the Guébie system except that a different set of elements agrees with the noun in each language. However, because all of the agreeing elements occur within the DP phase, each system above is predicted by the proposed analysis (cf. Prediction A, 36).

5.4 Bainuk

Bainuk, a Western Atlantic language spoken in Senegal and Guinea (Sauvageot, 1967), also shows phonological agreement within DPs. Most nouns in Bainuk take one of 18 fixed noun class prefixes; however, there is a class of prefixless nouns that triggers phonologically determined agreement. Prefixed nouns are much like human pronouns in Guébie, where semantic feature bundles determine the agreement marker; however, agreement class of prefixless nouns can be derived phonologically in the same way as the phonologically determined non-human pronouns.

(48)　**Bainuk prefixed nouns**

Singular	Plural	Gloss
si-nɔx	mu-nɔχ	'tree'
si-deːn	mu-deːn	'pirogue'
gu-sɔl	ha-sɔl	'tunic'
bu-sumɔl	i-sumɔl	'snake'
bu-domel	i-domel	'papaya'

　　Demonstratives (49a), numbers (49b), interrogatives (49c), pronouns (49d-e), and adjectives (49f) agree in noun class with the prefixing nouns. Prefixed nouns are marked for plural number by changing the noun class prefix.

(49)　**Prefixed noun agreement**

a.　s̲i̲-deːn-o in-s̲i̲
　　pirogue　this

　　'this pirogue'

b.　m̲u̲-deːn m̲u̲-nak
　　pirogues two

　　'two pirogues'

c.　s̲i̲-nɔx s̲e̲-rã̃
　　tree　which

　　'which tree?'

d.　in-s̲i̲
　　this-one

　　'this one (pirogue)'

e.　uɲ-g̲u̲
　　this-one

　　'this one (tunic)'

f.　si-deːn si-wuri
　　pirogue long

　　'long pirogue'

　　Prefixless nouns do not have a noun-class prefix to trigger agreement on the following modifiers. Because there is no prefix, no change in prefix change affect plurality for these nouns. Instead, there is a change in final vowel that makes a prefixless noun plural (Sauvageot 1987:18). Though there is no noun class prefix for this group of nouns, the first syllable, no matter its shape, surfaces as the agreement marker on demonstratives, numerals, Wh-words, adjectives, and pronouns.

(50) **Bainuk prefixless noun agreement**

a. **ka**ta:ma-ã   <u>ka</u>-nak-ã   b. **da**pɔn   <u>da</u>-wuri
river   two   grass   long
'two rivers'   'long grass'

The possible number of agreement prefixes is extremely high in Bainuk, not limited to three possible vowels as in Guébie, but rather determined by the number of distinct fist syllables in prefixless nouns. However, only a small set of nouns trigger such agreement in Bainuk, unlike Guébie where all non-human nouns require phonologically determine agreement.

Note that in Bainuk, phonological correspondence is anchored to the left edge of the agreement-controlling noun and the agreeing elements. Though this is distinct from Guébie, it is predicted by the proposed analysis (cf. Prediction B, 36).

5.5   Abuq

Abuq, also spelled Abu', a dialect of Arapesh spoken in Papua New Guinea (Nekitel, 1986), also shows phonologically determined agreement. Here, the final consonant of a noun triggers phonological agreement on demonstratives, adjectives, and verbs (Dobrin, 1995).

(51) **Abuq phonological agreement** (Nekitel 1986 cited in Dobrin 1995)

a. alema**n** afu-**n**-eri   **n**-ahe'
    man   good-CLN-ADJ CLN-went
    'a good man went'

b. almi**l** afu-**l**-i   **l**-ahe'
    bird   good-CLL-ADJ CLL-went
    'a good bird went.

c. ihiaburu**h** afu-**h**-i   **h**-ahe'
    butterfly   good-CLH-ADJ CLL-went
    'a good butterfly went.

Traditionally there are 13 possible final consonants in Abuq. Since contact with Tok Pisin and other languages, words have been borrowed with other final consonants. Even in borrowed words with non-native segments, like /r, p/ in (52), the final consonant of the noun triggers agreement, thus this is clearly a phonologically-determined system.

(52) **Borrowed words undergo phonological agreement**

a. pate**r** a**r**a
    priest this
    'This priest'

b. pai**p** a**p**a
    pipe this
    'This pipe'

In Abuq it is right-aligned *consonants*, rather than vowels (Guébie) or syllables (Bainuk) that trigger agreement. The analysis proposed in section 4 predicts such a system (cf. Prediction C, 36).

6   Discussion

6.1   Guébie's place in the typology of noun classes

We have seen that an interface approach to phonologically determined agreement accounts for the Guébie data as well as for a range of cross-linguistic phonologically determined agreement data.

We can ask where Guébie and these similar phonologically determined agreement systems fit into our typology of noun class systems from section 2. While part of the lexicon of each of these languages (Guébie and other Kru languages, Bainuk, and Abuq) is purely phonologically determined, semantic features are also necessary to determine the agreement markers of at least a small portion of the vocabulary. We have not yet found a system that is entirely phonologically determined, with no semantic criteria relevant. In Guébie, for example, all human nouns have specified pronoun forms irrelevant of the phonological form of the noun; though, for all non-human nouns, phonological form is the determining factor. This puts these systems near the 'phonology' end of our phonology/semantics noun class assignment scale; however, they are not as extreme as we might imagine a language could be.

(53)   **Guébie's place in the typology of noun class systems**

	Guébie Qafar Wolof		*Yimas*	*Dyirbal*	*Diyari*	

Form-based   **Meaning-based**
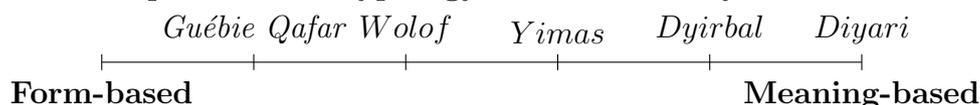
While Guébie nominal concord is not quite entirely phonologically determined, the analysis in section 4 does not rule out the possibility of a purely phonologically determined system. The analysis requires that any vocabulary item whose insertion criteria are met given the syntactic structure be inserted during the morphological component, leaving the phonology to take care of the rest. In this way, the proposed model predicts exactly the generalization by Corbett (1991) and that we saw in section 2 for Qafar, Russian, and others, that when semantic and phonological features determining noun class are at odds, the semantics will win out.

Given this analysis, we could imagine a language where no set of semantic person/number/gender features is spelled out by a particular vocabulary item during the morphological vocabulary insertion operation. This would leave the phonology to determine the output of all agreement features entirely.

The fact that we do not find such a system (entirely phonologically determined), is unsurprising from a functionalist perspective. As Corbett (1991) notes, the most common noun class distinctions are human versus non-human, animate versus inanimate, and masculine versus feminine. All of these features are prominent ones in daily human interaction, and it is not surprising that many grammars choose to distinguish between these semantic categories for ease of communication. While from the perspective of a formal grammatical model the analysis in section 4 predicts that a purely phonologically determined system could exist, the functional load of distinguishing between, say, human and non-human referents is too important for a grammar to ignore.

6.2   Is syntax phonology-free?

This paper began by questioning the accuracy of the assumption that syntax is phonology free. I return to that question here.

While phonological features are not predicted to influence morphosyntactic processes like agreement (Pullum and Zwicky, 1986, 1988), agreement within a noun phrase is often determined, at least partially, by phonological features. The question, then, is whether phonologically determined agreement systems can be modeled without violating the assumption that syntax is phonology-free. Crucially, the analysis proposed here does not require us to say that phonological information is present in the syntax, or that syntax is sensitive to phonological information in any way. Instead, agreement within the noun phrase is a morphological operation resulting in two or more syntactic heads that share morphosyntactic features. Phonological constraints, which are active only after the syntactic and morphological components of grammar, have access to morphosyntactic features of heads and ensure phonological identity between agreeing elements. In this way, the proposed analysis does not question the assumption of a phonology-free syntax.

One may wonder, however, whether the given analysis requires more stipulation or makes different predictions than an analysis which allows phonological information to be present in the syntax, before morphosyntactic agreement takes place. This is a valid question, and one that only more data and perhaps psycholinguistic experiments can illuminate. That is, in order to retract the assumption that syntax is phonology free, we as a field will want more evidence than just a single phenomenon (like phonologically determined agreement).

To address this point, here I present data from the Padee dialect of Sereer, an Atlantic language spoken in Senegal, which shows a phenomenon outside of agreement that seems to require syntactic sensitivity to phonological information (John Merrill, p.c.). Padee object pronouns are listed in (54).

(54)   **Padee object pronouns**(Soukka, 2000)

	Singular	**Plural**
1 incl.	-ɗɔɔ	-ɗʊʊ
1 excl.		-ɗii
2	-ɗaa	-ɗuu
3 anim.	-ɗɪ	ɓa
3 inanim.	wa	ca

In addition to the object pronouns listed above, there is a distinct object pronoun for each noun class of the form Ca, where C is the noun class consonant. There is no /ɗ/ noun class marker, and none of these Ca object markers are suffixes. In Padee, it is exactly those object pronouns which begin with the consonant /ɗ/ that are suffixes on the verb, while all other suffixes stand alone as free words. This is notable because there is no set of morphosyntactic features which picks out exactly those six suffixes which begin with /ɗ/; therefore, the only generalization about which object pronouns are suffixes is a phonological one.

While Soukka (2000) lists all of the object pronouns as suffixes, it can be shown in a variety of constructions that only those pronouns beginning with /ɗ/ are truly suffixal.

When a suffixing pronoun follows a verb ending in a consonant, the initial /ɗ/ of the pronoun assimilates to the consonant; for example, *ap+ɗi → appi*. Free word pronouns, those not beginning with ɗi, do not show any assimilation, *ap+ca → ap ca*.

Additionally, when there are multiple object pronouns within a clause, ordering restrictions shows that those pronouns beginning with /ɗ/ are suffixes. When both pronouns begin with consonants other than /ɗ/, they can be freely ordered. Likewise, when

both pronouns begin with /ɗ/, they can be freely ordered. However, when there is one of each type, the pronoun beginning with /ɗ/ must precede the other.

In multiclausal constructions, object pronouns can surface immediately after the highest verb, as in (55). This is true for both object suffixes, (55a), and free object pronouns (55b).

(55)   **Padee object pronouns on the highest verb**

    a.   Kodu waaɗ-ɗi ki=hot
        Kodu want-him INF=see

        'Kodu wants to see him.'

    b.   Kodu waaɗ ɓa   ki=hot
        'Kodu want them INF=see

        'Kodu wants to see them.'

However, there is a progressive construction where the word order is [Subj *na ki=*Verb]. In this construction, it is possible for object pronouns to follow the verb, or to surface between *na* and the verb. In the latter case, the clitic *ki=* must surface before those pronouns beginning with /ɗ/ in addition to surfacing immediately before the verb (56a), but other pronouns must surface before *ki=* (56b). This shows that those pronouns beginning with /ɗ/ must have a host, while other pronouns are free.

(56)   **Pronouns beginning with /ɗ/ must have a host**

    a.   Gelaŋ na ki-ɗi   ki=ñaɗ
        Gelang with INF-him INF=scold

        'Gelang is scolding him'

    b.   Gelaŋ na ɓa   ki=ñaɗ
        Gelang with them INF-scold

        'Gelang is scolding them'

    c.   *Gelaŋ na ɗi ki=ñaɗ
        Gelang with him INF-scold

        Intended: 'Gelang is scolding him'

    d.   *Gelaŋ na ki-ɓa   ki=ñaɗ
        Gelang with INF-them INF=scold

        Intended: 'Gelang is scolding them'

The data from assimilation, object pronoun ordering restrictions, and placement of the infinitive marker in progressive constructions confirm that in Padee, only those pronouns that begin with /ɗ/ are suffixal, while other object pronouns are free words. This is specifically of interest because there is no set of morphosyntactic features that can pick out only those pronouns that start with /ɗ/: first person singular and plural inclusive and exclusive, second person singular and plural, and third person singular animate, but not other third person pronouns. The only feature that all of these pronouns have in common is a phonological one; they all begin with /ɗ/. This type of system, where the phonological form of a morpheme determines its morphosyntactic status, should not exist if syntax is strictly phonology-free.

Since the Padee data above involves the interface of morphology and phonology as opposed to syntax and phonology, it is true that we could come up with an analysis for the Padee data that does not involve syntactic sensitivity to phonology. For example, we could reanalyze the Padee system to say that each of the first person singular and plural inclusive and exclusive, second person singular and plural, and third person singular animate pronouns are lexically specified as suffixes while the other pronouns are not. However, this overlooks the very clear phonological generalization that a particular phonological feature, here initial /ɗ/, triggers suffixation in Padee.

Instead of analyzing away the Padee data as a lexical coincidence, it might be productive to ask whether the existence of phenomena like phonologically determined agreement and phonologically dependent suffixation in the world's languages is enough to do away with the assumption that syntax is strictly phonology-free. If not, what kind of evidence would be more convincing? While I cannot answer these questions here, I propose that we as a field revisit the assumption of phonology-free syntax.

7   Conclusion

Here I provide an initial description of the phonologically determined agreement system of Guébie (Kru, Niger-Congo), and an interface-based analysis where agreement arises through phonological identity to output forms via morphological agreement mechanisms. In addition to accounting for phonologically determined agreement, the proposed analysis includes a formal account of ellipsis via constraints at PF.

I have shown that the proposed analysis predicts the attested cross-linguistic phonologically determined agreement systems (Corbett, 1991; Dobrin, 1995), though I leave as a question for further research whether it could serve as a model of gender and noun class systems more generally.

Crucially, this paper demonstrates that phonologically determined agreement systems can be modeled without requiring phonological features to be present in syntax. Thus *we can maintain that syntax is not sensitive to phonological features.* I raise another question in its place: Given the existence of partially phonologically determined agreement systems like Guébie and phonologically determined suffixation systems like Padee, do we want to maintain that syntax is phonology-free?

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