Introduction: How to best model process morphology, or morphological information that is manifested as a phonological process, has been in effect ignored in recent realizational theories of morphology. Here I argue for an interleaving approach between morphology and phonology based on Wolf's (2008) Optimal Interleaving that serves as a model for both process morphology and concatenative morphology.

In Distributed Morphology (DM) (Halle and Marantz 1994), Embick and Noyer (2005) treat umlaut, one instantiation of process morphology, as a readjustment rule, or a single phonological process that can apply in a number of morphosyntactic environments. However, since Readjustment in the strict sense can only affect a single Vocabulary Item in DM, Harley and Noyer (1999) observe following Lieber (1981) that all process morphology is reduced to allomorphy in DM. Allomorphy is an unsatisfying model of process morphology, since it involves listing multiple phonologically predictable forms. Here I present original data from scalar tone shift in Guébie (Kru) [Côte d'Ivoire] which supports a model of process morphology as handled by phonological constraints rather than listed allomorphs.

Data: In Guébie perfective versus imperfective aspect is marked by surface tone on the verb (1). There are four tone levels marked with numbers 1-4 where 4 is high; verbs are bold.

(1) **Morphological tone changes: perfective vs. imperfective**

	Perfective			**Imperfective**	
a.	ɔ^{3} **gbala**$^{4.2}$ si^{2}	'He climbed trees.'	b.	ɔ^{3} **gbala**$^{3.2}$ si^{3}	'He climbs trees.'
c.	ɔ^{3} **li**^{3} ɟa^{31}	'He ate coconuts.'	d.	ɔ^{3} **li**^{2}	'He eats coconuts.'
e.	ɟaci$^{2.31}$ **pa**^{31} gɔlɔ$^{3.3}$	'Jachi flipped the boat'	f.	ɟaci$^{2.31}$ **pa**^{21} gɔlɔ$^{3.3}$	'Jachi flips boats.'

There is good evidence that the perfective tone of the verb, (1a,c,e) is *basic* or underlying. Perfective tone matches the tone of the verb in SAuxOV sentences, where the auxiliary and not the verb encodes aspect.

(2) **Basic form of the verb**

e^{4} ji^{3} ɟa^{31} **li**^{3}
1SG.NOM will coconuts EAT

'I will eat coconuts'.

The verb surfaces with the same basic tone in every context except the imperfective. As shown in (1), tone on the first syllable of imperfective verbs in SVO sentences surfaces one step lower on the four-tone scale than the corresponding perfective verb. If the first syllable contains a contour tone, only the first level of the contour is affected.

(3) **Perfective to imperfective tone changes**
$4 \gg 3 \gg 2 \gg 1$

Some perfectives have a low tone (scalar value 1). Since imperfective aspect is realized by tone lowering, we might expect either that tone 1 perfectives would surface as super-low (scalar 0) in the imperfective, or that their forms would be neutralized across the aspects. Neither of these predictions holds. Instead, contrast between perfective and imperfective low-toned verbs is maintained by raising the final tone of the preceding word (the subject) by one step, even if this results in a super-high tone, tone 5 (4d).

(4) **Subject tone raises if verb is already low**

	Perfective	**Imperfective**
a.	ɛ^{3} ɓɔ^{1} 3SG.NOM wither.PFV 'It withered'	b. ɛ^{4} ɓɔ^{1} 3SG.NOM wither.IPFV 'It withers'
c.	e^{4} g^{w}rile$^{1.1}$ ɔ^{2} 1SG.NOM curse.PFV 3SG.ACC 'I cursed him'	d. e^{5} g^{w}rile$^{1.1}$ ɔ^{2} 1SG.NOM curse.IPFV 3SG.ACC 'I curse him'

Thus we see two possible surface realizations of the imperfective, one where the verb tone is one step lower than elsewhere, and one where the subject tone raises one step.

A constraint-based analysis is superior to allomorphy: Modeling the above facts with allomorphy is stipulative and uneconomical. An allomorphy analysis would say that every verb has two vocabulary entries, one for the imperfective and one for everything else. The first tone of the imperfective form would coincidentally be exactly one step lower on the four-tone scale than the corresponding default form. Not only would every verb have to be listed twice, but so would every subject. Because any subject could surface before a low-toned verb in the imperfective, where the subject tone would be one step higher than its default form, every subject would have to have two listed forms, one specific to imperfective contexts and one to everywhere else. On this analysis the predictable tonal relationship between the imperfective and elsewhere forms of the subject is entirely coincidental.

The form of a subject or verb in an imperfective context is predictable given the default underlying form of that stem. I propose that any phonologically predictable morphological process should be modeled with phonological rules or constraints, not as allomorphy. Here I present an account that combines aspects of DM with Cophonologies, based loosely on Wolf's Optimal Interleaving approach. The proposed model assumes that hierarchical morphosyntactic information serves as the input to constraint evaluation, where there are constraints on both morphological and phonological structure. Unlike Wolf, I assume the stratal serial structure of Cophonology Theory (Inkelas and Zoll 2005), rather than OT with candidate chains (OT-CC, McCarthy 2007).

Insertion of the correct vocabulary item for Guébie is trivial under this account, because each subject and verb has only one listed form. The alternations between perfective and imperfective forms are then derived via phonological constraints. One of the elements that makes the Guébie facts particularly interesting is their scalar nature. For modeling scalar phonology, I assume the apparatus of Mortensen 2006. The use of Mortensen's (2006) ENDMOST constraint in imperfective contexts is crucial. ENDMOST assigns more violations when the tone on imperfective verbs is further from the end of some logical scale, here the four-height tone scale. Faithfulness constraints ensure that tone on imperfective verbs does not surface too far on the scale from the input tone. A ban on super-low tones combined with constraints requiring contrast within a verbal paradigm results in subject raising when the verb is already low-toned. These constraints ensure subject tone raising exactly when the verb has a default low tone, and verb lowering otherwise.

By combining mechanisms of Cophonology Theory with DM, I address how to model the phonological predictability of process morphology in a realizational morphological theory.