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Over- and underexponence in morphology

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1 Introduction

Larry Hyman's research into the detailed morphological workings of Bantu languages has uncovered striking cases of two departures from the ideal structuralist morphological system: overexponence (as in affix doubling in Chichewa and other Bantu languages) and underexponence (as in H tone merger in Chichewa). Any theory of morphology must account for these effects. This paper explores how the Optimal Construction Morphology approach of Inkelas & Caballero (to appear) can account for both.

2 The basic model: Optimal Construction Morphology

Optimal Construction Morphology (OCM; Inkelas & Caballero to appear) is a target-driven cyclic approach to word formation in which, on each cycle of word formation, all of the morphological constructions in the language compete to combine with a given stem. OCM has elements in common with rule-based realizational approaches, e.g. Anderson 1992, Stump 2001, and with constraint-based approaches in Optimality Theory, e.g. Xu & Aronoff 2011.

OCM is target-driven in the sense that for a given morphosyntactic target (e.g. 'plural noun meaning BOOK'), all of the possible words that the grammar can create are compared to see which one is optimal for that particular target. Candidates are evaluated cyclically. On the first cycle of evaluation, a root is selected from the lexicon. On the next cycle, all of the individual morphological constructions (affixation, reduplication, truncation, etc.) that could combine with that root are compared to see which one's output is optimal, given the meaning target. Each winning output becomes an input to the next cycle of evaluation. Evaluation cycles continue until an output is produced which is of category 'Word' (as opposed to the initial category of 'Root', or an intermediate category of 'Stem') and matches the meaning target perfectly. At that point, the derivation is complete.

An illustrative, simplified example from English is provided below. In (1) we see a few morphological constructions in English that compete for attachment to bare noun roots:

(1)	PLURAL construction:	[[	$]_{\text{Noun.root}}$	$]_{\text{Noun.word.plural}}$
	ISH construction:	[[	$]_{\text{Noun.root}}$	$]_{\text{Adjective.word.“Xish”}}$
	WORD construction:	[[	$]_{\text{Noun.root}}$	$]_{\text{Noun.word}}$

The first two entries in (1) are suffixation constructions which add morphosyntactic information to the input stem and which promote the input Root to the category of Word. The third is a conversion construction which simply promotes an input root to the category Word, enabling it to be used in the syntax without changing its meaning. Each construction comes with its own cophonology (see e.g. Orgun 1996; Anttila 1997, 2002; Inkelas 1998; Inkelas & Zoll 2005). The ranked phonological constraints in that cophonology determine the phonological output form for the candiate produced by the corresponding morphological construction.

Competition among constructions such as those in (1) is mediated, for any given word being generated, by two types of constraints: faithfulness and markedness. Faithfulness constraints evaluate how well a given output (stem + single morphological construction) matches the morphosyntactic target for the word in question. Well-formedness constraints assess the form of the output. The nature and ranking of well-formedness (markedness) constraints may potentially differ across the cophonologies of different morphological constructions. We will discuss examples of well-formedness constraints in Section 3.

The tableau below shows how faithfulness constraints determine the outcome of the second cycle of derivation for a word with target meaning [BOOK, NOUN, PLURAL]. In a prior cycle, the root BOOK was selected from the lexicon as the closest match to the target. That root is the input to the tableau in (2), which compares the results of combining each (compatible) construction in the language with the input to see which best matches the target meaning.

(2)

	Target meaning: BOOK, NOUN, PLURAL Input meaning: BOOK Input form: *book*	FAITH-MEANING
☞a.	BOOK, NOUN, PLURAL Relevant construction: PLURAL *books*	
b.	BOOK, ADJECTIVE, “ISH” Relevant construction: -ISH *book-ish*	*! (PLURAL, “ISH”)
c.	BOOK, NOUN Relevant construction: WORD *book*	*! (PLURAL)

3 XY constraints

Numerous well-formedness constraints can affect word formation (Inkelas & Caballero to appear). This paper focuses on a basic member of this category, namely the set of ‘XY’ constraints. These constraints accomplish affixation (and other types of morphological exponence) by specifying the phonological form (Y) that a stem with morphosyntactic properties ‘X’ must assume. XY constraints are similar to the realizational rules of Anderson (1992) or Stump (1991, 2001) and to the exponence constraints of Xu & Aronoff 2011, a study which also explore issues of multiple vs. single exponence.

(3)

Construction	Cophonology
PLURAL construction:	XY constraint requires final /z/
ISH construction:	XY constraint requires final /ɪʃ/
WORD construction:	no XY constraint; imposes default stress assignment

This paper explores the various effects that an XY constraint can have on morhpological exponence, focusing on whether the XY constraint is present in one construction’s cophonology, or in many cophonologies. A taxonomy of possible effects is sketched below:

(4) Canonical exponence: an XY constraint with a unique Y exists in the cophonology of exactly one construction, the one which introduces property X
Underexponence: multiple constructions have XY constraints where X varies by construction but Y is the same; the same Y formative satisfies multiple XY constraints simultaneously
Overexponence: multiple cophonologies have an X constraint with the same X, causing the corresponding Y formative(s) to be introduced more than once

These possibilities will be discussed in turn in the following sections.

4 Canonical exponence

Canonical exponence is the situation in which Y unambiguously and exceptionlessly expones X. (This clean situation is possibly more common in introductory linguistics textbooks than in real language.) For example, English regular noun pluralization can be modeled using the XY constraint [NOUN.PLURAL, ALIGN-R-z], or PL-z for short, which is present in the cophonology of the pluralizing construction.

(5) Plural construction: takes as input a noun stem unmarked for number; produces as output a noun stem marked [plural]. Associated cophonology: enforces PL-z

The tableau in (6) shows that XY constraints are only relevant to candidates involving the construction whose cophonology contains the XY constraint. Candidates (6a) and (6b) are both formed by the noun plural construction, so are both subject to PL-z. Candidate (6c) is not formed by the noun plural construction and is therefore not subject to PL-z; the construction is simply not applicable. Candidate (6c) does worse than (6a) and (6b) in terms of matching the meaning target. (6a) does better than (6b) in terms of satisfying PL-z:[1]

[1] Note that while PL-z is irrelevant to candidate (6c), hence the ‘N/A’ mark, candidate (6c) does satisify the XY constraint for the ISH construction, requiring the presence of final [□□]. That constraint is not shown in this tableau but would be ranked below FAITH-MEANING. The expected situation is for all XY constraints to rank below FAITH-MEANING; if an XY constraint were ranked higher than FAITH-MEANING, the result would be that all words would be compelled to combine with a construction supplying meaning X, and to have form Y, regardless of the target meaning for any individual word.

(6)

	Target: BOOK, NOUN, PLURAL Input: BOOK *(book)*	FAITH-MEANING	PL-Z
☞ a.	BOOK, NOUN, PLURAL Construction: PLURAL *books*		✓
b.	BOOK, NOUN, PLURAL Construction: PLURAL *book*		*!
c.	BOOK, ADJECTIVE, "ISH" Construction: ISH *book-ish*	*!	N/A

The XY constraint in (6) is not, of course, completely 'canonical', in the sense that not all plural nouns end in the regular plural /-z/, and there are other suffixes (or enclitics) in English which also take the form /z/. However, the example suffices to illustrate XY constraints.

In the next sections we see how the basic technology of FAITH-MEANING and XY constraints produces not only canonical exponence but also underexponence and overexponence.

5 Underexponence: Multiple sources, one form

An example of underexponence that Larry Hyman has often used in his classes on phonology and morphology is the verb *hit* in English. The issue is why this verb fails to combine with the regular past tense suffix *-t*/*-d*, which would result in the ungrammatical **hitted*. Hyman has frequently observed (p.c.) that many verbs exhibiting this behavior end in *t* or *d*. Of 174 English irregular verbs, 38% of them end in *-t*/*-d* (and 55% end in coronal consonants of one sort or another).[2] Hyman's interpretation of this skewing is that a verb-final *-t*/*-d* has a tendency to be interpreted as past tense *-t*/*-d*, obviating the need for redundant suffixation of the regular past tense ending.

English has only a statistical tendency to underexpone past tense, in the sense of under-using the regular past tense suffix. But in other cases, including one that Hyman has brought to light, the pattern is fully regular. We will examine two examples in the next sections.

[2] Data compiled by Susan Jones; http://www2.gsu.edu/~wwwesl/egw/jones.htm

5.1 Nitinaht reduplication (two reduplicative exponents merge)

Stonham (1994) writes, of Nitinaht reduplication, that "[a] certain subset of the lexical suffixes in this language require that certain effects on the shape of the root be manifested, either length on the root vowel, reduplication of some portion of the root, or some combination of the above." (p. 40). Some affixes induce reduplication of the first CV of the root, copying vowel length if any ("NR" reduplication, in Stonham's terms). Others copy the first CV and lengthen the reduplicant vowel ("CV:R"). The relevant aspect of Nitinaht reduplication is that when more than one reduplication-triggering affix occurs in the same word, reduplication occurs only once. Stonham provides the following illustrative examples (p. 49):

(7) a. ƛ'u:ƛ'uqʷ + a:ʔdɬ + a:p (*ƛ'u:-ƛ'u-ƛ'uqʷ*)
[NR] [CV:R]
'X's legs are really big'
b. sa:sa:tq + 'aqsiɬ + a:p (*sa:-sa:-sa:tq*)
[NR] [CV:R]
'X's eyes were really itchy'
c. ba:baɬ + aski + yabɬ + a:p (*ba:-ba-baɬ*)
[NR] [CV:R]
'X is really cold on the shoulders'

Stonham proposes an analysis in which each suffix can require the root to assume a particular shape; the competing demands of multiple suffixes 'unify', in Stonham's terms. This insight is readily modeled using XY constraints in OCM. All of the suffixes in (7) are associated with a cophonology requiring the root to be reduplicated. The cophonologies of the 'CV:R' suffixes, in addition, require the reduplicant vowel to be long. (Still other suffixes are associated with cophonologies that lengthen just the root vowel, suggesting that lengthening and reduplication are logically decoupled.) Setting aside lengthening, the XY constraint in question requires that the root be reduplicated. It is present in cophonologies of all reduplicating suffixes. In (8), X stands for all constructions triggering reduplication, including the *-a:ʔdɬ, -a:p, -'aqsiɬ* and *-yabɬ* suffixation constructions in (7):

(8) X-REDUP: The input root must surface with CV reduplication

The XY constraint in (8) will be satisified as long as a reduplicated root is present, as shown in (9). For notational simplicity, the meaning elements of the tableau are suppressed here so that only form elements are on view.

The point of these tableaux is to show that multiple affixation does not trigger multiple reduplication:[3]

(9) Multiple reduplication-triggering suffixes: each X-REDUP satisfied by same reduplicant

1. Cycle of *-aːʔdɬ* suffixation:

	Input: ƛ'uqʷ	X-REDUP	*Struc
☞ a.	ƛ'u-ƛ'uqʷ-aːʔdɬ		
b.	ƛ'uqʷ-aːʔdɬ	*!	

2. Cycle of *-aːp* suffixation:

	Input: ƛ'u-ƛ'uqʷ-aːʔdɬ	X-REDUP	*Struc
a.	ƛ'u-ƛ'u-ƛ'uqʷ-aːʔdɬ-aːp		*! (ƛ'u)
☞ b.	ƛ'u-ƛ'uqʷ-aːʔdɬ-aːp		

As seen, successive applications of reduplication (e.g. losing candidate (9b), *ƛ'u-ƛ'u-ƛ'uqʷ-aːʔdɬ-aːp*) would produce excess structure, violating *STRUC with no offsetting gain in well-formedness.

5.2 H tone assignment in Chichewa (two tonal exponents merge)

Hyman & Mtenje (1999) demonstrate that when multiple morphological constructions in the Chichewa verb call for a H tone to be added to the verb stem, only one H is added. The H tones contributed by the various constructions merge rather than accumulating.

For example, Hyman & Mtenje (1999) observe that there are several verbal constructions requiring penultimate tone. Three of these (negative infinitive, aspectual *ka-*, reflexive *dzi-*) are illustrated in (10b-d). The forms in (10e) contain all three sources of a penultimate H, but only one H tone surfaces:

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[3] As Stonham observes (p. 48), the ability of an outer affix (in (9), *-aːp*) to determine whether the root is reduplicated violates strong versions of the Bracket Erasure principle, in which the internal morphological structure of a stem is invisible to the phonology applying on an outer cycle of affixation (see e.g. Siegel 1977, Allen 1978, Pesetsky 1979, Kiparsky 1982, Orgun & Inkelas 2002, Shaw 2009). However, weaker versions of Bracket Erasure which permit internal access within a particular stratum of morphology would be consistent with this analysis.

(10) Negative infinitive *ku-sa-*, aspectual 'go &' *ka-*, reflexive *dzi-*: all induce penultimate H (underlined)

a. Imperative: toneless roots, no penultimate H insertion

meny-a	'hit!'
thandiz-a	'help!'
vundikir-a	'cover!'
fotokoz-a	'explain!'

b. Negative infinitive: adds penultimate H

ku-sa-<u>mé</u>ny-a	'to not hit'
ku-sa-than<u>dí</u>z-a	'to not help'
ku-sa-vundi<u>kí</u>r-a	'to not cover'
ku-sa-fotoko<u>z-é</u>r-a	'to not explain to'

c. Reflexive *dzí-*: is itself H, but also adds penultimate H

ku-dzí-vúndi<u>kí</u>r-a	'to cover self'
ku-dzí-fótoko<u>z-é</u>r-a	'to explain to self'

d. Aspectual *ká-* is itself H, but also adds penultimate H

ku-ká-vúndi<u>kí</u>r-a	'to to & cover'
ku-ká-fótoko<u>z-é</u>r-a	'to go & explain'

e. Negative infinitive + aspectual *ká-* + reflexive: penultimate H's unify

ku-sa-ka-<u>dzí</u>-ph-a	'to not go & kill self'
ku-sa-ka-dzi-<u>mé</u>ny-a	'to not go & hit self'
ku-sa-ka-dzi-than<u>dí</u>z-a	'to not go & help self'
ku-sa-ka-dzi-vundi<u>kí</u>r-a	'to not go & cover self'
ku-sa-ka-dzi-fotoko<u>z-é</u>r-a	'to not go & explain to self'

A similar pattern is exhibited by verbal constructions requiring final tone. For example, the verb in (11) contains a H-toned verb root, an intensive suffix, a passive suffix, and a subjunctive suffix, all of which assign H to the final vowel of the verb stem. Only one H tone is observed, rather than four:

(11) [ti- [[[[pez] -etsets] -edw] -e]] → ti-pez-etsets-edw-é 'let's be found a lot'

H	H	H	H
find	INT	PASS	SUBJ

We can model the tonal differences between the affixation constructions in (10) and those in (11) by assigning them different cophonologies. The constructions in (10) have cophonologies enforcing an XY constraint requiring that the penultimate vowel be H-toned. The constructions in (11) instead all are affiliated with cophonologies enforcing an XY constraint to the effect that the *final* vowel must be H-toned. The respective cophonologies rank PENULT-H and FINAL-H differently:

(12)

X	Y
Negative Infinitive	PENULT-H » FINAL-H
Aspectual *-ka*	
Reflexive	
Intensive	FINAL-H » PENULT-H
Passive	
Subjunctive	

By modeling the two tonal patterns with XY constraints, rather than with floating H's and rules for their linking, we predict that, rather than *adding* a H tone, the constructions just require a H tone to be present in a particular location. This requirement can result in the addition of H if none is present in the input; it will result in no change if H is already present in the input in the desired location. It can also result in the shifting of H if one is present, but in a different location, in the input.

Because it is cyclic, OCM makes clear predictions in the case of complex candidates built by two constructions each associated with distinct cophonologies. The cophonology associated with the outermost construction in a candidate is the one which applies in that tableau. This can be illustrated using the Chichewa constructions seen so far. Hyman & Mtenje show that when a Final-H-assigning suffix (subjunctive *-e*, (13a)) is attached outside of a Penult-H-assigning suffix (3^{rd} reflexive *-dzi*, (13b)), H ends up on the final syllable (13c):

(13)

a. ti-vundikir-é	'let us deceive'	Subjunctive assigns Final H
b. ku-dzí-vúndíkír-a	'to help self'	Reflexive assigns Penult H
c. ti-dzi-vúndíkir-its-é	'let them deceive themselves'	Subjunctive and Reflexive compete; Subjunctive wins, assigns Final H

Hyman & Mtenje (1999) motivate the layering of Subjunctive *-e* outside of Reflexive *-dzi* on the grounds that the Subjunctive takes wider semantic scope than the Reflexive.

5.3 Underexponence vs. anti-homophony

Since the underexponence of penultimate H in Chichewa is so easy to model, the question naturally arises as to how OCM would model the opposite situation, in which all four constructions add a new H tone, and the four H's accumulate in the verb stem. Or, similarly, how might one model a language like Nitinaht in which each reduplication-triggering affix induces a new reduplicative copy, or for that matter any language in which homophonous segmentally fixed affixes are allowed to occur in sequences? The answer lies in anti-homophony constraints.

Even in real Nitinaht, such constraints are needed, since inflectional reduplicative prefixes do not 'unify' their reduplicative demands with those of derivational suffixes of the kind seen earlier in (8). For example, the Distributive construction induces prefixing CV reduplication. Stonham (1994:59) notes that the Distributive can combine with an already reduplicated stem, producing two instances of reduplication, e.g. *ka-ka-kawad-ataχ* 'DIST$_{\text{RED}}$-RED-killer_whale-ataχ$_{\text{RED}}$). A way of modeling the difference between the Distributive prefix and the other affixes triggering reduplication is by using anti-homophony constraints. Since the Distributive is not itself associated with a segmentally overt affix, this is an intuitively straightforward solution. The tableau, below, assumes that the input *ka-kawad-ataχ* 'hunting killer whales', combines in both output candidates with the Distributive morphological construction, which is associated with the same X-Redup constraint seen earlier in (8). The cophonology of the Distributive contains the constraints shown in the tableau:[4]

(14) Cycle of distributive affixation: X-REDUP and ANTI-HOMOPHONY force repeat of reduplication

	Target meaning: Distributive of 'hunting killer whales' Input meaning: 'hunting killer whales' ka-kaw'ad-ataχ	X-REDUP	ANTI-HOM	*STRUC
a.	ka-kaw'ad-ataχ Construction: Distributive	✓	*!	
☞	ka-ka-kaw'ad-ataχ	✓		*

[4] Stonham's own account of these facts differs; he suggests that inflectional affixes are blind to the internal structure of derivational stems. For this reason, their reduplicative demands cannot be satisifed by reduplication on the derivational stratum. On Stonham's account it is coincidence that the inflectional Distributive is marked only by reduplication, not (also) by a segmentally fixed affix. By contrast, an anti-homophony account predicts that double reduplication should be allowed just in case it would be the only mark of a morphological category.

b.	Construction: Distributive			

In conclusion, the difference between underexponence and 'normal' exponence is governed not only by the distribution of XY constraints in the cophonologies of the language but also by the ranking of anti-homophony constraints. Underexponence of the kind discussed in this section corresponds to haplology, the phenomenon to which Menn & McWhinney draw attention in their well-known (1984) paper on the Repeated Morph Constraint (RMC). The RMC bans sequences of homophonous affixes. One response to situations in which the morphology of a language might be inspired to create such sequences is haplology, in which one affix appears but does the work of both. This is precisely the situation illustrated in Chichewa affixes that contribute H tones, and Nitinaht derivational affixes that trigger reduplication, seen earlier. However, as Menn & McWhinney observe for other languages, and as illustrated here with Nitinaht inflectional reduplication, the RMC also admits numerous exceptions. Modeling haplology effects with violable and rerankable constraints provides an appropriately flexible means of modeling both regular exponence and underexponence.

6 Overexponence: One source, multiple forms

We have seen how XY constraints can contribute to regular and to underexponence. The third logical possibility, overexponence, can result when the same XY constraint is present in two different cophonologies — one for the individual morphological construction adding meaning X, and one for another construction to which stems possessing property X are input.

Overexponence is discussed (under the terms 'extended exponence' or 'multiple exponence') by numerous authors, including Matthews 1974; Stump 1991, 2001; Anderson 2001; Blevins 2003; Harris (in press); Xu & Aronoff 2011, and Inkelas & Caballero (to appear). A familiar example comes from Breton (Stump 1991a:678, 696). Breton nouns pluralize either through stem suppletion (15a) or the addition of the regular plural suffix *-où* (15b). Singular nouns diminutivize through the addition of *-ig*. Plural diminuatives show overexponence of plural. The root forms a plural in the usual way (suppletion or *-où* suffixation). The diminutive *-ig* attaches to the plural stem, and then the regular plural suffix *-où* is added outside the diminutive:

(15) Breton diminutive plurals require two exponents of plural: root.**PL**-DIM-**PL** (a) OR root-**PL**-DIM-**PL** (b):

		singular	singular diminutive	plural	plural diminutive
a.	'bone'	maen	maen-ig	mein	mein-ig-où
	'stone'	askorn	askorn-ig	eskern	eskern-ig-où
b.	'boat'	bag	bag-ig	bag-où	bag-où-ig-où
	'prayer'	pedenn	pedenn-ig	pedenn-où	pedenn-où-ig-où
	'thing'	tra	tra-ig	tra-où	tra-où-ig-où

Perhaps the most compelling example of overexponence in the literature comes from work on Bantu affix doubling, by Hyman.

As documented in Hyman 2002 (see also Downing 2005), Bantu languages can exhibit suffix doubling in response to what Hyman characterizes as a tension between the logical syntactic/semantic ("scope-based") order in which derivational suffixes should appear, vs. the strict linear templatic requirements imposed by the language.[5] Hyman provides evidence for a pan-Bantu affix ordering template, CARP (root-Causative-Applicative-Reciprocal-Passive). CARP represents the preferred linear order in which these four valence-changing affixes appear when any of them co-occurs with any of the others:

(16) CARP template (Hyman 2002), instantiated in Chichewa:

Root	>	-its-	>	-il-	>	-an-	>	idw-
		CAUS		APP		REC		PASS

In Chichewa words where semantic considerations motivate an order of affixation which is inconsistent with CARP, Hyman shows that an inner affix can be added again as an outer affix so that its second instantiation appears in the correct (CARP-based) order with respect to neighboring affixes. This is illustrated in (17), in which with the Applicative and Reciprocal suffixes combine with the root *mang-* 'tie'. According to Hyman, the two different possible logical orders of attachment of these suffixes should produce two different meanings:

5 See Downing 2005 for an account of causative doubling in Jita which is based on paradigm uniformity.

(17) *mang-* 'tie'
   a. [[*mang*] APP] REC] 'tie [something] for each other'
   b. [[*mang*] REC] APP] 'tie each other for [someone]/at [some place]'

The first of these two logical orders, in (17a), is consistent with the CARP template, and the corresponding verb is generated unproblematically:

(18) [[*mang*] APP] REC] *mang-il-an-*
   'tie [something] for each other'

The second of these two orders, however, in (17b), conflicts with CARP. In this case, Hyman shows, two "repairs" for the conflict between scope-based and templatic ordering are possible. Either the linear order in (17a) is used instead, producing homophony, or affix doubling occurs:

(19) [[*mang*] REC] APP] **mang-an-il-*
   'tie each other for/at'

   mang-il-an-
   (homophonous with (18))

   mang-an-il-an-
   (doubling of reciprocal *-an-*)

The affix doubling examples resemble Breton diminutives; the same affix is added twice, if and only if another affix intervenes, and without adding any apparent meaning.

Affix doubling of this kind can be modeled using XY constraints. The key insight is that the attachment of one affix prevents an inner affix from satisfying a high-ranked XY constraint; hence the inner affix must be added again. Where the Breton and Chichewa XY constraints cause a departure from canonical exponence is in their distribution. In Chichewa, the XY constraints instantiating the CARP affixes occur in two places: in the cophonology associated with the specific morphological construction in question, and again in a general stem-level cophonology to which all derived stems in the language are subject. It is this latter stem-level construction, and its associated cophonology, which gives the Chichewa verb stem its templatic character.

The following constructions and constraints can model the Chichewa reciprocal doubling illustrated in (19). First are the individual affixation constructions, whose cophonologies feature the constraints in in (20). The Reciprocal construction takes a stem as input and outputs a stem in which the agent and patient are coindexed and associated with the subject. Its cophonology, via the constraint RECIP-an, requires the output to end in *-an*. The Applicative construction takes a stem as input and outputs a stem with an additional object argument, associated with locative, instrumental, beneficiary, etc. semantics. Its cophonology, via the constraint APPLIC-il, requires the output to end in *-il*:

(20) RECIP-an: a stem with reciprocal argument structure must end in *-an*.
APPLIC-IL: a stem with applicative argument structure must end in *-il*.

What makes Chichewa templatic is the requirement that the output of each suffixation consruction is input to the Dstem construction, which enforces wellformedness. 'Dstem' (Derivational Stem) is the term given by Downing (1997) to the verbal subconstituent which contains the root and any derivational suffixes, and which itself is the input to inflectional suffixation and prefixation. Specifically, the Dstem cophonology enforces the CARP template. Each individual XY constraint, from the individual derivational affixation cophonologies, is also present in the Dstem cophonology, ranked according to CARP:

(21) Dstem cophonology: CARP

ALIGN-R-*idw-* » ALIGN-R-*an-* » ALIGN-R-*il* » ALIGN-R-*its-*

We will assume for purposes of this analysis that each derivational suffix combines with a root (Rstem) or Dstem and produces an output of category Rstem. The reason for this assumption is to force the output of derivational suffixation to be converted back to a Dstem by means of the Dstem forming construction, which enforces the CARP template. Only Dstems are capable of being inflected (forming Istems) and passing on as complete words to the syntax.

The Dstem cophonology, and the obligatoriness of the construction associated with it, is what makes the system templatic. This analysis imports directly into OCM the insight of Hyman & Mchombo 1992, in which morphological features are spelled out cyclically by ordered rules.

To see how the analysis works, consider, as an example, the verb 'tie each other, for the benefit of someone else or at a location', which is an applicativized reciprocal. One the first cycle, the root *mang-* 'tie' is selected from the lexicon. The tableaux, below, start with the second cycle, in which all of the morphological constructions of Chichewa are considered to see which does the best job of bringing *mang-* 'tie' closer to the meaning target of 'tie each other for/at'.

To simplify matters, the tableaux are limited to transparent candidates in which the only differences in form are those forced by satisfaction of XY constraints.

(22) Suffixes and Dstem construction compete for root *mang-* 'tie'

	Target: '[[tie each other] for /at]' Input: 'tie' (*mang-*) Category: Dstem	FAITH	RECIP- an	APPLIC- il
☞ a.	mang-an- Construction: Reciprocal Category: Rstem	*	✓	N/A
☞ b.	mang-il- Construction: Applicative Category: Rstem	*	N/A	✓
c.	mang-a Construction: (inflection) Category: Istem	**!	N/A	N/A

Tableau (22) produces two winners: (22a) and (22b). (Candidate (22c) loses because it does not possess either of the constructions that bring candidates (22a) and (22b) closer in meaning to the target. That is why the XY constraints in this tableau are inapplicable to it.) We will track each successful candidate through the next cycle of affixation. First, both must submit to the Dstem construction, which is satisfied by the existing affixation and requires no changes. No other constructions compete for these inputs; the Dstem construction is the only one that can combine with stems of the category Droot.

(23) Dstem construction licenses *mang-an-* and *mang-il* outputs from above

	Target: '[[tie each other] for /at] Input: 'tie each other' (*mangan-*) Category: Droot	FAITH	RECIP- an	APPLIC- il
☞ a.	mang-an- Category: Dstem	* (Appl)	✓	N/A
☞ b.	mang-il Category: Dstem	* (Recip)	N/A	✓

Now, both *mang-an-* and *mang-il* are ready for further affixation. We track them in turn, starting with *mang-an* 'tie each other':

(24) Applicative and inflectional suffixation compete for input *mang-an-* :

	Target: '[[tie each other] for /at] Input: 'tie each other' (*mangan-*) Category: Dstem	FAITH	RECIP-an	APPLIC-il
☞ a.	mang-an-il- Applicative construction Category: Rstem		*	✓
b.	mang-an-a Inflectional construction Category: Istem	*! (Applic)	N/A	N/A

The winning output of this tableau is *mang-an-il* 'tie each other for/at', which is perfect except that it is only an Rstem and cannot exit the lexicon without being converted to a Dstem, the precursor to inflectability and wordhood. As seen, the Dstem construction forces another iteration of *-an* suffixation:

(25) *mang-an-il* converted to Dstem cophonology:

	Target: '[[tie each other] for /at] Input: 'tie each other' (*manganir-*) Category: Rstem	FAITH	RECIP-an	APPLIC-il
☞ a.	mang-an-il-an- Dstem construction Category: Dstem		✓	*
b.	mang-an-il] Dstem construction Category: Dstem		*!	✓

Thus *mang-an-il-an* is the best output when *mang-an* is chosen on the first cycle of affixation.

When *mang-il* is chosen on the first cycle of affixation, a different result obtains. The tableaux in (26) and (27) track the progress of the Dstem *mang-il* on its path to wordhood. First, *mang-il* is input to two competing constructions: further derivation (reciprocal) and inflection:

(26) Reciprocal and inflectional suffixes compete for *mang-il* (=output of tableau (23)):

	Target: '[[tie each other] for /at] Input: 'tie for/at' (*mang-il-*) Category: Dstem	FAITH	RECIP- an	APPLIC- il
a.	mang-il-an Reciprocal construction Category: Rstem	(✓)	✓	*
☞b.	mang-il-a] Inflectional construction Category: Istem	*!	N/A	N/A

Candidate (26a) clearly outperforms candidate (26b) on FAITH; a reciprocalized applicative (26a) is closer than a plain applicative (26b) to the target meaning of an applicativized reciprocal. However, (26a) is not completely identical in scope to the target meaning. This partial faithfulness is indicated by the parenthesized check mark.

The next tableau tracks *mang-il-an-*, whose only viable option is to be converted to a Dstem, which requires inspection by the Dstem cophonology:

(27) *mang-il-an-* converted to Dstem:

	Target: '[[tie each other] for /at] Input: 'tie for e. o.' (*mang-il-an-*) Category: Rstem	FAITH	RECIP- an	APPLIC- il
☞a.	mang-il-an Dstem construction Category: Dstem	?	✓	*
b.	mang-il-an-il Dstem construction Category: Dstem	?	*!	✓

In this case, double affixation is no improvement. The faithful *mang-il-an-* (27a) outperforms *mang-il-an-il* (27b). The ranking of RECIP-an » APPLIC-il in the Dstem cophonology is what creates the asymmetry between *mang-an-il-an-* (the winner of tableau (25)) and **mang-il-an-il* (the loser of tableau (27)).

One question remains, namely why *mang-il-an-* can mean either 'tie each other for/at' or 'tie (something) for each other', while *mang-an-il-an* can only mean 'tie each other for/at'. This follows, on the OCM analysis, from cyclicity. It is assumed that after the first cycle of suffixation, a simple reciprocal (e.g. *mang-an-*) is syntactically monovalent, though its single subject argument is linked to two semantic roles (e.g agent, patient in the case of 'tie each other'). Applicativizing such a stem results in the addition of an object argument bearing a different thematic role: instrumental, locative, etc., producing a meaning like 'tie each other for a reason/at a place/with an instrument'. This is the correct prediction for *mang-an-il*, which we have seen must surface as *mang-an-il-an* for templatic reasons. By contrast, a simple applicativized verb like *mang-il* has three arguments: the syntactic subject is associated with agentive semantics, the original object is associated with patient thematic role, and the the object added by the applicative construction is associated with benefactive, locative, instrumental thematic roles. Reciprocalizing such an input (*mang-il-an*) conindexes the subject with either the original object (the patient) or the added object (the benefactive, location, instrument). This is what provides for the morphosyntactic ambiguity of *mang-il-an*.

Hyman 2002 provides a different, very interesting account in which affix doubling *and* the semantics of *mang-il-an* and *mang-an-il-an* follow from the free ranking of two constraints. One is CARP constraint, termed "Template", or "T" in Hyman's analysis. The other is a SCOPE constraint (termed "Mirror", or "M"), which compels affixes to appear in a linear order reflecting their scope relations. In Chichewa, Hyman proposes, the key interaction is between T and a conjunction of M and T. Tableau (28), adapted slightly from Hyman 2002, illustrates the anlaysis of a reciprocalized applicative (28i) and an applicativized reciprocal (28ii). Hyman interprets the T and M&T constraints as licensers. If all of the affixes in a given candidate are fully licensed by a constraint, the candidate satisfies that constraint:

(28)

i.	Logical input: [[[*mang-*]APPLIC]RECIP]	T	M & T
a.	mang-an-il		
☞ b.	mang-il-an	il-an	
c.	mang-an-il-an	il-an	
d.	mang-il-an-il		
ii.	Logical input: [[[*mang-*]RECIP]APPLIC]	T	M & T
d.	mang-an-il		
☞ f.	mang-il-an	il-an	
☞ g.	mang-an-il-an	il-an	an-il-an
💣 h.	mang-il-an-il	il-an	il-an-il

On Hyman's analysis, none of the winners (*mang-il-an* (28b,f), *mang-an-il-an* (28g)) is perfect. *mang-il-an* violates M&T, in that the *il-an* sequence is not licensed by M&T. *mang-an-il-an* violates T (the *an-il* sequence is not licensed by T). However, each is optimal in context. Hyman does note one problem with his analysis: it predicts *mang-il-an-il* (28h) to be as good a "repair" as *mang-an-il-an* (28g) for the Scope/CARP problem posed by applicativized reciprocals, yet (28h) is ungrammatical. Hyman speculates that a cyclic analysis could explain this, noting that for input [[[*mang*-]RECIP]APPL], *mang-an-il-an* is an improvement over **mang-an-il* in terms of scope, while for input [[[*mang*-]APPL]RECIP], *mang-il-an-il* is *not* scopally superior to *mang-il-an*. Hyman writes:

> "Cyclicity seems to be crucial here… A cyclic spell-out is allowed to override TEMPLATE, but only if it is repaired by a templatic sequence. A templatic sequence [like *mang-il-an*--SI] would have no reason to be "repaired" … and hence *-il-an-il-* is not an appropriate output for [an applicativized reciprocal -SI]."

The cyclic analysis offered here in the OCM framework exploits this insight of Hyman's.

7 Conclusion

In conclusion, Larry's Hyman's insightful work on Bantu languages has uncovered problems of morphological exponence which pose challenges to any model of morphology. This paper has suggested that Optimal Construction Morphology is a suitable framework for handling these problems.

Works cited

Allen, M. 1978. *Morphological investigations*. PhD thesis, Massachusetts Institute of Technology.

Anderson, S. 1992. *A-morphous morphology.* Cambridge University Press, Cambridge.

Anttila, A. 1997. Deriving variation from grammar. *Variation, change and phonological theory*, ed. F. Hinskens, R. Van Hout, and W. L. Wetzels. John Benjamins, Amsterdam.

Anttila, A. 2002. Morphologically conditioned phonological alternations. *Natural Language and Linguistic Theory* 20(1).

Downing, L. 1997. Correspondence effects in Siswati reduplication. *Studies in the Linguistic Sciences* 25.

Downing, L. 2005. Jita causative doubling provides optimal paradigms. *Paradigms in phonological theory*, ed. L. Downing, T. Hall, and R. Raffelsiefen. Oxford University Press, Oxford.

Hyman, L. M. & S. Mchombo. 1992. Morphotactic constraints in the Chichewa verb stem. *Berkeley Linguistic Society* 18.350-364.

Hyman, L. M. 2002. Suffix ordering in Bantu: a morphocentric approach. *Yearbook of Morphology* 2001, 2002.

Hyman, L. M. and A. Mtenje. 1999. Prosodic morphology and tone: the case of chichewa. *The prosody-morphology interface*, ed. R. Kager, H. van der van der Hulst, H. and W. Zonneveld. Cambridge University Press, Cambridge.

Inkelas, S. 1998. The theoretical status of morphologically conditioned phonology: a case study from dominance. *Yearbook of Morphology*, 1997.

Inkelas, S. and G. Caballero. to appear. Word construction: Tracing an optimal path through the lexicon. New theoretical tools in the modeling of morphological exponence. Special Issue of *Morphology*, ed. by J. Trommer.

Inkelas, S. and C. Zoll. 2005. *Reduplication: doubling in morphology*. Cambridge University Press.

Kiparsky, P. 1982. Lexical morphology and phonology. *Linguistics in the morning calm*, ed. I. S. Yang. Hanshin, Seoul.

Matthews, P. H. 1972. *Inflectional morphology*. Cambridge University Press, Cambridge.

Matthews, P. H. 1974. *Morphology*. Cambridge University Press, Cambridge.

Menn, L. and B. MacWhinney. 1984. The repeated morph constraint: toward an explanation. *Language* 60(3).

Orgun, C. O. 1996. *Sign-based morphology and phonology: with special attention to Optimality Theory*. Doctoral dissertation, University of California, Berkeley.

Orgun, C. O. and S. Inkelas. 2002. Reconsidering bracket erasure. *Yearbook of Morphology 2001.*

Pesetsky, D. 1979. *Russian morphology and lexical theory*. Doctoral dissertation, MIT.

Shaw, P. 2009. Inside access. *The Nature of the Word: Essays in Honor of Paul Kiparsky*, ed. K. Hanson and S. Inkelas. MIT Press, Cambridge, MA.

Siegel, D. 1974. *Topics in English morphology*. Doctoral dissertation, MIT.
Stonham, J. 1994. *Combinatorial morphology*. Benjamins, Amsterdam.
Stump, G. 1991. On the theoretical status of position class restrictions. *Yearbook of Morphology* 1991, ed. G. Booij and J. van Marle. Kluwer, Dordrecht.
Stump, G. 2001. *Inflectional morphology: a theory of paradigm structure.* Cambridge University Press, Cambridge.
Xu, Z. and M. Aronoff. 2011. A realization optimality-theoretic approach to extended morphological exponence. *Journal of Linguistics* 1-35.