Causative Formation in Kammu: Prespecified Features and Single Consonant Reduplication*

Kazue Takeda
University of California, Irvine

1 Introduction

This paper investigates single consonant reduplication (henceforth SCR) and related affixation processes for the causative formation in Kammu, a language belonging to the Mon-Khmer branch of the Austro-Asiatic language family, spoken in northern Laos and in adjacent area of Vietnam, Thailand and China.[1] Figure (1) illustrates the process of SCR in the derivational framework, given by Svantesson (1992):

(1)

		p		p		
		|		|	
CVVC	→	CC-CVVC	→	CC-CVVC	→	ps.ʔəs
| V |		| V |		| | V |		
ʔ ə s		ʔ ə s		ʔəs ʔ ə s		(Svantesson 1992, 1983)

SCR like (1) has posed a problem for the analyses that claim that reduplication affixes should be regarded as a syllable (Broselow and McCarthy (1983), among others), since that kind of reduplication process needs to refer to a phonological

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[1] The following phonemes are observed in Kammu (see Svantesson 1983 for detailed characterization).

Vowels:								
short			long			diphthongs		
i	ɨ	u	i:	ɨ:	u:	ia	ɨa	ua
e	ə	o	e:	ə:	o:			
ɛ	a	ɔ	ɛ:	ʌ:	ɔ:			
				a:				

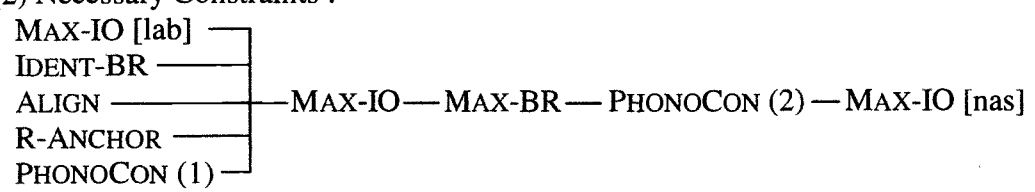
Consonants:					
	labial	dental/coronal	palatal	velar	glottal
stops: unaspirated	p	t	c	k	ʔ
aspirated	p^h	t^h	c^h	k^h	
implosive	b	d			
nasals	m	n	ɲ	ŋ	
fricatives		s			h
lateral		l			
trill		r			
glides	w		y		
laryngealized glides	ʔw		ʔy		

unit smaller than a syllable. On the other hand, it has served as a piece of evidence for positing a templatic specification for the reduplicant (Marantz (1982), Bell (1983)). In this paper, I argue, on the basis of syllable-final consonant reduplication in Kammu, that we can explain the pattern of SCR by interacting constraints and do away with a templatic specification of C in the framework of Optimality Theory (Prince and Smolensky (1993), McCarthy and Prince (1993a, b, 1994, 1995) (henceforth M & P), among others).

Other than the reduplication process in (1), Kammu has three kinds of causative formation (two prefixes ([p-], [pn-]) and an infix ([-m-])). No one has argued so far, by presenting a convincing analysis of their distribution, that all these causative affixes, including the one which induces SCR, are allomorphs of the same morpheme.[2] In this paper, I examine the distribution of these affixes and argue that they are allomorphs of the same morpheme, with their distribution being determined by the interaction of general constraints and some phonotactic constraints active in Kammu. I assume that the causative morpheme consists of [labial] and [nasal] features, and a reduplicative affix. What is characteristic about causative formation is that not all the features specified for the causative affix can be realized on the surface due to the dominant constraint curtailing the shape of prosodic word: the realization of the reduplicative affix is suppressed in some cases, and the [nasal] feature is sacrificed in other cases. The hierarchically ordered violable constraints in Optimality Theory enable us to successfully characterize a seemingly complicated distribution pattern of four allomorphs, which cannot be easily achieved in a rule-governed system.

The following is the constraint hierarchy I propose to characterize the distribution of the four allomorphs of the causative morpheme:

(2) Necessary Constraints :



(3) a. Phonological Constraints (1)
MINIMAL WORD, ONSET,
IAMBIC FOOT, *ONSET [nas],
FOOT CONSTRAINT, *NUC/[laryn],
*LAB-LAB, *C-CLUSTER

b. Phonological Constraints (2)
*STRUCTURE/σ
*STRUCTURE/μ

In (2), we see that various phonological constraints dominate MAX-BR, which captures the properties of the causative reduplication in Kammu that MAX-BR is sacrificed in various cases for the observance of the phonological constraints in

[2] Svantesson (1992) suggests the possibility of treating [p-] and [-m-] as allomorphs. See Chen (1988) for a similar analysis.

(3a). The constraints in (3b) play a role in choosing between [p]-prefixation and [pn]-prefixation, when the candidate with [pC]-prefixation violates more highly ranked constraints.

The organization of this paper is as follows. In section 2, we provide the basic data of causative formation. Section 3 deals with characteristic syllable structures in Kammu, which play important roles in determining the shape of outputs in causative formation. Section 4 presents an analysis of the four types of causative affixes within Optimality Theory. Section 5 summarizes the paper.

2 Basic Data[3]

As briefly mentioned in the previous section, Kammu has four types of causative affixes: three of them are prefixes and the other is an infix, as shown in (4): [4, 5]

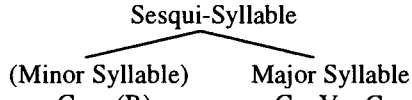
(4)

- monosyllabic words CVV/CV(V)C
  - (i) pC-: words with a minor syllable bearing tone
    mec (ˆ) → pc.mec (´ ˋ)
  - (ii) a. p-: monosyllabic words with a consonant cluster
    rəh (ˆ) → prəh (´)
  - b. p-: words with a toneless minor syllable
    ŋɔ:m (ˆ) → p.ŋɔ:m (ˆ)
  - (iii) pn-: words with a minor syllable bearing tone
    sis (´) → pn.sis (ˆ ´)
- words with toneless minor syllable C.CVV/C.CV(V)C
  - (iv) -m- : words with a minor syllable bearing tone
    s.ka:t (´) → sm.ka:t (´ ´)

[3] All the data in Kammu discussed in this paper are taken from Svantesson 1983, 1992.

[4] I will use terms such as minor/major syllables and sesqui-syllables to refer to the structure and its subparts in (i), following Svantesson (1983, 1992). Sesqui-syllables consist of a minor syllable (without a vowel) and a major syllable (with a vowel).

(i)



[5] Diacritics within parentheses indicate tone: (•) corresponds to high tone and (•) to low tone. The basic tonal pattern in Kammu is as follows: Here I assume that a syllable containing at least one mora is a tone bearing unit.

Single Syllable - - - (H)/(L)/*(HL)/*(LH)
Sesqui-Syllable With Minor Syllable consisting of single consonant - - - (H)/(L)/*(HL)/* (LH)
With Minor Syllable consisting of two consonants - - - (HL)/(LH)/(LL)/*(HH)

The prefixes are attached to monosyllabic verbs, while the infix goes with sesqui-syllabic words. By attaching the prefix [pC-], we obtain sesqui-syllabic causative forms with a copy of the syllable-final consonant of the base in the second position of the minor syllable, as in (4i). The prefixation of [p-] is divided into two sub-cases. In one case, the resulting form ends up in a monosyllabic word with a consonant cluster, as in (4iia). In the other case, the prefixation of [p-] yields a word with a toneless minor syllable, as in (4iib). (4iii) illustrates [pn]-prefixation. By prefixing [pn-], we obtain sesqui-syllabic causative forms with a minor syllable bearing tone. The last type of causative formation involves the infix [-m-]. Infixation of [-m-] produces sesqui-syllabic forms with a minor syllable bearing tone, as in (4iv) .[6]

2.1 [pC]-Prefixation

The most unmarked way to form causative expressions is to attach the prefix [pC]-to the base, as exemplified in (5). This process involves copying of the syllable-final consonant onto the second position of the minor syllable. In (5a-d), copied consonants are stops, fricatives, nasals, and liquids, respectively.

(5) a.	la:k (ˋ)	'to tell lies'	pk.la:k (ˊˋ)	mec (ˋ)	'to hear'	pc.mec (ˊˋ)
b.	ro:s (ˋ)	'angry'	ps.ro:s (ˊˋ)	ʔə:s (ˋ)	'to cover'	ps.ʔə:s (ˊˋ)
c.	pa:n (ˋ)	'to drunk'	pn.pa:n (ˊˋ)	ma:n (ˋ)	'pregnant'	pn.ma:n (ˊˋ)
d.	ca:r (ˋ)	'thin'	pr.ca:r (ˊˋ)	kə:y (ˋ)	'to be used'	py.kə:y (ˊˋ)

The consonants that do not undergo copying are the glottals [h, ʔ], and labials [p, m, w]. When the base ends with one of these sounds, other types of causative formation (such as [p]-/[pn]- prefixation) are chosen over [pC]-prefixation, as shown in the following subsections. This indicates that causative formation seeks to adopt [pC]-prefixation whenever possible, and that [p]-/[pn]-prefixation applies only if [pC]-prefixation is prohibited by other independently motivated constraints.

[6] What is worth mentioning here is that according to Svantesson (1983), if the root verb is bigger in size than a monosyllable or a sesqui-syllable with a toneless minor syllable, prefixation or infixation is not available but rather modal verbs /ʔəh/ (ˋ) 'to make' and /ʔuun/ (ˋ) 'to let, to give' are used to form causative expressions. This strongly suggests that the morphological process of causative formation is restricted by some phonological constraints regulating the prosodic size of words. Bernard Tranel (p.c.) pointed out to me that this sensitivity to the size of the base is reminiscent of the condition observed for the comparative/superlative formation (-er/-est vs. more/most) in English. I will leave the problem of selecting between periphrastic and affixal causative formation open, and will restrict myself to the analysis of affixal causative formation.

2.2 [p]-Prefixation

A second type of causative formation, [p]-prefixation, is further divided into two subtypes. In the first type, the resulting causative expression yields the form of single syllable with a consonant cluster beginning with [p], as in (6a). In the other type, [p]-prefixation produces a sesqui-syllabic word with a minor syllable consisting of [p] alone, as in (6b) and (6c). The crucial difference between the two subtypes lies in the fact that in the first subtype, the combination of the prefix [p-] and the first consonant of the base verb yields licit consonant clusters in Kammu, while that is not the case in the second subtype.

(6) a.	rəh (ˋ)	'to rise'	prəh (ˊ)	luh (ˊ)	'to have a hole'	pluh (ˊ)
b.	ŋo:m (ˋ)	'to weigh down'	p.ŋo:m (ˊ ˊ)	cra:p (ˊ)	'to get stuck'	p.cra:p (ˊ ˊ)
c.	ka: (ˋ)	'to climb'	p.ka: (ˋ)	cɨa (ˊ)	'seed'	p.cɨa (ˊ)

Notice here that the examples in (6a) and (6b) involve base verbs ending with glottals and labials, which are not attested in [pC]-prefixation. It seems plausible to consider that [p]-prefixation is adopted in these examples since [pC]-prefixation is not available for them.

2.3 [pn]-Prefixation

A third type of causative formation involves [pn]-prefixation, which yields a sesqui-syllabic form with a minor syllable consisting of [pn], as in (7). Here again, we observe that the base verbs in (7) end with consonants which cannot undergo syllable-final consonant reduplication in [pC]-prefixation. This also suggests that the same line of explanation as we provided for [p]-prefixation is applicable: [pC]- prefixation is unmarked and [pn]-prefixation emerges only when the former is unavailable.

(7) a.	mah (ˋ)	'to eat'	pn.mah (ˊ ˋ)	kle? (ˋ)	'husband'	pn.kle? (ˊ ˋ)
b.	tɨ:m (ˋ)	'to believe'	pn.tɨ:m (ˊ ˋ)	nʌ:m (ˋ)	'happy'	pn.nʌ:m (ˊ ˋ)

2.4 [m]-Infixation

The fourth type of causative formation is [m]-infixation, which applies only to sesqui-syllabic base verbs and yields sesqui-syllabic forms with the infix [-m-] in the second position of the minor syllable.[7]

(8)	k.ses (ˊ)	'to fall'	km.ses (ˋ ˊ)	t.lu:y (ˊ)	'to hang'	tm.lu:y (ˊ ˋ)
	h.cɔ? (ˊ)	'thin'	hm.cɔ? (ˊ ˋ)	s.kar (ˊ)	'straight'	sm.kar (ˊ ˋ)

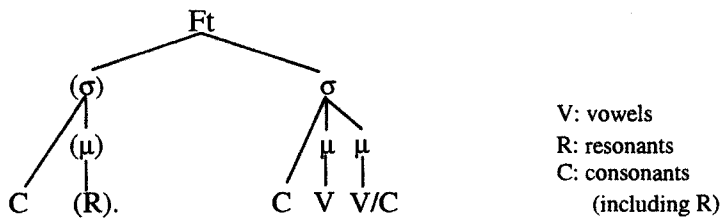
[7] The infix can be realized as the coronal nasal [n] or the palatal nasal [ɲ]. See Takeda 1997 for the relevant discussion.

None of the prefixes may occur with base verbs in (8). Since the infix [-m-] and the prefix [pn-] share [labial] and [nasal], it seems plausible to regard the infix [-m-] as an allomorph of the causative morpheme.

3 Syllable Structure in Kammu

First, let us consider the structure of basic words in Kammu, which is schematized in (9).[8] I regard as a nucleus the first moraic segment either in the minor or in the major syllable. Although consonants can appear in the onset or coda position of the major syllable in a fairly free manner, we have narrower restrictions on consonant clusters and on the combination of consonants which form a minor syllable.

(9)



The segments that can form a minor syllable alone are [p, t, c, k, c^h, k^h, h, r]. If we have two consonants in the minor syllable, the second one must basically be either a liquid or a nasal.[9]

If we examine the structure in (9), we immediately notice that Kammu lacks patterns such as simple V, CV, and VC. The following is a list of constraints which are necessary to characterize the properties of basic words in Kammu.

(10) MINIMAL WORD: A prosodic word must be at least bimoraic.
(11) ONSET: A syllable must have an onset.
(12) FOOT CONSTRAINT: A foot must have a σ_H . (σ_H = head syllable)
(13) HEAD SYLLABLE CONSTRAINT: σ_H must have a [-cons] segment.
(14) *NUCLEUS/[-sonorant]: [-sonorant] segments cannot appear in the nucleus position of the syllable.
(15) IAMBIC FOOT: A foot must be maximally iambic.

MINIMAL WORD in (10) explains why Kammu does not allow forms such as V or CV: They are not bimoraic. ONSET in (11) plays a role in excluding onsetless syllables such as V and VC. FOOT CONSTRAINT in (12) guarantees, in combination with HEAD SYLLABLE CONSTRAINT in (13), that a foot involves a

[8] See Gafos 1998 and Sloan 1988 for different approaches to minor syllables.
[9] Palatal nasal [ɲ], however, cannot show up freely in the second position of the minor syllable.

syllable which dominates [-cons], as in (16). They exclude feet without a vowel (e.g. CRC).

(16)

(σ_H = head syllable; μ_H = head mora)

The constraint *NUCLEUS/[-son] in (14) belongs to a family of constraints *NUCLEUS/[F] and has the effect of excluding [-son] from the second position of the minor syllable. This explains the fact that only nasals and liquids can appear in that position in Kammu in the non-reduplicative context.[10]

IAMBIC FOOT in (15) ensures that a foot must be right headed in Kammu. It explains the absence of CVC.CR and CVC.CV in the language.[11] Furthermore, the qualification "maximally iambic" requires that the right hand side of the foot be salient enough in contrast with the left hand side of the foot. Here I claim that forms such as CV.CV and CR.CV are prohibited since they are not asymmetric enough.[12] In these forms, both sides of the foot have the same saliency in terms of the number of mora. Hence they are nonexistent in Kammu. One might wonder why then CV.CVC is not allowed. It is clear that CV.CVC is normally regarded as a licit iambic foot with the right syllable heavier than the left syllable. I assume here that there is a scale on stress patterns, as illustrated below.[13]

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[10] See Takeda 1997 for the explanation of the obstruents occurring in the relevant position as a result of reduplication.

[11] This nicely accords with the fact that there is no suffixing process in Kammu. I am grateful to Moira Yip for bringing this point to my attention.

[12] What is worth mentioning here is that Kammu lacks CV syllables altogether, which is very rare cross-linguistically, considering that a CV syllable is the most unmarked of all possible syllables and prevalent among languages. The lack of CV syllables in Kammu can be derived from IAMBIC FOOT in this language. This suggests that syllable types allowed in a given language are not obtained simply by drawing an arbitrary line in the static markedness hierarchy of syllable types. But rather they are determined through interaction of several constraints. The reason why a CV syllable is prevalent in many languages is because it satisfies ONSET and NO CODA. With no other constraint, Kammu should have allowed CV syllables. But MINIMAL WORD excludes a word consisting of CV alone and IAMBIC FOOT rules out a word with a CV.CV or CV.CVC pattern, which altogether yields the total absence of CV syllables. I owe these observations to Moira Yip (p.c.).

[13] The scale in (17) is different from the one proposed by Prince (1990), which is shown below.

(i) a. Iambic. LH >> {LL, H} >> L b. Trochaic. {LL, H} >> HL >> L

The difference between (17) and (i) lies in the status of the H syllable (CVC, in my notation). In this paper, I will just postulate the scale in (17) and leave justification and discussion on theoretical implications for future research.

(17) ⟵ Kammu ⟶

0.CVC (>> C.CVC >> CR.CVC) >> CV.CVC >> CV.CV >> CVC.CV

⟵ iambic trochaic ⟶

Figure (17) illustrates a scale between the extreme iamb and the extreme trochee. In a language which does not allow the presence of minor syllables, only CVC and CV.CVC patterns emerge as an iambic foot. Kammu, however, has minor syllables attached to the major syllable, and C.CVC. and CC.CVC patterns can be realized as legitimate iambic feet. The CV.CVC pattern is excluded from the legitimate iambic feet, because of the constraint in (15).[14] The decision on where to draw a line separating a licit from an illicit one depends on each language, and in Kammu, the line should be drawn between CR.CVC and CV.CVC.

To sum up the observation, the size and shape of the basic words in Kammu are strictly regulated by the constrains listed in (10)-(15). Most of the constraints in (10)-(15) are undominated in Kammu, and importantly, the forms resulting from causative formation are also regulated by these constraints. The basic word forms allowed in the language are given below, for the sake of exposition.[15]

(18) a. CVV/CVC b. C. CVV/C.CVC c. CR. CVV/CR.CVC

4 An Optimality Theoretic Analysis

In this section, I explain the distribution of the four types of causative in terms of interacting constraints in Optimality Theory. First, let us consider the input of causative expressions. We have an overt realization of a [labial] feature in all the patterns of causative formation: [labial] is realized as [p] in [pC]-, [p]-, and [pn]-prefixation, and as [m] in [m]-infixation. However, a [nasal] feature and a reduplication affix show up in some cases but not in others. For example, the [nasal] feature is overtly realized only in [pn]-prefixation and [m]-infixation, and the reduplication process is visible on the surface only in the case of [pC]-prefixation. In spite of the partial realization of the [nasal] feature and reduplication affix, we still assume that the [nasal] feature and reduplication affix constitute a causative affix together with the [labial] feature, since that will enable us to provide a principled explanation of the distribution of the four types of causative affixes, with interacting constraints provided below.

In the first subsection, we provide an account for the [pC]-prefixation pattern and show that this prefixation pattern is the least marked. In the

[14] Griffith (1994) and Hayes (1995) observe that Cambodian also has an iambic pattern and exhibits a vowel reduction/ shortening in the minor syllable, reinforcing the durational contrast between syllables within the iambic foot.

[15] For a more detailed discussion on how to exclude other potential syllable structures, see Takeda 1997.

subsequent subsections, we reveal how the other affixation patterns emerge in place of [pC-] prefixation.

4.1 [pC]-prefixation

[pC]-prefixation involves SCR, by which the syllable-final consonant is copied onto the second position of the minor syllable prefixed to the base. The relevant data are partially repeated in (19):

(19) (=(5)) a. la:k (ˋ) 'to tell lies' pk.la:k (ˊˋ) mec (ˋ) 'to hear' pc.mec (ˊˋ)

Regarding [pC]-prefixation, we have several questions to address: (i) why do we have SCR rather than total reduplication?; (ii) why are the [labial] feature and the reduplicant realized overtly on the surface but not the [nasal] feature?; (iii) why does only the syllable-final consonant undergo reduplication?

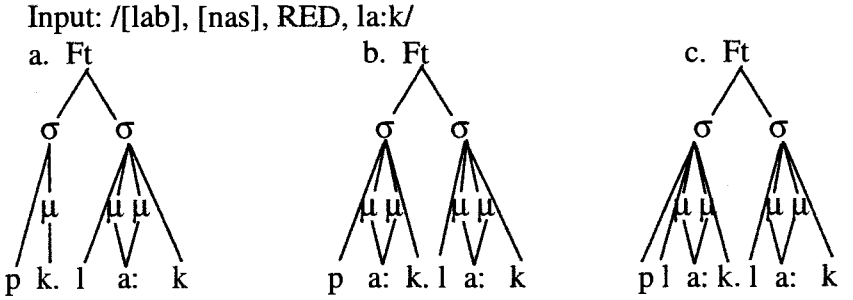
The answer to the first question is directly related to the shape of basic words in Kammu we discussed in the previous section. Recall here IAMBIC FOOT in (15): A foot must be maximally iambic. We assume that IAMBIC FOOT, as well as other constraints such as MINIMAL WORD and FOOT CONSTRAINT, is undominated, hence the ranking in (21).

(20) MAX-BR: Every segment of the base has a correspondent in the reduplicant. (M & P (1995))

(21) IAMBIC FOOT >> MAX-BR

Given the undominated status of IAMBIC FOOT, words of the form CV.CVC or CVC.CVC cannot be realized on the surface. This explains why the form resulting from total reduplication in (22c), is not possible: It involves no violation of MAX-BR, but crucially violates a highly ranked IAMBIC FOOT. The same constraint prohibits the reduplication of a nucleus vowel along with the final consonant in (22b).

(22) Input: /[lab], [nas], RED, la:k/



In either (22b) or (22c), the right syllable has the same number of moras as the left one and hence the entire foot does not qualify as a licit iambic foot in Kammu.[16] As a result, these two are ruled out due to the violation of IAMBIC FOOT, leaving the form [pk.la:k] in (22a) as the optimal output, although it involves more violations of MAX-BR.[17] Now the answer to the first question is clear. The choice of SCR over total reduplication follows from the ranking in which IAMBIC FOOT is ranked higher than MAX-BR.[18, 19]

Next, let us consider the second question: why does the [nasal] feature never show up on the surface in [pC]-prefixation, while the [labial] feature is realized overtly? This property of [pC]-prefixation is captured by positing the constraint ranking in (25). The definitions of the constraints in (25) are given in (23)-(24).

(23) MAX-IO [labial]: [labial] in the input has a correspondent in the output.[20]

(24) MAX-IO [nasal]: [nasal] in the input has a correspondent in the output.

(25) MAX-IO [labial] >> MAX-BR >> MAX-IO [nasal]

(26) Input: /[lab], [nas], RED, la:k/

	MAX-IO [lab]	MAX-BR	MAX-IO [nas]
a.☞ pk.la:k		**	*
b. lk.la:k	*!	*	*
c. pn.la:k		***!	

[16] I consider that the syllable-final consonant [k] in the base in (22) is not moraic. If it were, this would create a sufficient moraic asymmetry between the two syllables in (22b, c). The problematic candidates are excluded by a dominant constraint *[μμμ]$_{\sigma}$. I owe this argument to Bernard Tranel (p.c.).

[17] Note here that *NUCLEUS/[-son] in (14) is violated in (22a). In fact, the occurrences of obstruents in the second position of the minor syllable are allowed in reduplication. See Takeda 1997 for the relevant discussion.

[18] Another possible way to characterize SCR, which Bernard Tranel (p.c.) pointed out to me, is to assume a constraint regulating the size of reduplicative affixes to minimum and to rank it higher than MAX-BR. Although this explanation is plausible, I will continue to attribute the presence of SCR to the dominant constraints on the shape of prosodic words in this language over MAX-BR, since the present analysis can explain the presence of SCR without resorting to the above constraint.

[19] I consider that the [labial] feature is realized as [p] but not as any other labial consonants, because [p] is the least marked [labial] consonant in Kammu. For the same reason, the [nasal] feature is realized as [n] in [pn]-prefixation. I am grateful to Hidehito Hoshi and Bernard Tranel for bringing this point into my attention.

[20] MAX-IO [lab] and MAX-IO [nas] in (23)-(24) are different from IDENT-IO [lab] and IDENT-IO [nas] in that the former two ensure the realization of the features in question, whereas the latter two prohibit the quality change of the relevant features.

The tableau in (26) validates the constraint ranking in (25). Among the three candidates in (26), the ranking in (25) correctly chooses [pk.la:k] in (a) as the optimal output. First, the most highly ranked MAX-IO [lab] excludes the form [lk.la:k] in (b), since it does not contain an overt realization of the [labial] feature. [pk.la:k] in (a) and [pn.la:k] in (c) tie with respect to MAX-IO [lab] and the choice between them is passed over to the next highly ranked constraint, MAX-BR. [pk.la:k] involves two violations of MAX-BR and is favored over the form [pn.la:k], since [pn.la:k] incurs three violations of MAX-BR. Also crucial here is the ranking between MAX-BR and MAX-IO [nas]. If the ranking were reversed, then [pn.la:k] in (26c) would be chosen as more harmonious, contrary to fact. Thus, (25) yields a correct output.

We still have other candidates to consider. First, let us examine the form [mk.la:k]. The constraint ranking in (25) wrongly selects [mk.la:k] over [pk.la:k] as the optimal output, since the former ties with the latter regarding MAX-IO [lab] and MAX-BR, and crucially satisfies MAX-IO [nas]. Here we need to prevent the [nasal] feature from being realized as [m] in the onset position. The important fact which seems relevant here is that Kammu does not have any minor syllables with nasals in the onset position. This leads us to assuming the following phonotactic constraint.

(27) *ONSET/[nas]: Nasals cannot appear in the onset position of the minor syllable.

The undominated status of the constraint in (27) explains both the ungrammaticality of [mk.la:k], and the absence of minor syllables beginning with nasals in Kammu. The ranking in (28), with the constraint in (27) newly added, enables us to obtain the appropriate form as an output. The problematic form [mk.la:k] is correctly ruled out due to the violation of *ONSET/[nas].

(28) *ONSET/[nas], MAX-IO [lab] >> MAX-BR >> MAX-IO [nas]

However, the revised constraint ranking in (28) still cannot exclude the potential form [km.la:k]. *ONSET/[nas], which plays a crucial role to rule out the form [mk.la:k], does not affect the form [km.la:k], since [km.la:k] has a [nasal] segment in the second position of the minor syllable, not in the onset position. The realization of a nasal consonant in the second position of the minor syllable is independently attested in Kammu, which means that [km.la:k] is not ruled out because of a phonotactic constraint violation. To resolve the problem, we resort to ALIGNMENT in (29). Ranking ALIGN higher than MAX-IO [nas], as in (30), will give us the correct result. Here we further assume that ALIGN and MAX-IO [lab] are undominated, since they never get violated.

(29) ALIGN (Red, R, σ, R): The right edge of the reduplicant must align with the right edge of a syllable. (M & P (1994))

(30) MAX-IO [lab], ALIGN >> MAX-BR >> MAX-IO [nas]

The problematic form [**k**m.la:k] is ruled out as a violation of ALIGN and loses to the actual form [p**k**.la:k].

Although ALIGN in (29) guarantees that the reduplicated segment appears in the final position of the minor syllable, it does not answer the third question: why does the syllable-final consonant of the base but not consonants in other positions undergo copying? Even if we reduplicate the onset consonant onto the second position of the minor syllable, the resulting form in (31b) ties with the actual form in (31a) with respect to every relevant constraint observed so far.

(31) Input: /[lab],[nas], RED, la:k/

	MAX-IO [lab]	ALIGN	MAX-BR	MAX-IO [nas]
a. p**k**.la:k			**	*
b. p**l**.la:k			**	*

To capture the fact that only the syllable-final consonant of the base is reduplicated, we need to resort to RIGHT ANCHOR, which outranks LEFT ANCHOR.[21]

(32) {RIGHT, LEFT}-ANCHOR: Any element at the designated periphery of the base has a correspondent at the designated periphery of the reduplicant. (M & P (1995))

Given that R-ANCHOR plays a crucial role in choosing the actual form [pk.la:k] over [pl.la:k], one might argue that we can obtain the desired result in terms of R-ANCHOR, without invoking ALIGN. However, we still need ALIGN to exclude the potential candidate [p.**k**la:k]. If we simply replace ALIGN in (30) by R-ANCHOR, we obtain the ranking MAX-IO [lab], R-ANCHOR >> MAX-BR >> MAX-IO [nas]. The two candidates [p**k**.la:k] and [p.**k**la:k] tie with each other regarding relevant constraints, especially regarding R-ANCHOR, since the consonant at the right edge of the base correctly has a correspondent at the right of the reduplicant. What is crucial here is that the form [p.**k**la:k] incurs a violation of ALIGN, although it does not violate R-ANCHOR. This indicates that we need to keep ALIGN together with RIGHT ANCHOR as high-ranking constraints to correctly choose the actual form [pk.la:k] over [p.kla:k]. To recap, R-ANCHOR is responsible for reduplicating only the syllable-final consonant of the base in causative formation and ALIGN is responsible for the location of the reduplicant.

Before we go onto the next subsection, a brief mention of the forms resulting from [p]- and [pn]-prefixation is in order. First, let us examine the forms [p.la:k] and [pla:k], obtained by [p]-prefixation. In [p.la:k], [p] forms a minor

[21] L-ANCHOR plays no crucial role in Kammu. Assuming that L-ANCHOR is inactive, I ignore it in the discussion to follow.

syllable by itself, and in [pla:k], [p] is incorporated into the syllable of the base. Both of them lose to the actual form [pk.la;k], since they involves more serious violation of MAX-BR. Here we have seen that MAX-BR plays a crucial role in ruling out a [p]-prefixation output.

Another potential candidate, [pn.la:k], produced by [pn]-prefixation requires a slightly more complicated argument. We need to consider two different candidates [pn.la:k] and [p**n**$_1$.la:k$_1$] for the same surface sequence of segments. The segment [n] in [pn.la:k] is an overt realization of the feature [nasal] and [pn.la:k] thus does not involve a correspondent of the base, yielding severe violation of MAX-BR. On the other hand, [n] in [p**n**$_1$.la:k$_1$] is a correspondent of the syllable-final consonant of the base, and at the same time manifests the feature [nasal]. Since [p**n**$_1$.la:k$_1$] involves only two violations of MAX-BR, it is wrongly chosen as optimal.

We have two potential ways to exclude [p**n**$_1$.la:k$_1$]. One is to resort to prohibiting coalescence, and the other is to take IDENT-BR into consideration. Restricting coalescence is not plausible in Kammu, since there are several instances of coalescence in causative formation.[22] In contrast, referring to IDENT-BR is more desirable, since reduplicated elements exactly match their correspondents in the base in their quality, and the values of the features of the reduplicant never undergo any change in causative formation. Here we assume IDENT-BR in (33) and place it in undominated position in the constraint ranking in (34), since it is not violable in any instances of causative formation.

(33) IDENT-BR: Reduplicant correspondents of a base [α F] segments are also [α F]. (M & P (1995))

(34) MAX-IO[lab], IDENT-BR >> MAX-BR >> MAX-IO [nas]

Given the constraint ranking in (34), the problematic form [pn$_1$.la:k$_1$] is ruled out as a violation of IDENT-BR, since the reduplicant [n] and its correspondent [k] in the base differ from each other in their feature values. Thus, it follows from the ranking in (34) that [pC]-prefixation rather than [pn]-prefixation provides us with the correct optimal form.

To sum up the discussion in this subsection, the ranking (I) IAMBIC FT >> MAX-BR provides an answer to the question as to why we have single consonant reduplication instead of total reduplication. The ranking (II) *ONSET/[nas], IAMBIC FT, MAX-IO [lab] >> MAX-BR >> MAX-IO[nas] explains why the prespecified feature [labial] and a reduplicative affix are overtly realized on the surface in [pC]-prefixation, but not the [nasal] feature. The reason why [pC]-prefixation reduplicates the syllable-final consonant of the base onto the syllable-final position of the minor syllable derives from the constraints (III) ALIGN (Red, R, σ, R), R-ANCHOR >> MAX-BR. Lastly, the constraint ranking (IV) IDENT-BR,

[22] See section 4.3 for relevant discussion.

MAX-IO [lab] >> MAX-BR >> MAX-IO [nas] accounts for why the reduplicant never undergoes quality change in [pC]-prefixation.

4.2 [p]-prefixation and [pn]-prefixation

In this subsection, we are concerned with the examples in which [p]- and [pn]-prefixation are preferred to [pC]-prefixation. [p]- and [pn]-prefixation take place basically when [pC]-prefixation is not applicable due to independent constraints. The choice between [p]- and [pn]-prefixation is made in terms of the ranking between *STRUCTURE and MAX-IO [nas], as presented below.

We begin with [p]-prefixation. As we observed in section 2, the prefix [p-] takes a simple syllable as its base and yields a simple syllable beginning with a consonant cluster or a sesqui-syllabic word with a toneless minor syllable. The relevant examples are repeated below, for convenience.

(35) (=(6)) a. rəh (ˋ) 'to rise' prəh (ˊ) luh (ˊ) 'to have a hole' pluh (ˊ)
b. ŋo:m (ˋ) 'to weigh down' p.ŋo:m (ˊ ˊ) cra:p (ˊ) 'to get stuck' p.cra:p (ˊˊ)
c. ka: (ˋ) 'to climb' p.ka: (ˋ) cɨa (ˊ) 'seed' p.cɨa (ˊ)

Let us first consider why no reduplicant can occur on the surface in the causative form for the base verb [ka:] in (35c). The constraint ranking proposed in the previous section chooses the optimal form [p.ka:].

(36) MAX-IO [lab], IAMBIC-FT, R-ANCHOR >> MAX-BR >> MAX-IO [nas]

If the candidate involves the copy of a vowel, the rightmost segment of the base, as in [pa:.ka:], it incurs a violation of IAMBIC FOOT, which restricts the well-formed foot structure in Kammu. The form [p.ka:], in contrast, fulfills the requirement of IAMBIC FOOT and wins over [pa:.ka:]. Why then can we not reduplicate a consonant from the base, yielding the form [pk.ka:]? What is fatal about the form [pk.ka:] is a violation of R-ANCHOR. Since [pk.ka:] involves a copy of a consonant located in the left edge of the base, it violates the undominated constraint R-ANCHOR, and hence loses to the [p]-prefixed form [p.ka:]. What we obtain from the above discussion is that if the base verb ends with a vowel, the causative form cannot contain an overt realization of the reduplicative affix, because of the undominated constraints IAMBIC FOOT and R-ANCHOR.

The constraint ranking provided in the previous section, however, is not sufficient to predict the correct causative forms in (35a) and (35b). For example, the [pC]-prefixed form [ph.luh] is incorrectly chosen over the actual form [pluh], since the former involves less violations of MAX-BR. We need a constraint which properly excludes the unwanted candidate [ph.luh]. The important observation here is that the based in (35a, b) end with glottals or labials. If we apply [pC]-

prefixation to the examples ending with glottals or labials, the resulting forms will be excluded by the phonotactic constraints given below.

(37) *NUCLEUS/[laryngeal]: [laryngeal] segments cannot appear in the nucleus position of the syllable.

(38) *LAB-LAB: A syllable cannot contain two adjacent labial segments. [23]

(37) prevents glottals from occupying the nucleus position. (38) is necessary to explain the failure of copying [labial] sounds onto the second position of the minor syllable. (38) excludes sequences such as [pp], [pw], and [pm] from minor syllables. [24]

Suppose that these phonotactic constraints are undominated and outrank MAX-BR, as indicated in (39). This ranking provides us with desired results in producing causative forms for the base [rəh] and [ŋo:m]. The [pC]-prefixed form [ph.rəh] is ruled out as a violation of *NUC/[laryn], although it involves less violation of MAX-BR than the optimal form [prəh]. In a similar way, the [pC]-prefixed form [pm.ŋo:m] is excluded due to the violation of *LAB-LAB, and loses to the actual form [p.ŋo:m].

(39) *NUC/[laryn], *LAB-LAB >> MAX-BR

In both cases, the less harmonious form violates phonotactic constraints and loses to the optimal form, which involves more violations of MAX-BR. This explains why [p]-prefixation is favored over [pC]-prefixation in these cases.

However, we still need to elucidate why [p]-prefixation is preferred to [pn]-prefixation in these cases. We have two points to consider. The first point we need to explain is that [p]-prefixation is chosen over [pn]-prefixation when the base starts with consonants which can form a legitimate consonant cluster with [p] (e.g. [prəh] and [pluh]). The other point is that when the base begins with a non-consonant cluster forming consonant and ends with a consonant which will induce a phonotactic constraint violation with [pC]-prefixation, either [p-]- or [pn]-

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[23] Given the fact that Kammu does not allow a sequence of palatal consonants (e.g. *[cc], *[cs], *[cɲ], and *[cy]), it seems plausible to argue that *PALATAL-PALATAL is active in Kammu. This further leads us to consider that *LABIAL-LABIAL and *PALATAL-PALATAL are subsumed under the family of constraints *PLACE-PLACE, which might in turn be incorporated into the more general constraint regulating the OCP phenomenon. While *LABIAL-LABIAL and *PALATAL-PALATAL are inviolable, *CORONAL-CORONAL and *VELAR-VELAR are violable, and we can observe several examples in which the sequence of coronal consonants or velar consonants forms a minor syllable. This fact suggests the following ranking.

i) *LABIAL-LABIAL, *PALATAL-PALATAL >> MAX-BR >> *CORONAL-CORONAL, *VELAR-VELAR

[24] *LAB-LAB regulates the sequence of consonants. The sequence of a vowel and a consonant falls outside of this constraint.

prefixation is basically applicable, leaving the choice between them to other factors (e.g. [p.ŋo:m] vs. [pn.nʌ:m]).

To deal with the first point, let us assume the following constraints.

(40) a. *STRUCTURE/σ: Do not build a syllable.
b. *STRUCTURE/μ: Do not build a mora. (Cf. Zoll 1993, Hewitt 1995)

The constraint in (40a) guarantees that we syllabify segments into the least number of syllables whenever possible, whereas the constraint in (40b) ensures that a toneless minor syllable (without a mora) is preferred to a tone-bearing minor syllable (with a mora). Suppose here that *STRUC/σ is ranked lower than MAX-BR, as in (41).

(41) *NUC/[laryn], *LAB-LAB >> MAX-BR >> *STRUCTURE/σ >> MAX-IO [nas]

Given a base verb [rəh], all the relevant candidates [prəh], [p.rəh], and [pn.rəh] tie with respect to MAX-BR and the decision is passed over to the next constraint, *STRUC/σ. Both [p.rəh] and [pn.rəh] contain two syllables and hence lose to [prəh], which involves only one syllable.

The justification for the ranking in (41) comes from the example of [pC]-prefixation. If the order of MAX-BR and *STRUC/σ were reversed, then we would obtain the incorrect result: [pla:k] is wrongly chosen over [pk.la:k] for the base [la:k], since the former involves less syllables than the latter. Hence MAX-BR must dominate *STRUC/σ.

Next, let us consider the second type of [p]-prefixation, in which [p] by itself constitutes a minor syllable. The reason why [p] cannot be incorporated into the base in the same way as [prəh] is that possible consonant clusters are restricted in Kammu, as depicted in (42).

(42) *C-CLUSTER: No consonant clusters in the onset position of the major syllable are allowed except for the following: [pl, pr, ph, tr, th, cr, ch, jr, kl, kr, kw, kh, hm, hn, hɲ, hl, hr, hw, hy, k^hw].

(43) *C-CLUSTER >> MAX-BR >> *STRUCTURE/σ >> MAX-IO [nas]

Given the undominated status of (42), the candidate parallel to [prəh] is disallowed for the base /ŋo:m/, since the onset consonant cluster [pŋ] is not permitted in Kammu. Hence, [p.ŋo:m] wins over [pŋo:m].

Although we succeed in excluding the form [pŋo:m] in terms of *C-CLUSTER, the constraint ranking in (41) wrongly chooses the [pn]-prefixed form [pn.ŋo:m] as optimal: [p]-prefixed form [p.ŋo:m] loses to [pn.ŋo:m] with respect to MAX-IO [nas], although the two forms have an equal number of violations regarding MAX-BR and *STRUC/σ. How can we choose the [p]-prefixed form over the [pn]-prefixed form? Here the other *STRUCTURE constraint comes into

play. Suppose that *STRUC/μ is added to the constraint ranking in (41). We obtain the ranking in (44).

(44) *LAB-LAB, *NUC/[laryn] >> MAX-BR >> *STRUCTURE/σ,
*STRUCTURE/μ >> MAX-IO [nas]

The crucial ranking is the one between *STRUC/μ and MAX-IO [nas]. The form [p.ŋo:m] contains two moras and the other form [pn.ŋo:m] involves one more mora, inducing a severer violation of *STRUC/μ. As a result, [p.ŋo:m] is chosen, as desired.

The constraint ranking in (44) also provides us with an actual form for the examples in (35c), where the base verb ends with a vowel: [ka:]. The form [p.ka:] violates *STRUC/μ less than [pn.ka:] and hence wins against [pn.ka:]. If this ranking between *STRUC/μ and MAX-IO [nas] is reversed, the resulting ranking will choose [pn.ŋo:m] and [pn.ka:] as optimal. In fact, this reversed ranking is at work when we get [pn]-prefixed forms.

Let us take a brief look at the basic data of [pn]-prefixation, repeated below.

(45)(=(7)) a. mah (ˆ) 'to eat' pn.mah (´ˆ) kleʔ (ˆ) 'husband' pn.kleʔ (´ˆ)
b. tɨ:m (ˆ) 'to believe' pn.tɨ:m (´ˆ) nʌ:m (ˆ) 'happy' pn.nʌ:m (´ˆ)

Just as in the case of [p]-prefixation, the base verbs of [pn]-prefixation end with segments which cannot occur in the second position of the minor syllable. The constraint ranking in (46) will provide us with the correct result for the base /mah/. Among the relevant candidates [ph.mah], [p,mah], and [pn.mah], the [pC]-prefixed form [ph.mah] is ruled out as a violation of *NUC/[laryn].

(46) *NUC/[laryn], *LAB-LAB >> MAX-BR >> *STRUC/σ >> MAX-IO [nas] >> *STRUC/μ
└— re-ranking —┘

What plays a crucial role in choosing the [pn]-prefixed form over [p]-prefixed form is the ranking of MAX-IO [nas] placed higher than *STRUC/μ, which I argue is obtained through re-ranking. To conclude, the choice between [p]-prefixation and [pn]-prefixation depends upon the ranking between MAX-IO [nas] and *Struc/μ. If MAX-IO [nas] is highly ranked, then [pn]-prefixation takes place and if the ranking is reversed, the [p]-prefixed form emerges. The reason why these two types of prefixation do not freely alternate is arguably because the choice between them has been lexicalized.[25]

[25] More precisely, I consider that there is an unmarked constraint hierarchy, and that some lexical items are marked as assessed by a slightly different constraint ranking. See Prince and Smolensky 1993, Tranel 1996, and Inkelas, Orgun and Zoll 1996 for related discussion.

4.3 [m]-infixation: Coalescence of [lab] and [nas] Features

[m]-infixation basically applies to sesqui-syllabic words with a toneless minor syllable and yields sesqui-syllabic words with a tone-bearing minor syllable. The relevant data are partially repeated below.

(47)(=(8)) k.ses (ˊ) 'to fall' km.ses (ˋ ˊ) t.lu:y (ˊ) 'to hang' tm.lu:y (ˊ ˋ)

We can regard the infix [m] as resulting from coalescing the [labial] and [nasal] features of the causative morpheme, which are substantiated as separate segments in [pn]-prefixation. We attempt to clarify the properties of [m]-infixation by addressing the following questions: (i) why does infixation rather than prefixation take place; (ii) why do other types of causative formation not apply to the bases in (47)?

The answer to the first question straightforwardly follows from the ranking established above. If [m] is prefixed to the base /ses/, then the resulting form [mk.ses] will violate a phonotactic constraint *ONSET/[nas], which is undominated as shown in (48).

(48) *ONSET/[nas], MAX-IO [lab] >> MAX-BR >> MAX-IO [nas]

Thus, we obtain infixation [km.ses] rather than prefixation due to the constraint *ONSET/[nas].

The answers to the second question are also provided by the ranking obtained in the previous discussion. First, let us consider [pC]-prefixation.

(49) IAMBIC FT, MAX-IO [lab] >> MAX-BR >> MAX-IO [nas]

Among the potential outputs created by [pC]-prefixation, [k.ps.ses] and [ps.k.ses] are ruled out as a violation of IAMBIC FOOT, although they incur less violations than the optimal output regarding MAX-BR.[26] Similarly, the form [ks.ses] violates MAX-BR less severely than the actual form [km.ses] but lacks the overt realization of the labial feature. As a result, the [m]-infixed form survives as optimal. From this example, we can conclude that IAMBIC FOOT and MAX-IO [lab] play crucial roles in preventing [pC]-prefixation from applying to sesqui-syllabic bases.

Before we proceed to examining [p]-prefixed forms and [pn]-prefixed forms, there is another candidate we need to consider regarding [pC]-prefixation:

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[26] Note that we need to exclude the candidates where [k.ps.ses] and [ps.k.ses] are parsed k.[ps.ses]/ps.[k.ses] ([...] indicates a foot), respectively. Since these candidates satisfy IAMBIC FOOT, the proposed constraint ranking alone cannot provide a correct result. We need to ensure that the word consists of an iambic foot and nothing more. Here I assume, following Bernard Tranel (p.c.), that a high-ranking constraint PARSE-SYLLABLE prohibiting unfooted syllables is operative to exclude the unwanted candidates.

[ps.ses]. The candidate [ps.ses] is wrongly chosen as optimal against the ranking in (49) over the actual form [km.ses] since [ps.ses] incurs less violations of MAX-BR, although it fails to realize one segment originally present in the input. The problem here lies in the absence of MAX-IO with respect to the root in the ranking. Since MAX-IO with respect to the root is never sacrificed to satisfy MAX-BR, MAX-IO must dominate MAX-BR. With this necessary modification, we obtain (50).

(50) IAMBIC FT, MAX-IO[lab] >> MAX-IO >> MAX-BR >> MAX-IO[nas]

The modified ranking in (50) correctly predicts the [m]-infixed form as optimal. The candidate with a reduplicated consonant in [ps.ses] loses to the [m]-infixed form [km.ses] since [ps.ses] violates the highly ranked constrain MAX-IO.

The ranking in (50) also excludes the [p]-prefixed form and the [pn]-prefixed form, and explains why the candidate with coalescence in [km.ses] is most harmonious. The [pn]-prefixed form [pn.ses] which realizes both [labial] and [nasal] as separate segments, involves a fatal violation of MAX-IO, and the [p]-prefixed form [pk.ses], which preserves the segments of the base in the input, is ruled out because of the violation of MAX-IO[nas]. The [m]-infixed form [km.ses] successfully retains the segments of the base in the input while realizing [labial] and [nasal] on the surface. Hence [km.ses] is optimal.

We have now demonstrated that for the sesqui-syllabic base verbs in (47), given the constraint ranking established in (2) with MAX-IO added, the three types of prefixation yield less harmonious forms and accordingly, the form produced by infixation is chosen as optimal. This result, in turn, suggests that the constraint ranking developed originally to explain that the prefixation patterns is appropriate.

5 Summary

In this paper, I have argued that the four types of causative affixes in Kammu are allomorphs of the same morpheme and that their distribution can be explained through interaction of hierarchically ordered constraints. In doing so, I have shown that SCR in causative formation in Kammu can be dealt with without assuming a templatic specification.

6 References

Bell, S. J. 1983. "Internal C reduplication in Shuswap", *Linguistic Inquiry, 14* (2), 332-338.

Broselow, E., and J. McCarthy 1983. "A Theory of internal reduplication," *The Linguistic Review, 3* (1), 25-88.

Chen, Y. 1998. Causative affix in Kammu. Paper presented at LSA Annual Meeting.

Gafos, D. 1998. "Eliminating long-distance consonant spreading," *Natural Language and Linguistic Theory, 16,* 223-278

Griffith, T. 1994. Vowels and implosives in Cambodian and Constraint Theories. Ms., University of California, Irvine.

Hayes, B. 1995. *Metrical stress theory: Principles and case studies.* Chicago: University of Chicago Press.

Hewitt, M. A. 1995. Single segment reduplication in Optimality Theory. Ms.

Inkelas, S., C. O. Orgun, and C. Zoll. 1996. Exceptions and static phonological patterns: Cophonology vs. prespecification. Ms., University of California, Berkeley and University of Iowa.

Marantz, A. 1982. "Re Reduplication", *Linguistic Inquiry, 13*, 435-482.

McCarthy, J., and A. Prince. 1993a. Generalized alignment. Ms., University of Massachusetts, Amherst and Rutgers University.

_____. 1993b. Prosodic morphology I: Constraint interaction and satisfaction. Ms., University of Massachusetts, Amherst and Rutgers University.

_____. 1994. The emergence of the unmarked: Optimality in prosodic morphology. Ms., University of Massachusetts, Amherst and Rutgers University

_____. 1995. "Faithfulness and reduplicative identity," in Beckman, J. N., L. W. Dickey, & S. Urbanczyk eds., *Papers in Optimality Theory. University of Massachusetts Occasional Papers in Linguistics 18*, 249-384. University of Massachusetts, Amherst: GLSA.

Prince, A., and P. Smolensky. 1993. Optimality Theory: Constraint interaction in generative grammar. Ms., Rutgers University and University of Colorado, Boulder.

Prince, E. 1990. "Quantitative consequences of rhythmic organization," in *Parasession on the Syllable in Phonetics and Phonology*, 355-398. Chicago Linguistic Society.

Sloan, K. 1988. "Bare-consonant reduplication: Implication for a prosodic theory of reduplication", in Borer, H., ed., *Proceedings of WCCFL 7.* Stanford: Stanford Linguistic Association, 319-330.

Svantesson, J.-O. 1983. *Kammu phonology and morphology.* Sweden: CWK CLEERUP

_____. 1992. "Syllable constituents in Kammu reduplication," *Phonologica* 1992, 266-274.

Takeda, K. 1997. Single consonant reduplication and causative formation in Kammu. Ms., University of California, Irvine.

Tranel, B. 1996. "Exceptionality in Optimality Theory and final consonants in French," in Zagona, K., ed., *Grammatical Theory and Romance Languages.* Amsterdam/Philadelphia: John Benjamins, 275-91.

Zoll, C. 1993. Directionless syllabification and ghosts in Yawelmani. Ms., University of California, Berkeley.