University of Konstanz
Faculty of Humanities

Revisiting Chamorro: A Cyclic Account of Reduplication and Infixation

Term paper for Introduction to Phonological Theory and Analysis

Student: Barış Bay
Mentor: Dr. Fernanda Barrientos Contreras
Submission Date: 01/09/2025
Revision Date: 28/02/2026

Contents

1 Introduction

1.1 Scope of the paper

This term paper examines how Chamorro morphophonology, in particular the interaction of infixation, reduplication, and umlaut, can be re-analysed within a cyclic, pre-phonological framework. The main aim is to recast the Chamorro data under Kalin's (2022) model of the morphosyntax–phonology interface. By adopting this cyclic, serial morphophonology, the paper seeks to show that Chamorro's seemingly complex patterns can emerge naturally from the timing of operations rather than from parallel constraints, so long as the reduplicant's phonological content is inserted at a later stage (see section 3.2). Crucially, the re-analysis uses the restricted phonology at the morphophonological level in Kalin's model to propose a novel way of deriving the overapplication of umlaut.

The central aims of this paper are (i) to re-analyse the interaction between umlaut, infixation, reduplication, and the resulting overapplication effect, following Kalin's morphophonological model and (ii) to model the overapplication of the umlaut under a cyclic, rule-based approach.

1.2 Infixation

Infixes have been a topic of systematic linguistic inquiry for over five decades. Alan Yu (2007, p. 1) points to Russell Ultan (1975) for the first systematic typological study of infixation and considers it a foundational milestone in the field. In the decades since Ultan's study, infixation has remained a persistent puzzle, precisely because infixes (often) surface as disruptions of the root, which may well be their most defining quality. That is, unlike prefixes and suffixes, which attach at the edges of words, infixes typically interrupt the continuity of a root or stem by being inserted into its interior (1a–b).

(1) Chamorro passive of transitive verbs (Chung 2020, pp. 263–266)

VERB	PASSIVE	
a. bisita	b-i'n-isita	'visit'
b. tattiyi	t-i'n-attiyi	'follow'

This disruption violates what is called the "concatenative ideal," in which morphemes are ordered linearly, remain contiguous, and preserve their segmental integrity (see Bye and Svenonius 2012 for further discussion). Importantly, this violation of linearity poses a problem for piece-based theories of morphology like Distributed Morphology (Halle and Marantz 1993), since infixes appear in positions that a constrained syntax cannot generate. To that end, infix placement has often been treated as a domain in which phonology exerts decisive influence. Most notably, McCarthy and Prince (1993) proposed that affix placement results from the ranking of morphological alignment constraints against prosodic well-formedness constraints. Under this view, an affix may be forced into an infixal position if the phonology blocks its realization at the periphery. This approach, commonly known as the $P \gg M$ model, has been foundational in shaping the understanding of infixation phenomena. Yet, subsequent work revealed empirical and conceptual difficulties, including cases of non-optimizing or seemingly arbitrary infix placement (Yu 2007), as well as cases that result in opacity that cannot be neatly captured by parallel evaluation of constraints (Harizanov 2017; Kalin 2022).

Kalin (2022), looking at a variety of languages with suppletive allomorphy involving an infix, has argued that infixation is indirect and pre-phonological, with conclusions about suppletive allomorphy that pose a serious challenge to parallel models like $P \gg M$. She has also proposed a cyclic model of the morphosyntax–phonology interface, in which infixation follows linear concatenation and exponent choice (2).

(2) Linear concatenation < Exponent choice < Infixation < Phonology

To that end, this paper focuses on Chamorro, an Austronesian language whose morphology allows umlaut (triggered via certain exponents), infixation, and reduplication to apply to the same root (Chung 2020). Previously, Harizanov (following Topping and Dunga 1973) has demonstrated that the opaque interaction between morphological and phonological processes in Chamorro requires a cyclic, derivational approach with a serial architecture in the grammar. This essentially aligns with Kalin (2022) and the central argument advanced in this paper. Additionally, this paper extends the analysis of the interaction of infixation with umlaut, a phenomenon that has not received a detailed explanation in Harizanov's work.

2 Background

As mentioned in the previous section, infixation phenomena present a challenge for piece-based theories of morphology, as they appear internal to a host morpheme. From a typological perspective, infixation is relatively rare but not marginal; it is attested across language families including Austronesian, Austroasiatic, and Indo-European. The rarity of infixes, compared to prefixes and suffixes, has led some linguists to question whether they constitute a natural class at all, or whether they are better seen as artifacts of other morphological mechanisms (Bye and Svenonius 2012).

The challenge lies in the fact that infixation disrupts two principles of linear morphology: contiguity (morphemes should not be discontinuous) and proper precedence (morphemes should not overlap). Infixes therefore call into question the assumption that morphology is fundamentally concatenative. This tension has prompted decades of debate over whether infix placement is determined primarily by phonological well-formedness, by morphological alignment, or by some interaction of the two.

In that regard, McCarthy and Prince's (1993) propose that affix placement results from the interaction between prosodic constraints (P) and morphological alignment constraints (M). For example, constraints such as ONSET and NOCODA favour syllables of a particular shape, while ALIGN-AFFIX-L/R require an affix to appear at an edge. The crucial insight is that if phonological constraints outrank morphological alignment ($P \gg M$), an affix may be forced into a non-edge position, resulting in infixation. Conversely, if $M \gg P$, the affix surfaces as a prefix or suffix.

This model captures the intuition that infixation is phonologically optimizing: the grammar prefers a less marked phonological structure, even if it means misaligning the affix. It also integrates infixation into the general architecture of Optimality Theory, where the same mechanism of constraint interaction accounts for phenomena as diverse as stress, syllabification, and reduplication.

However, the $P \gg M$ model faces several problems. First, it predicts that infixation should always serve phonological well-formedness, but as Yu (2007) demonstrates, there are many anti-optimizing cases where infixation introduces phonological irregularities rather than resolving them. Second, the

model struggles to handle opacity, as in Chamorro, where the placement of infixes and the shape of reduplicants interact in ways that do not emerge from parallel optimization.

For example, in regard to anti-optimizing cases, Yu provides the following example: in Atayal, the animate actor focus marker *-m-* appears immediately after the first consonant, regardless of whether this placement degrades phonological well-formedness, as in (3a–c).

(3) Atayal animate actor focus (Egerod 1965, as cited in Yu 2007, pp. 263–266)
a. qul q-m-ul 'snatch'
b. kat k-m-al 'bite'
c. kuu k-m-uu 'too tired, not in the mood'

To account for such patterns, Yu proposes a theory of Generalized Phonological Subcategorization (GPS), in which infixes are specified to attach relative to prosodic or segmental pivots called *edge pivots* (first consonant, first vowel, final syllable, final vowel) and *prominence pivots* (stressed syllable, stressed foot, stressed vowel). Thus, according to Yu, infixation is the result of lexical specification and is direct and morphological.

A later approach by Bye and Svenonius (2012) puts forward an indirect and phonological account of infixation by proposing that infixes can be accounted for via the structural relation of antitropism (IDENT[ANTITROPAL]), whereby a segment of the affix is lexically specified as not aligned to the edge where it is introduced by the syntax (as a prefix or a suffix). The final position of the affix is then determined by the interaction of this lexical specification with phonological constraints as in (4), taken from Bye and Svenonius (2012, p. 475).

(4) $/_{\omega}\sim m + kuu/$ 'too tired animate actor focus'

$[_{\omega}\sim m_x + k_1u_2u_3]$	IDENT[antitropal]	LINEARITY	*CxOns
a. $m_xk_1u_2$:	$*!$		$*$
b. k_1u_2:m_x		$\prec$ 12 x $*$ $*!$	
☞ c. $k_1m_xu_2$:		$\prec$ 12 x $*$	$*$

Kalin (2022) aligns with the Bye and Svenonius account in that affixes are introduced in the syntax (or morphosyntax) as either prefixes or suffixes. However, based on findings on allomorphy involving infixation, she argues that infixation must be pre-phonological and that infixation arises only at the interface between morphology and phonology, as a result of the lexical specifications of the exponent (rather than the morpheme itself). Hence, Kalin's approach accounts for the opacity and non-optimizing behaviour of infixes, which are difficult to capture in fully parallel, constraint-based (phonologically optimizing) models. Her proposed model also accounts for the interaction between infixation and suppletive allomorphy, via the aforementioned timing of operations in (2). To that end, based to her findings, exponent choice must precede infixation, as, for example, suppletion can be conditioned only at the edge identifiable via edge-orientation (whether the morpheme is a prefix or a suffix) as in (5–6), taken from Kalin (2022):

(5) Verbal plural in Hunzib (Northeast Caucasian, Dagestan; van den Berg 1995:81–82)

a. -baa / V:-final stems

- e.g.: ʔ*āqa-baa* 'be thirsty (pl)' (root: ʔ*āqaa*)

b. -á- / elsewhere

- infix; pivot/placement: before last consonant
- e.g.: *e<yá>ke* 'burn (pl)' (root: *eke*)

(6) Unattested example

a. -n- / before a nasal in its infixed position

- infix; pivot/placement: before final syllable
- e.g., *ba<n>mat* (root: *ba.mat*)

b. -ka / elsewhere

- e.g., *basat-ka* (root: *ba.sat*)

Relatedly, she presents that non-suppletive allomorphy involving an infix is only conditioned in an infix's infixed position as in (7), taken from Kalin (2022):

(7) Nominalizer in Leti (Austronesian, Indonesia; Blevins 1999:390)

a. nia- / Class I verbs

- e.g.: *nia-keni* 'act of putting, placing' (root: *keni*)

b. -ni- / Class II verbs

- pivot/placement: before first vowel
- e.g.: *k<ni>asi* 'act of digging' (root: *kasi*)
- Non-suppletive alternants (Blevins 1999:391–392):
  - *s<n>uri* 'pour, pouring' (root: *suri*)
  - *d<i>avra* 'act of cutting, cut' (root: *davra*)
  - *r<i>esi* 'victory' (root: *resi*)
  - *r<∅>uru* 'trembling' (root: *ruru*)

Hence, she concludes that exponent choice and infixation must precede (morpho)phonology the infix is in its surface position before any (morpho)phonological alternations can take place, resulting in non-suppletive allomorphy. One crucial point to add here is that Kalin distinguishes two subtypes of non-suppletive allomorphy: surface type and restricted type.

Surface-type non-suppletive allomorphy arises when two phonologically close forms can be derived from a single underlying representation by a clearly motivated and language-general phonological process. The alternation is fully attributable to the regular phonology of the language. In contrast, restricted-type non-suppletive allomorphy also involves small phonological distance and a motivated phonological process, but that process is not active throughout the language. It applies only to specific morphemes or domains. Thus, she proposes a restricted phonology that applies prior to surface phonology where phonological processes that are not language general must apply. This empirical asymmetry adds to a derivational ordering in which suppletive allomorph choice precedes phonology, while non-suppletive alternations—whether surface-general or restricted—are handled by phonological processes applying after exponent insertion. In other words, restricted phonology

must operate in the morphophonological component (cyclically, after insertion), such that all cases involving small phonological distance but can't be derived via a language general phonological process are treated as non-suppletive allomorphs of restricted type rather than as suppletive allomorphs. A caveat concerns precisely this classification decision. Kalin explicitly acknowledges that if one were to adopt a more conservative boundary, treating all alternations that are not strictly language-general surface phonology as suppletive, then certain restricted alternations would count as suppletion. This, in turn, would undermine the generalization that suppletive allomorph choice is regulated only from the underlying stem edge and always precedes phonology. However, her decision on this classification is supported by her findings as large phonological distances in stem-internal alternations are systematically absent.

Bringing everything together, under Kalin's approach, the process unfolds in two main steps. First, affixes are linearly attached at the periphery of the stem, as prefixes or suffixes, as per syntactic (or morphosyntactic) rules. Second, realization unfolds cyclicly from bottom-up via following operations: (i) concatenation, (ii) exponent choice, (iii) exponent insertion (also linear displacement based on lexical specifications) (iv) restricted phonology. The cycle repeats until all morphemes in the domain are exponed. Finally, the resulting string is sent to the surface phonology. The process is repeated for every phase and spell-out domain. Hence, infixation occurs, or does not occur, during the mapping from morphological structure to phonological form based on COIN (Conditions on Insertion) and COIP (Conditions on Position). These conditions are similar to the split subcategorization frame, resembling Yu (2007) but decomposed into two distinct mechanisms, which are able to govern suppletive allomorphy (Kalin and Rolle 2023).

3 Analysis

3.1 Chamorro Infixation, Reduplication, and Umlaut

Chamorro provides a case of opacity in the interaction of infixation and reduplication. The language has an infix *-in-* (along with a similar infix *-um-*) that serves various grammatical functions such as passive voice (8a–b), agreement (9a–b), and nominalization (Chung 2020).

(8) Chamorro passive of transitive verbs (Chung 2020, p. 212)

VERB	PASSIVE	
a. bisita	b-i'n-isita	'visit'
b. tattiyi	t-i'n-attiyi	'follow'

(9) Chamorro SG./DU. agreement (Chung 2020, p. 25)

VERB	SG./DU. AGR	
a. chotchu	ch-u'm-otchu	'eat'
b. ta'yuk	t-u'm-a'yuk	'jump'

Chamorro also marks the progressive aspect via partial reduplication, which can be described as a reduplicant that targets the stressed syllable and affixes it to the word; for example, *'konni?* becomes *'kokonni?* (10).

(10) Chamorro progressive (Harizanov 2017, p. 11)

VERB	PROGRESSIVE	
a. ‘saga	‘sa-sa-ga	‘stay’
b. ‘konniʔ	‘ko-ko-nniʔ	‘take’

However, when reduplication and infixation co-occur, the output is opaque in that infixation is contingent on the shape of the stem as modified by reduplication, but not vice versa. The reduplicant is derived from the base and reduplication “ignores” the infix, so the infix is not copied (11a–c), adapted from Harizanov (2017).

(11)

VERB	INFIX	REDUPLICATION	INFIX+REDUPLICATION		
a. ‘saga	s-u’m-aga	‘sa-sa-ga	s-u’m-a-sa-ga	(*sumamaga)	‘stay’
b. ‘tangis	t-u’m-atangis	‘ta-ta-ngis	t-u’m-a-ta-ngis	(*tumamangis)	‘cry’
c. ‘h6nao	h-u’m-anao	‘ha-ha-nao	h-u’m-a-ha-nao	(*humahanao)	‘go’

This points to a mismatch between what a purely parallel or single-step application would predict and what the grammar actually produces. Both Harizanov’s (2017) cyclic account and Kalin’s (2022) cyclic morphophonological model can account for this opacity (see section 3.2). However, one additional puzzle arises from the fact that *-in-* triggers an umlaut: the vowel immediately following the infix is fronted (e.g., /o/ → /e/). For example, the verb *‘konniʔ* (‘take’) with passive *-in-* becomes *ki’nenniʔ* as in (12), adapted from Harizanov (2017).

(12)

VERB	INFIX+UMLAUT	
‘konniʔ	k-i’n-enniʔ	‘take’

Crucially, when infixation of *-in-* triggers umlaut and a reduplicant is attached to the stem, the umlaut seems to apply[1] to both the reduplicant and the base, yielding *ki’nekenniʔ* and not *ki’nekonniʔ* (13), adapted from Harizanov (2017).

(13)

VERB	INFIX+REDUPLICATION+UMLAUT	
‘konniʔ	k-i’n-ekenniʔ(*k-i’n-ekonniʔ)	‘take’

Harizanov proposes a cyclic derivation similar to Kalin’s, in which phonological operations like insertion of segmental material into the reduplicant, phonological affixation, and umlaut apply cyclically, with each cycle triggered by the Vocabulary Insertion of certain terminals. Hence, Harizanov (2017), assuming the following syntactic hierarchy AGR < ASP < V[2], accounts for the opacity effect by ordering reduplication before the infixal exponent is inserted, so the infix is not visible at the point of reduplication (14).

[1]Note also that, synchronically, Chamorro umlaut is not a language-general alternation, and overapplication of umlaut is only observed in the context of reduplication and does not normally spread to the right (Harizanov, 2017).

[2]The syntactic hierarchy assumed here places Aspect structurally closer to the Root than Voice, such that Root and Aspect merge prior to the introduction of Voice, yielding earlier Vocabulary Insertion for Aspect relative to Voice. As noted by Harizanov2017, however, independent evidence for this language-specific structural assumption is limited in Chamorro.

(14)

1. Output of syntax
   [Voice [Asp [V]]]
2. Vocabulary insertion of V
   [Voice [Asp ['konni?]]]
3. Vocabulary insertion of Asp
   [Voice [red 'konni?]]
4. Reduplication
   [Voice [ko ['konni?]]]
5. Phonological affixation of RED
   [Voice ['kokonni?]]]
6. Vocabulary insertion of Voice
   [−in ['kokonni?]]]
7. Phonological affixation of -in
   [ki'nokonni?]
8. Umlaut
   [ki'nekenni?]

However, the overapplication effect of the umlaut triggered by infixation is not explained in detail. Harizanov attributes the pattern to a base–reduplicant identity effect in the sense of Base-Reduplicant Correspondence Theory (McCarthy and Prince 1993, 1995, 1999 as cited in Harizanov 2017), and notes that several implementations are possible as long as they preserve identity between base and reduplicant.

However, analysing umlaut overapplication through Base–Reduplicant Correspondence Theory would presuppose a constraint-based phonological component; and as Harizanov (2017) already notes, it would have to be one that is implemented serially (e.g., Stratal Optimality Theory; Kiparsky 2000, 2003). This would in turn require a matching revision of the rule-based account in (14). Though, this paper argues that a serial, rule-based account using Kalin's model is possible, provided that reduplication applies in a two-step operation.

To that end, the analysis below will model umlaut overapplication in Chamorro within Kalin's framework by proposing an operation that splits reduplication between restricted and surface phonology, analogous to Arregi and Nevins' (2012) Agree-Link and Agree-Copy, which distribute agreement across syntax and morphology.

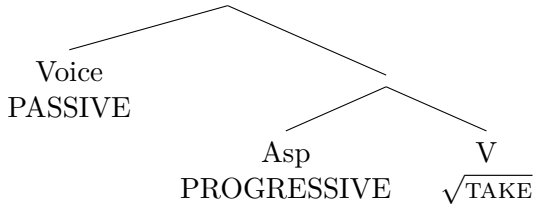
3.2 Umlaut Overapplication

The most immediate challenge for a rule-based account is the paradoxical timing it requires: reduplication must occur early enough that the infix is not yet visible, yet the umlaut triggered by that infix must still "apply" to both the base and the reduplicant. A hypothetical ordering in which umlaut applies first, followed by reduplication and then infixation, would in fact yield the correct surface form, since the reduplicant would copy an already-fronted base vowel. But such an ordering is ruled out on conceptual grounds, if not for any other reason, then simply because

the umlaut is introduced by the infix and cannot precede it. It is also important to note that umlaut, not being a language-general phonological process triggered by a morphological exponent, would have to apply at a morphophonological level. Under Kalin (2022), this would be at restricted phonology. Hence, under the current constellation, the supposed order of a rule-based account would have to be REDUPLICATION < INFIXATION < UMLAUT < UMLAUT, which cannot yield the attested form. Consequently, we propose to model this as a two-step operation—a LINK step that links the skeletal structure of an initially empty reduplicant to the base, followed by a COPY step that supplies the reduplicant with the base's segmental content. This split operation therefore provides the mechanism needed to derive umlaut overapplication in Chamorro (15).

(15)

Step 1: Building



Step 2: Linearizing

[PASSIVE − [PROGRESSIVE − [$\sqrt{\text{TAKE}}$]]]

Step 3: Cyclic operations

Cycle 1		
a.	Exponent choice: $\sqrt{\text{TAKE}}$ → *konniʔ*	*konniʔ*
b.	Linear displacement: n/a	—
c.	Restricted phonology: n/a	—
→	Output:	*konniʔ*
Cycle 2		
a.	Exponent choice: PROGRESSIVE → *red*	⟨*red*⟩*konniʔ*
b.	Linear displacement: *red* → *-o*	*ko*⟨*red*⟩*nniʔ*
c.	Restricted phonology: link	*ko*⟨*CV*⟩*nniʔ*
→	Output:	*ko*⟨*CV*⟩*nniʔ*
Cycle 3		
a.	Exponent choice: PASSIVE → *-in-*	⟨*in*⟩*ko*⟨*CV*⟩*nniʔ*
b.	Linear displacement: *-in-* → *V*	*k*⟨*in*⟩*o*⟨*CV*⟩*nniʔ*
c.	Restricted phonology: umlaut	*k*⟨*in*⟩*e*⟨*CV*⟩*nniʔ*
→	Output:	*k*⟨*in*⟩*e*⟨*CV*⟩*nniʔ*

Step 4: Surface phonology

kinekenniʔ

The current account adopts the analysis of Chamorro reduplicant as an infixal exponent rather than a prefix. Prior accounts noted that the copied (C)V appears internal to the word, right before the original stressed syllable. Yu (2007) and Inkelas (2008) propose that Chamorro's progressive reduplicant is an infix that is inserted after the stressed vowel of the base. In this view, the reduplicant immediately follows the base's stressed syllable (as an infix) instead of attaching at an outer edge.

Hence, in our account, the linking operation takes place after the exponent choice and the linear displacement of *red*, which copies the base. Then *-in-* is introduced as a prefix and promptly goes through linear displacement before it triggers umlaut as part of the restricted phonology. After umlaut is triggered, it affects the base before the output is sent to the surface phonology. Finally, the copy operation takes place in the phonological grammar, where the linked segments from the base are copied onto the reduplicant, yielding *kinekenniʔ*.

While this approach does not definitively rule out the possibility of a constraint-based analysis, it demonstrates that the observed pattern can be derived without directly invoking Base–Reduplicant Correspondence Theory, provided that segmental mapping to the reduplicant occurs at a later stage, namely in the phonological grammar. Hence, the analysis offers an alternative, rule-based account of umlaut overapplication in Chamorro.

4 Conclusion

4.1 Main Points

We provide an answer to the question of Chamorro umlaut overapplication in reduplication by appealing to restricted phonology and late segmental mapping. In our account, the vowel-fronting umlaut triggered by the infix *-in-* applies only to the base in its own cycle. Crucially, the reduplicative infix is introduced in a separate (earlier) step, and its segmental content is not fixed until the level of full phonological grammar. This means that by the time the reduplicant's vowel is realized, the base's vowel has already undergone umlaut to /i/, and the reduplicant is simply mapped with that fronted vowel. The result is that both base and reduplicant surface with an identical front vowel, creating the appearance that umlaut "overapplies". Under our analysis, this pattern is a natural consequence of the timing of operations: umlaut is a morphophonological process applying to the base as part of restricted phonology, whereas the actual segmental projection of the reduplicant happens later. This approach accounts for the overapplication without the need to invoke any special Base–Reduplicant identity constraints, whereas, constraint-based accounts would attribute the overapplication to an explicit reduplicant identity constraint (e.g. enforcing base–reduplicant faithfulness; McCarthy and Prince 1995).

A further prediction follows from the two-step model: because the reduplicant lacks segmental content until the copy operation, it cannot condition phonologically triggered allomorphy, and it can only trigger and/or undergo suprasegmental (but not segmental) phonological processes while it is only an empty skeletal template.

4.2 Implications and Further Research

The main implications of the analysis are as follows: (i) Chamorro reduplication, infixation, and umlaut do not pose a challenge to Kalin's approach and proposed model of morphophonology; (ii) (at least some) cases of overapplication in reduplication can be re-examined under a cyclic morphophonological lens. If Chamorro's pattern can be explained by timing and cyclic structure, similar patterns in other languages might yield similar results without invoking identity constraints.

This line of reasoning naturally extends to implication (ii): revisiting putative cases of overapplication may reveal that some can be reanalysed with the two-step approach advanced here.

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28/02/2026: During the revision of this analysis, I became aware of Frampton (2009), which proposes a closely related derivational mechanism. The present analysis independently converges on Frampton's proposal and provides additional empirical support from Chamorro.