

CONFLUENCE IN PHONOLOGY:
EVIDENCE FROM MICRONESIAN REDUPLICATION

by

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ABSTRACT

This dissertation explores the phonological systems of Micronesian languages, in search of patterns that are consistent throughout the family and others that are unique to subgroups and individual languages. Using data from Pohnpeian, Mokilese, Pingilapese, Puluwat, Chuukese, Woleaian, Marshallese, and Kosraean, the study focuses on reduplicative morphology as an illustrative window into the phonology of each language.

Each language is treated with an Optimality-Theoretic analysis, and consequently the phonology of each is attributed to the same set of principles. However, as a whole, the analyses cannot explain the existence of common and unique patterns within the family. A model of language change called Confluence is presented in order to account for typological trends among related languages.

The model acknowledges that learners of languages settle on a grammar based on ambient data; thus, the acquired grammar should approximate the grammar that produces the ambient data. However, a number of perceptual and articulatory factors have the result that the set of data that the learner perceives is unlike the set of data that the ambient grammar would predict. As a consequence, the learner's grammar may differ from that of the ambient grammar.

Because of the inclusion of perceptual and articulatory biases in the model, Confluence predicts several outcomes. First, a particular pattern might be resistant to change, or the same innovation might be likely to occur independently in different languages, and either way it is an observable property of otherwise divergent languages.

Second, two or more co-occurring grammatical traits of a particular language can be shown to have a common source.

Each of the predictions of Confluence is supported in the language analyses. Examples of robust patterns include coda consonant restrictions, moraic feet, and bimoraic reduplicative prefixes. Two examples of recurring innovations are the introduction of final vowel deletion and the avoidance of initial geminate consonants in favor of some other structure. Phonological patterns that co-occur in a principled manner include geminate inventories and morpheme alignment, foot structure and final vowel lenition, and a cluster of properties that consists of length contrasts, word maximality, morpheme alignment, and segment inventories.

1. Confluence

1.1 Introduction

This work stands at the crossroads of three vast domains of linguistic study: Micronesian languages, Optimality Theory, and reduplication. Each is a field in itself. Micronesia offers an empirical swath of language data, from segment inventories to pragmatic intricacies; Optimality Theory is Gilgamesh, the gentle giant of phonology; reduplication has had phonologists and morphologists rewrite books already written.

The task at hand is to analyze the reduplicative paradigms of a representative sample of Micronesian languages using the formal mechanisms of Optimality Theory, a theory of phonology that characterizes the sound patterns of languages as the function of a set of ranked, competing constraints.

The enterprise begins with a simple observation: the reduplicative systems of Micronesian languages resemble each other in form and function. This should be no surprise, as they are related to each other in a historical and cultural manner. Beyond that, though, we ought to be curious. Do the theories of grammar to which we subscribe have anything to add to this observational fact? Can they even capture it?

Answering these questions serves as a test of generative phonology, particularly of Optimality Theory, in three ways, largely because of the depth of understanding that reduplication adds to phonological analysis of any language. First, the ability to account for the phonological systems of individual languages is a test of any phonological theory. Second, it is an implicit claim of any linguistic theory that languages which differ minimally at an observational level should differ minimally at a formalized descriptive and explanatory level. Third, Optimality Theory predicts many more possible languages than are attested, so is there anything at all that can check that generative power, to tell us why we see the languages that we do rather than the ones that we do not?

Let us rephrase the questions in the context of the Micronesian family: first, each language offers some empirical fact that presents a challenge for any theory of phonology. Pohnpeian reduplication is bound by Quantitative Complementarity and nasal substitution. Mokilese allows syllable boundaries to smudge reduplicant edges. Pingilapese has a strange way of avoiding codas. Woleaian and Chuukese have reduplicative allomorphs that appear on opposite sides of the stem. Marshallese, Gilbertese, and Kosraean offer additional, individual challenges to the notion of reduplicative morphemes and prosody. Each of these requires a great deal of exposition to arrive at an analysis that properly accounts for individual, language-specific intricacies.

Second, in spite of the individual peculiarities of each Micronesian language, there are still many observations that are consistent either within subgroups or across the family. In turn, a collection of formal analyses can test whether the shared surface patterns have a link in shared formal generalizations.

Third, the analyses I develop call on numerous constraints, the permutable rankings of which form a vastly large set, yet we see no more than ten distinct systems. The number may actually be a little higher, depending on how one counts dialects and

languages in the Chuukic continuum, but certainly in the double digits and not the thousands. What is additionally striking is that although the languages in the family share a great deal of formal structure, they tend to differ by two or more formal contrasts, and not by individual ones.

Knowing that these languages are related, and also having a confidence about their formal manifestation, we can use variation within the Micronesian family as evidence for the favouring of certain kinds of innovation over others. I refer to this third contribution as a model of phonological Confluence, which provides a means of sorting attested languages out from computable but unattested ones. I elaborate on the Confluence hypothesis in Section 1.2. The rest of the chapter is devoted to a discussion of the role of Confluence in generative typology, in contrast with other lines of thought, within linguistics and without.

1.1.1 *Phonology, tendency, and the Permutation problem*

The analysis in this work is based in the framework of Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1993). For a detailed discussion of the machinations of Optimality Theory, see Chapter 3.

Optimality Theory considers phonology to be a function of rankable, universal constraints. Regardless of the source of the universality of such constraints (be it genes, God, logic, or physics), language variation is a function of constraint ranking. The factorial permutations of possible rankings translate to Optimality's predictions of phonological typology.

The permutation of constraint ranking is extremely large, but finite. Some logically imaginable systems (or subsystems—single ranking relationships) are unattested, which often leads phonologists to conclude that they represent impossible human languages. The set of possible rankings should reflect this: if a system is completely unattested, then there should be no configuration of constraints that allows such an impossible system to occur.

In other words, although Optimality Theory offers a model of typology, it does so only in a categorical sense. For example, languages with coda consonants are possible, and the constraint set allows such languages to occur. However, languages tend to favor place-linked coda consonants over heterogeneous ones. The model does not encode anything about the likelihood of such languages, because in the set of all possible configurations of formal constraints, the requirement of place-linking is predicted to outrank the opposing requirement of place-identity exactly half the time.

What is missing from the predictions of factorial permutation is a reflection of the fact that some possible systems are simply *rare*. The set of possible rankings does not encode this. Conversely, some systems or subsystems are widely attested. In this work, I operate with the premise that the rarity of a possible system is directly related to its instability, either because it is unlikely to occur as a new and innovative phenomenon, or it is unlikely to transmit over generations as languages change. Likewise, the wide attestation of particular systems or subsystems is taken as evidence of their stability over time. There is direct evidence of stability in divergent languages, derived from a

common source, for they retain some formal properties (Constraint rankings) but innovate others.

This is the basic problem: the logical permutation of formal properties is not equivalent to the set of attested human languages. Furthermore, the likelihood of particular phonological systems is more than a function of chance. I provide a preliminary statement of this “permutation problem” in (1) below. I return to the permutation problem in Section 1.5; prior to doing so, I offer a fuller discussion of the phenomenon and mechanism of Confluence.

- (1) The permutation problem: permutation \neq attestation
Some phonological systems are more likely than others to occur.

To address the permutation problem, sometimes we are tempted to appeal to fixed formalisms, like constraint rankings that are constant across all languages. In other words, constraint A outranks constraint B *in every language*. As I will argue in Section 1.5, the devices of fixed constraint scales are stipulative, as they have no reason for existence other than their empirical fit. What if, instead, there is some set of principles *outside the formal component* that makes some rankings more likely to transmit accurately than others? This likelihood of transmission of a phonological system from one generation to the next is what I refer to as the phenomenon of Confluence.

- (2) Confluence The higher-than-chance likelihood of occurrence of a phonological system.

When languages share parts of their phonological systems, they can be characterized as sharing formal configurations of constraints. If a formal configuration is shared among languages, I take it as evidence that such a configuration is expected due to its stability. I refer to such expected constraint rankings as Confluent rankings.

To address the existence of Confluent rankings, I introduce the Confluence model in Section 1.2. The model attributes Confluent rankings to a set of principles that are external to the formal phonological component, and as such it absolves Optimality Theory of the responsibility of restricting its own typological predictions of diversity.

We will see that diversity among Micronesian languages is indeed not random: members of the family show evidence of shared syntactic, morphological, and phonological structures, including restrictions on moraic consonants, foot structure, and word size. Each, however, is unique in any number of ways. As such, the language family offers a microcosm of typological tendency. These languages have existed and diverged with little outside influence (save lexical) for thousands of years. Many are well-documented, and they all use reduplication productively. Thus, it is within our power to arrive at a precise level of detail about particular aspects of each language’s phonology. With such detail, we can then see what they share in formal terms, and look for answers for such shared structures as a test case of the Confluence model.

1.1.2 Overview of the dissertation

In the remainder of this chapter, I introduce and develop the hypotheses of phonological Confluence. I introduce a formal model in Section 1.2 and discuss its properties and predictions. In Section 1.3, I expand on the permutation problem, and in Section 1.4 I discuss an analogy between linguistic and genetic innovation, and finish in Section 1.5 with a preliminary example. This chapter presupposes some knowledge of Optimality Theory; for a discussion of the model, the reader is referred to Chapter 3.

To test the Confluence hypothesis, a great deal of phonological analysis and argument is necessary, which cannot take place without clarifying the empirical and theoretical issues that form the basis of my argument. I therefore continue in Part I (which includes this chapter) with two modes of review. First, in Chapter 2 I provide a descriptive survey of the grammars of Micronesian languages, illustrating how they are related to each other, what they have in common, and what makes each unique. I focus on those grammatical aspects that have import for the study of reduplication: phonological restrictions, stress patterns, and verbal transitivity. In Chapter 3, I introduce the Optimality-Theoretic model of phonology and of reduplication, with particular attention to the notions of Anchoring, Correspondence, and the Prosody-Morphology interface. I also discuss some representational issues of prosodic structure and the way they interact with the output-oriented approach of OT.

With these tools in place, I then investigate the reduplicative patterns of individual languages. I begin in Part II with the Pohnpeic sub-group, and with Pohnpeian first of all in Chapter 4, to illustrate the importance of footing and prosodic quantity for reduplication. Pohnpeian, more widely known as Ponapean, is perhaps the most well-known Micronesian language for reduplicationists, because of its unique patterns of quantitative complementarity and nasal substitution. I follow this in Chapter 5 with an analysis of Mokilese and Pingilapese, two languages closely related to Pohnpeian; neither has the same exact patterns that make Pohnpeian famous, but both show some properties that are nonetheless eerily similar. There is enough to see among these languages to draw some conclusions about common threads within the Pohnpeic group; thus in Chapter 6 I use the subgroup as a first test of the Confluence hypothesis.

I follow a similar trail for the Chuukic languages in Part III, with some additional meat for the grinder. The analysis of Woleaian in Chapter 7 brings to light the issue of unpredictable allomorphy, the treatment of which very happily has much to say about the emergence of morpheme ordering and reduplicative prosody. The remainder of the Chuukic discussion is concerned with variations in segmental alternations, but we will see that other Chuukic languages like Puluwat and Chuukese (also known as Trukese) in Chapter 8 also have the allomorphy attested in Woleaian. Chapter 9 is a parallel to Chapter 6 in that it uses the Chuukic subgroup as another test of the Confluence hypothesis.

Part IV is devoted to the more peripheral languages of the family, handled in increasing order of time-depth of their divergence from the Chuukic-Pohnpeic group. I first treat Marshallese reduplication, which shows some similarity with the Chuukic and Pohnpeic languages, but which also introduces some larger-scale grammatical

differences. Of particular interest for the Confluence hypothesis is the means by which Marshallese treats its reflex of what appears elsewhere in the family as initial gemination.

Last, I discuss Kosraean, which shows evidence of much phonological innovation, and has a phonemic inventory and consonant distribution that differs greatly from other Micronesian languages. Still, the language has a typically Micronesian reduplication pattern, and shares with Marshallese some properties that are not seen in the Chuukic-Pohnpeic group. I account for a phenomenon called the ‘Binarity Effect’ in Kosraean, and show how its manifestation, along with the language’s consonant distribution, offers additional evidence for the Confluence hypothesis.

I conclude in Chapter 12 by summarizing the patterns that support the Confluence hypothesis in individual languages and sub-groups, to which I add a discussion of phonological properties that are common across the language family. These, too, offer support for the claims made by Confluence, which I introduce in the next section.

1.2 *A model of phonological confluence*

A summary statement of the permutation problem is repeated in (3) below, but rephrased in Optimality-Theoretic terms. OT expresses formal phonological systems as the function of ranked, violable constraints. In this light, the permutation problem takes two forms; one pertains to the appearance of individual patterns, the other, to the collocation of patterns.

- (3) The permutation problem in OT
- a. Some formal constraint rankings are more likely than others to occur.
 - b. Some pairs of constraint rankings are likely to co-occur.

In our discussion of the Pohnpeic subgroup in Chapter 6, we will see an example of the first kind of problem, that some rankings are more likely than others to occur. In the Pohnpeic languages, non-homorganic sequences are resolved with epenthesis, as in /*tep-tep*/ → *tepi-tep*. However, homorganic sequences are not resolved with epenthesis, and the means of resolving homorganic sequences is less consistent, as in Mokilese *pap-pap*, Pohnpeian *pam-pap*, and Pingilapese *paa-pap*. The ranking that resolves homorganic sequences varies from language to language, but there is no language that resolves homorganic sequences with epenthesis, as in **papi-pap*. The ranking that resolves only non-homorganic sequences with epenthesis is consistent across the subgroup. I take these facts as evidence that the ranking which resolves only non-homorganic sequences with epenthesis is a stable one, and thus likely to remain unchanged.

In Chapter 9 we will see that the Chuukic subgroup shows an example of the second kind of problem, that some pairs of constraint rankings co-occur. In Woleaian, final feet must be bimoraic, and final short vowels are devoiced, as in (*fato*)(*fato*), but in Chuukese, final feet are monomoraic, and final vowels are deleted, as in /*sɔto-sɔto*/ → (*sɔto*)(*sɔt*) (Note that the final consonant is not moraic). The ranking that derives final

deletion co-occurs with the ranking that tolerates final monomoraic feet; no language has synchronic deletion and requires bimoraic final feet.

Both versions of the permutation problem refer to the likelihood of particular systems. The facts of the Pohnpeic group suggest that a system which resolves homorganic sequences with epenthesis is unlikely, despite its formal possibility. Similarly, the facts of the Chuukic group suggest that a system which deletes final vowels but requires final binary feet is unlikely, even though it is formally possible. Consequently, the systems that *are* attested are examples of Confluent systems.

1.2.1 *The Confluence hypothesis*

In this section I develop the hypothesis of Confluence in more detail. First, let us acknowledge the Optimality-Theoretic claim that languages differ formally by their constraint rankings, and moreover, that languages can (in fact, tend to) differ by more than one constraint ranking.

Next, let us agree that languages experience innovation, or change over time, in part by developing a change in the priority of their constraint hierarchy. However, my position is that it is not sufficient to say that a change in ranking describes or causes an innovation (for a discussion of such claims, see §12.7.4), and in fact, the opposite direction of causation is more appropriate. Grammar is learnable and learned from data, a process upon which I expand in Section 1.2.2. In addition, the data generated by the originating grammar is not guaranteed to be precise, as we will see in Section 1.2.3. Thus, should there be any change in the available data, the learned grammar will differ from that of the originating grammar. This premise echoes Ohala (1981), who places the locus of language change in the listener. I offer a similar premise in (4):

(4) Premise: the locus of innovation

The genesis of innovation is in the perception of a set of phonetic representations that differs from the set predicted by the Source grammar.

In Section 1.2.2 I introduce a model that uses “the listener” as a player in language change and typology, but which places the actual locus of innovation in several places between the Source grammar and the language-acquirer. A consequence is that language change need not be characterized as single changes in constraint ranking.

In contrast, it would be odd for “active reranking”—constraints ranking themselves—to be the genesis of innovation, since languages do not necessarily differ from each other by the ranking of a single pair of constraints. Even so, when more than one reranking is needed to characterize the difference between two languages, it may be that multiple changes in rank can be attributed to a single cause.

However, by attributing innovation to things outside the domain of the constraint hierarchy, it is possible to have functional, principled extra-linguistic reasons for the existence of Confluent rankings. As a result, Optimality Theory (or any generative model of phonology) need not be tailored to reflect certain typological tendencies; such tendencies are independently predicted.

In other words, I argue that grammatical innovations in phonology may vary in their probability of occurrence, but this probability need not be stipulated or encoded in a theory of synchronic grammar. As a result, some generalizations can be expected without added restrictions to the theory. I restate this as the Confluence hypothesis below:

(5) Hypothesis: Confluence

Confluence is a function of physics, cognition, and culture, not of UG.

In Section 1.2.2, I introduce a model of Confluence that addresses the permutation problem. This model has important implications for the typological coverage of OT. We will see that as a model of typology, OT allows a vast range of grammars, but Confluence predicts “ruts” in typology that reflect near-universals. Thus the set of *expected* languages is smaller than the set of *possible* languages. The ultimate consequence of this is that a model of grammar does not need formally to encode the existence of Confluent phonological systems.

In the following subsection, I illustrate the basic mechanism of Confluence, as a basis for understanding the kinds of collocations predicted by the Confluence hypotheses. I also offer some contrasts between Confluence and other models that depend on the means of transmitting grammatical principles over generations.

1.2.2 *The Confluence mechanism*

At an informal level, the Confluence mechanism depends on the ability of learners to create phonological grammars that account for the ambient word-forms to which they are exposed. As a result, the Confluence mechanism incorporates the learner’s establishment of grammar into an explanation of the permutation problem.

We will see that the mechanism shares some assumptions with other formal models of change, including Drift (Sapir 1949, Lakoff 1972) and Evolutionary Phonology (Blevins 2003). I return to these models in detail in §12.7.

There are several steps involved in the Confluence process. First, we begin with a “Starting Point”: the language of the adult, caregiver, or conservative system, a language spoken with a uniform system. Its surface distribution of phonological elements is predictable from its set of ordered (ranked) principles and its set of lexical items. In an idealized world, learners ultimately converge upon the same sets of lexical items and ordered principles. I discuss a formalization of this process in greater detail in Section 1.2.2.1.

At the Starting Point, speakers—who I will call caregiver-peers—produce phonetic representations, the forms of which are predicted by their lexical items and ordered principles. These phonetic representations are the set of ambient forms which learners later use as a basis for learning. However, learners do not depend directly on the ambient forms: they depend on the interpreted percept. In an idealized world, learners perceive the ambient forms exactly as speakers produce them.

Ideal world or not, the learner has at her disposal a set of perceived forms. She uses these forms to formulate her own set of lexical items and ordered principles. If her set of perceived forms matches the set of ambient forms, her formal grammar will in all likelihood be identical to that of the caregiver-peer. I illustrate this process in Figure (6).

(6) The Confluence mechanism

Starting point: source grammar	<i>Caregiver-peers have a set of lexical items, ordered principles, and intended output forms</i>
↓	
“ambient forms”	<i>These are the forms produced by the caregiver-peer system.</i>
↓	
[perceived forms]	<i>This is the set of interpretations of ambient forms.</i>
↓	
Acquired grammar	<i>The learner uses the set of perceived forms as evidence for her own set of lexical items and ordered principles.</i>

The move from Perceived forms to the End Point is a complex one; this is the step at which the learner establishes her own grammar, based on the set of perceived forms. I discuss this process in greater detail in the following subsection.

1.2.2.1 *A formal learning algorithm*

Optimality Theory is a model of phonology and of phonological typology. It can also serve as a theory of learning, as pursued by Smolensky (1996), Tesar & Smolensky (1996), Boersma (1998), and Boersma & Hayes (2001). Exposed to the forms of the ambient language, learners do three things: interpret representations of ambient forms, decide on appropriate underlying representations, and rank constraints to be consistent with surface patterns.

1.2.2.2 *Formal properties of the learning algorithm*

The learner begins with an “Initial State”: a set of unranked constraints—Tesar & Smolensky claim that all Markedness Constraints must outrank all Faithfulness Constraints, but Boersma argues the constraint set can be randomly ordered. The choice is unimportant for us; what is crucial is that the learner begins with a ranking that does not accurately reflect the phonology of the language she is to acquire.

The learner has several tools at her disposal: first, she has knowledge of the output representations of adult forms; these are also called “Input” in the acquisition literature, but I eschew this usage to avoid confusion, and adopt instead “Ambient forms”. She also can use these ambient forms to gain fairly quickly an adult-like set of abstract underlying representations. Smolensky (1996) offers a formal account for how this can be so; essentially, the learner’s underlying representations will be identical to adult ambient forms. Here the learning model is somewhat insufficient, for forms wherever the underlying representation cannot be identical to the surface form, we also need the learner to acquire the right abstract underlying representation for alternating. It will have to suffice for us that where there is evidence for alternation, the learner adopts abstract underlying forms.

A last tool for the learner to use is the strategy of reranking constraints. Even if the learner has accurate knowledge of ambient forms and accurate underlying representations, she is still developing her phonological grammar. The Initial State grammar will generate all kinds of errorful outputs because of her immature constraint hierarchy, but the development of an adult-like system is *error-driven* and capitalizes on any such inaccurate output. The error-driven algorithm works as follows: the learner adjusts her system using her awareness of adult forms and her own errors: she demotes all constraints that the adult form violates, and promotes all those that her errorful form violates. Tesar & Smolensky do not directly address the time frame involved in such reranking processes, but in Boersma’s model, reranking is gradual and incremental. Ultimately, the learner will arrive at a hierarchy with no output errors.

This formal application of OT to phonological acquisition is a partial analog to the Confluence mechanism illustrated in Figure (6). In fact, the error-driven mechanism corresponds roughly to the step between the establishment of the set of perceived forms and the End Point. The Confluence model adds two things to the learning algorithm: the possibility that variation in the adult forms could lead to new default ambient forms, and that the ambient form might not match the perceived form. In addition, the Confluence hypothesis in (5) claims that this role of variation and perception is outside the domain of the formal grammar. I expand on this in the following section.

1.2.3 *Noise in the mechanism*

Note that the process in (6) is essentially a learning path, and as I have mentioned, in an idealized world the End Point’s set of lexical items and ordered principles will match those of the Starting Point.

However, ours is not an idealized world. Noise can occur anywhere in the system: there may be competing subsets of ordered principles or lexical items at the starting point; there may be variation in the set of ambient forms; there may be misperceived items in the Perceived forms; there may be new interpretations of perceived evidence at the End Point. As a consequence, the formal system of the End Point could differ from that of the Starting Point. Thus I offer an enriched illustration of the Confluence mechanism in Figure (7).

(7) Noise in the Confluence mechanism

Starting point: source grammar	
↓	
“ambient forms”	<i>Articulatory, cognitive, cultural effects: Phonetic factors can induce variation; maintenance of contrast restricts it</i>
↓	
[perceived forms]	<i>Perceptual, cognitive, cultural effects: Perceptual effects can mask the interpretation and representation of ambient forms</i>
↓	
Acquired grammar	<i>Learner uses the set of perceived forms as evidence for her own set of lexical items and ordered principles.</i>

A crucial point to be made is that the Noise which can affect the end result does not include the noise of early childhood acquisition. Although I refer to the acquisition process as an important player in the Confluence mechanism, I do not claim that child phonology effects have any necessary role in determining the form of the final acquired grammar. Instead, the acquisition process is important insofar that it can lead the learner to a grammatical system that very closely resembles that of the source grammar, and Noise at the articulatory and perceptual points can prevent this resemblance from being absolute. Further, it can continue to do so over a lifetime, as these Noise effects have a continual role, forcing the speaker to adjust her grammar to cope with new innovations through adulthood.

In the remainder of this subsection, I expand upon the nature of Noise and its role in this mechanism, and I introduce a means of restricting its effects that I refer to as Cognitive Counterbalance. I will concern myself with two Noise-prone points: Articulatory Confluence will be a function of noise between (7a) and (7b), while Perceptual Confluence will be a function of noise between (7b) and (7c). I leave aside the possibility of noise between (7c) and (7d), but return to it shortly.

1.2.3.1 Noise in articulation

One source of noise is variation in the set of ambient forms. Such variation as a generality is a combined function of articulatory, cognitive, and cultural pressures. Articulatory pressures have the effect of increasing the number of possible variants of any particular word form. Cognitive and cultural pressures provide a counter-balance; I formalize these pressures in (8).

- (8) COGNITIVE COUNTERBALANCE: Avoid variants that obscure phonological contrast or lexical recoverability.
 CULTURAL COUNTERBALANCE: Avoid culturally dispreferred variants.

In this work I rely more on Cognitive Counterbalance than on Cultural Counterbalance to offset the effects of Noise, simply because information on the cultural significance of phonological innovations in Micronesian languages is underdeveloped. Nevertheless, I incorporate both principles as ‘feedback loops’ that operate at two points: first, at the caregiver-peer’s production of ambient forms, and at the learner’s identification of appropriate target forms.

Thus, to offset articulatory Noise, Cognitive Counterbalance may discourage the caregiver-peer from producing some articulatory variants if they result in a loss of recoverability through loss or neutralization of a contrast. Cultural pressures can have an influence in either direction: some variants may be socially dispreferred, while others are prestigious. When the acquirer bows to Cognitive Counterbalance, the formal effect is the maintenance of Faithfulness constraints.

In other words, the mechanism admits variation insofar as cognition and culture will allow it. As different variants could appear with different frequency, the learner could conceivably consider any of them as the true default form that her grammar should predict. If she chooses a default form that is different from what the caregiver-peer would consider default, she will converge on an innovative grammar.

1.2.3.2 Noise in perception

Another source of noise is in the misperception of ambient forms. The learning process depends on the ability of the learner’s ear to catch everything that the caregiver-peer’s mouth produces. This ability is not infallible. Some portions of the ambient string will be perceptually marked; that is, they will be relatively difficult to perceive accurately. This is true of segments with marked feature combinations, which may be interpreted as less marked ones; for example, front round vowels could be perceived as front unround or back round vowels. Other segments might be perceptually marked in certain positions; for example, consonants in syllable-final positions may be less accurately identified. In addition, segments in unstressed syllables might be prone to misperception.

As a result, even if the caregiver-peer’s speech shows little surface variation of the kind described above, the learner might arrive at a set of ambient forms that differs from the intended output of the adult grammar. Again, this new set of perceived forms provides evidence for an innovative grammar.

Furthermore, as with articulatory noise, cognitive and cultural factors may provide a counterbalance to the effects of noise. The learner may use situational or grammatical context to avoid a misperception that would otherwise generalize a loss of phonological contrast. The learner might also use sociological knowledge to determine that a particular perceived form is not appropriate and not to be used as evidence for adjusting her grammar to accommodate.

1.2.3.3 Other loci of noise

Now we can briefly touch upon the third possible locus of noise: new interpretations in the move between perceived evidence and the End Point. This we may

tentatively call Cognitive Confluence, and an example can be seen in the learnability of stress systems. Hammond (1991) shows that all stress systems of the world can be learned with words of no greater length than seven syllables, despite the logical possibility that stress systems could exist which are distinct only in words of eight or more syllables. The absence of such stress systems is something Hammond attributes to a limit of short-term memory: even if such a system were randomly to develop, it is unlikely to be learned consistently enough to remain stable over time. This is consistent with the role of noise in Articulatory and Perceptual Confluence: the weak evidence here is drowned out by the noise of limited memory.

1.2.3.4 An example

Now it is possible to sketch out a hypothetical example of the mechanism. Let us imagine a language that includes the lexical item *pato* and a stress system that builds a moraic trochee across this form, yielding [páto]. Even if this is the intended output of the Source grammar, various articulatory pressures can induce a number of spoken variants, including a spirantized [fáto], a nasalized [máto], one with medial voicing [pádo], and one with final-vowel devoicing [pátɔ̥]. Several of these will be blocked or avoided by the speaker's desire, unconscious or not, to maintain a contrast between this and other forms, and to ensure recoverability of the lexical item from the ambient form. Even so, some variants may still slip through this cognitive filter.

In addition, the variants that are not kept out of the set of ambient forms are subject to perceptual restrictions. Some of the variants may have feature combinations that are difficult to perceive, and as a result, it may be that some of them are misperceived. The entire process is illustrated schematically in Figure (9) below:

(9) Hypothetical implementation

Source grammar e.g. /pato/ → [páto]	<i>Phonetic factors can induce variation</i> [páto], [pátɔ̥], [pát], [pádo]
↓	<i>maintenance of contrast restricts variation, whether motivated or not, preventing</i> [máto], [pató], [tó], [fáto]
<i>ambient forms</i> [pátɔ̥], [páto]	<i>subset of unblocked variants</i>
↓	<i>Perceptual effects can mask ambient forms</i> e.g. [pát] not [pátɔ̥]
<i>perceived forms</i> [pát], [páto]	
↓	
Acquired grammar /pato/ → [pát]	← <i>Learner uses perceived forms as evidence</i>

This example illustrates how the model predicts only a few imaginable variants to end up as members of the set of perceived forms, despite a vast set of plausible variants. Thus, given a static grammar at the starting point, fewer imaginable grammars are possible outcomes. Furthermore, because articulatory and perceptual noise only target weak elements, the outcome grammars will tend to have common properties: intolerance of voiceless sonorants, heterogeneous obstruent codas, whatever else the articulatory and perceptual systems encourage. This is the source of typological ruts.

1.2.3.5 Noise and salience

Noise in both articulation and perception has the effect of changing representations. In both domains, the change is motivated by phonetic pressures. However, such pressures are not without restraint. Some phonological elements are going to be more likely than others to resist noisiness. This is partly a function of the relative salience of some phonological units; as a result, it does not need to be built into the model of synchronic grammar. If phonological systems were without relative salience, noise would affect anything randomly.

The generalization so far is that weak evidence changes. Noise affects elements in relatively weak positions: unstressed portions of feet, unreleased or syllable-final (i.e., post-vocalic) consonants, and perceptually marked segments like voiceless sonorants. These kinds of elements do not form a natural representational class, but are united in being overshadowed by more salient units nearby.

Still, it is not quite sufficient to say that a segment can guarantee its own perseverance simply by virtue of its salient position. For example, a front round vowel may be perceptually salient by being in a stressed syllable, but its combination of frontness and roundness is still perceptually marked. An alveolar obstruent coda may be perceptually salient by having the clearest closing formant transition, but is still in a perceptually marked position, such as a coda.

Moreover, I have claimed that this power of Noise can only affect weak elements. There is thus a reasoned account of why phonological elements in weak or marked positions are prone to variation and misperception. However, there is not yet a reasoned account of why salient elements are not so prone. One might simply appeal to a principle that learners simply want to get the salient parts right: this is equivalent to the claim that non-noise leaves unmarked segments untouched.

Some pursuit of this notion will make it more acceptable, and in fact, I have already built it into the Confluence mechanism in Figure (7) as Cognitive Counterbalance. First, at the point of Articulatory Confluence, variation is induced by phonetic factors, but the appearance of some variants is checked by cognitive and cultural factors. Second, at the point of Perceptual Confluence, misperception is a risk for weak elements, but the learner has grammatical and contextual clues to mitigate such effects.

1.2.3.6 Noise and Markedness

This counterbalance is important, for without it, the Confluence mechanism would predict all grammars to evolve to a fully unmarked state, in which all words are

tata, or worse, phonetically null. I call this prediction the apparent upward mobility of Markedness, and explain here why it is a risk, as well as how the mechanism avoids it.

Naturally, any argument that Confluence predicts all languages to reduce to systems that only allow *tata* is an absurd one. Nevertheless, some less absurd predictions must be addressed. For example, one might wonder how any language would ever develop any marked segments or elements, when the mechanism proposed here predicts movement towards unmarked structures.

First, it should be clear that with no opposing forces, innovation towards unmarkedness *is* the prediction of the model. In the articulatory domain of the mechanism, variation is motivated by phonetic factors, and the appearance of new variants is driven by the needs of articulatory markedness.

Thus, if an intended output form includes a segment with a marked combination of gestures, or one in a marked articulatory position, it might find itself in competition with a less marked variant. Should the learner grammaticize this less-marked variant, she will do so by having a particular Markedness constraint ranked higher than it would be in the adult grammar.

Likewise, if an intended output form includes a segment with a marked combination of perceptual features, or one in a marked perceptual position, it could find itself competing with a less perceptually marked variant. If the learner misperceives the marked segment as some less marked form, she will again converge on a grammar with a Markedness constraint ranked higher.

As a result, the formal situation of Faithfulness >> Markedness for some feature or structure is inherently unstable. The reverse ranking represents a system at rest, but the opposing cognitive and cultural forces help prevent all systems from resolving to the resting state. The contrasts or social markers signified by the marked segments might be too valuable for the learner to allow Markedness to obscure.

Although the counterbalancing pressure of cognition and culture can hold off the upward mobility of Markedness, it does not allow for the innovation of marked structures. It is not my ultimate goal to explain the appearance of marked structures, but given that I present Confluence as a model of typology and of change, it must have room for the hypothetical innovation of marked structures out of unmarked ones. Where do they come from?

Ironically, the answer is partly in the pressure of Markedness itself. Structures can be marked in some ways and not others. To return to the example of front round vowels, their innovation could be driven by some process that makes them *less* marked, such as a harmonic process, as in German umlaut (Penzl 1949), or a co-articulatory effect of some third feature like tongue root advancement (Archangeli in prep).

In addition, some marked structures might develop *simply* out of the need to create contrasts, a phenomenon alternately called MINIMAL DISTANCE (Flemming 1995), SPACE (Padgett 1997), or DISPERSION (Lindblom 1990, Sanders 2003). Such effects can account for the emergence of front rounded vowels in French, which historically had no harmonic process like that responsible for Germanic umlaut. French front round vowels have Latin back vowels as their source, whereas French back round vowels derive from

vocalized laterals. A Dispersion account would attribute the fronting of what had been back vowels as a means of maintaining contrasts among round vowels—a push-chain in the Labovian sense.

Moreover, some marked structures might arise as social markers. French uvular rhotics and English and Spanish interdental fricatives may come to mind as marked structures that became adopted because they were associated with aristocratic or royal speech. Palmer (2000) provides a summary of arguments that discount such folk-etymology claims. The interdental is part of a regular sound change in both Germanic and Castillian Spanish, but the uvular fricative, although not an aristocratic innovation, may nevertheless have had a social import in revolutionary Paris.

To summarize so far, we have seen that various factors can affect the representation of ambient and perceived forms. A result of the Confluence mechanism is that we may encounter cases in which the formal system of the End Point differs in multiple ways from that of the Starting Point. However, such multiple distinctions may have a common principled reason for their existence; the same bit of noise at some step or other could predict multiple changes.

Furthermore, the way Confluence encodes phonetic and cognitive factors gives rise to a duplication of effects, but not of principles. Under the Confluence model, grammar duplicates articulatory and perceptual pressures: things that begin as ease of articulation or perception become grammaticized when the learner converges on a grammar that *formally requires the observation* of such pressures. In other words, principles grounded in articulatory and acoustic physics begin as accidental tendencies but become formal requirements. Grammar also duplicates the cognitive checking mechanism by formalizing it as Faithfulness. This is an important contrast between Confluence and lexicon-optimizing and dispersion models, in which the organization of the lexicon duplicates the regularity of surface phonological patterns.

1.2.4 *Testing for Confluence*

The argument that is developing is rooted in the observation that divergence in language is not random. I have proposed a hypothesis that is intended to account for this non-randomness. The most developed incarnation of this hypothesis is the Confluence mechanism, which incorporates adult synchrony, variation, learning, and the counterbalance of cognitive and cultural pressures to account for the potential differences between conservative and innovative grammars.

Having visited the intricacies of the mechanism, we can now determine what is necessary to test its predictive power. Because Confluence makes reference to tendencies of grammatical systems, it cannot be tested against data from a single language. The phonologist must analyze data from at least one language in conjunction with one or more other languages or with known generalizations of articulatory or perceptual Markedness (which are based on data from a wide range of languages).

In the latter case, one should first consider a particular marked structure, and determine if the language has it. If the language does not have the marked structure, then the Confluence hypothesis is supported.

If the language does have the marked structure, then we next must determine: does the structure maintain a contrast? Is its appearance not attributable to a competing Markedness requirement? Is its less marked variant socially dispreferred? If the answer to all three questions is no, then Confluence is not supported.

The method of testing Confluence will differ somewhat when looking at more than one language, especially if the languages are related. In such a case, historical stages become retrievable, with reliability increasing as the number of attested relatives increases. Whether or not reliable historical information is available, we can search the attested modern languages for shared structures and for unique ones.

The Confluence hypothesis is supported under the following circumstances. First, they must share some part of their formal systems, such as a block of ranked constraints. In other words, there must be evidence that a ranking like $C_1 \gg C_2 \gg \dots C_n$ is found in each language of interest. An alternative situation of constraint blocks occurs if the pair $[C_1, C_2]$, unranked with respect to each other, outrank the pair $[C_3, C_4]$ in one language, but the opposite rank holds in some other language. Another possibility is that the ranking $C_1 \gg C_2$ if and only if $C_3 \gg C_4$. Each of these is a confluent ranking.

Second, it must be the case that the constraint block is a formalization of some physically preferred effect, either in the domain of articulation, perception, or learnability. This provides a principled reason for why the particular property is learnably robust from one generation to the next, or a principled reason for its innovation at more than one point in time and space. If there is no such principled reason, the Confluence hypothesis is not supported.

When related languages are distinct along a certain parameter, there is also a means of determining if the distinction is consistent with Confluence. First, if the facts for the parent language are known, the Confluence hypothesis is supported if there is a principled reason for reanalysis in the innovative language. Second, if the facts for the parent language are not known, the Confluence hypothesis can be supported if there is a principled reason for reanalysis in either direction between the related languages, or from some imaginable common source to the attested ones.

The Confluence hypothesis would be refuted under the following conditions: there is evidence that a language allows changes only in its most salient structures, with no external motivation. In formal terms, a counterexample would be the existence of a multitude of contrastive constraint rankings, with no principled reason that is common to any of them. In other words, there are no constraint blocks that are common among the languages of interest, or if there are any such blocks, there is no discernible motivation for their existence.

In the remainder of this work, I pursue detailed phonological analyses of Micronesian languages. The results of these analyses are fully developed constraint rankings, which allows for comparisons of phonological systems in the search for contrastive constraint rankings. Later in this work there are several opportunities to test Confluence in such a manner; in particular, Chapters 6, 9, 10, and 11. In many cases, languages (both within subgroups and across the family) differ from each other in

multiple ways. It will be my claim that collocations of contrastive constraint rankings reflect Confluence of phonological patterns.

In the remainder of this chapter, I return to several arguments in greater depth. In Section 1.3, I discuss the permutation problem in detail, mainly to show why Confluence is needed to address it. In Section 1.4, I discuss the analogy made between linguistic diversity and evolution, in the hope that it will illuminate the role of Confluence in phonological typology. In Section 1.5, I introduce a real example of Confluence, and discuss it in terms of this and other models of change.

1.3 Optimality Theory, typology, and the permutation problem

Optimality Theory, at its heart, is intended as a model of phonological grammar. As Chapter 3 shows in more detail, Optimality Theory seeks to attribute phonological patterns to a set of universal principles, formalized as constraints. As a generative theory, it has the additional goal of being able to predict all and only the attested forms of individual languages, and all and only the attested phonological systems in the world's languages. Optimality Theory is thus a theory of typology: ideally, all permutations of constraint rankings are possible languages.

1.3.1 The Boggle model

The simplest interpretation of OT's typological power is what I call the 'Boggle' model, after the board game in which players search for words in a crude randomization of letters. In Boggle, a transparent, closed container holds 25 wooden cubes in a 5×5 grid, and each cube has a letter on all six faces. The container is shaken and the cubes fall where they may in the grid: as a result, any configuration of those 25 cubes is as likely to occur as any other configuration.

In the Boggle model of OT, any configuration of constraints is as likely as any other to be attested as an actual grammatical system. It is as though the constraint set CON is the container and the constraints are blocks; languages of the world differ because those constraints can fall anywhere within CON. Such an interpretation of permutation arises in Anttila's (1997) account of optionality in Finnish genitives: his claim is that in the absence of sociological constraints, rates of optionality should exactly reflect permutations of constraint rank, where each possible ranking is equally likely.

The plain Boggle model of OT is at odds with the permutation problem: many possible configurations are unattested, and many more are very unlikely: these we can call typological near-gaps. To a large extent, gaps in typology guide the formalization of phonological theories. For example, if a particular type of pattern is unattested, no permutation of CON should allow it.

The role of typology in guiding the theory is easily illustrated with a few canonical examples. First, Prince & Smolensky (1993) pursue a constraint account of Jakobson's syllable typology. The basic observation is that no language of the world requires codas or forbids onsets, but many languages either forbid codas, require onsets, or both.

Prince & Smolensky attribute this robust cross-linguistic fact to the activity of the universal constraints ONSET and NOCODA, and their interaction with input-output faithfulness constraints. A language with Faithfulness undominated will *allow* onsetless, codaful VC syllables, but no configuration of the constraints could produce a language that exclusively requires them.

The lack of such a system is formally attributable to the absence of a few imaginable constraints from the universal set: notably, the hypothetical constraints HAVECODA and NOONSET. In other words, the lack of languages that allow only VC syllables leads Prince & Smolensky to conclude that there are no such constraints; thus, OT typologically predicts no such language.

A similar typological gap arises in reduplicative theories. McCarthy & Prince (1999) acknowledge what they call the ‘Kager-Hamilton Problem’, which dogs templatic theories of reduplication. The problem is so named for René Kager and Philip Hamilton, each of whom brought it to light: given a theory of phonology that allows rankable correspondence constraints and templatic output conditions on the size of reduplicants, languages which back-copy their templates are predicted to be possible. Given the absence of such a language from the known typology of reduplicating languages, McCarthy & Prince’s response is to propose the abandonment of morpheme-specific templatic requirements, which absolves the OT model of the Kager-Hamilton problem.

Such gaps in typology are relatively easily accounted for in the Boggle model of OT: ruling out an imaginable constraint from the universal set is equivalent to playing Boggle, observing that no English word has the letter μ , and thus eliminating the character from any face of the wooden blocks.

1.3.2 *Near-gaps*

However, some trends in typology are merely *near-gaps*, and do not reflect an absolute impossibility. For example, Maddieson (1984, 2002) observes that in languages with a voicing contrast for stops, those whose inventories have *b*, *d*, but no *g* – “**g*-systems”, such as Dutch, Thai, and Czech – are much more common than **b*-systems. In fact, in the UCLA Phonetic Segment Inventory Database, there are 18 languages which qualify as **g*-systems (mostly Austro-Asiatic and Austro-Thai), but only 2 languages that are **b*-systems: Nyangumata (Pama-Nyungan, O’Grady 1964) and Mixe (Penutian, Crawford 1963), each of which has *p*, *t*, and *k*, and *d* and *g*. A theorist might then ask, does this mean the ranking **g* > FAITH > **b* is fixed?

Fixing the rank of these two constraints has two effects: it characterizes this tendency as a stipulative, unexplained property of human language, and it categorically prevents **b*-systems from ever occurring—yet they are but rare, not unattested.

On the other hand, the Boggle model of OT predicts that **g* and **b* systems should be roughly equally attested, since **g* > FAITH > **b* is as probable as **b* > FAITH > **g* to occur. One way around this is to assign universal probability weights to constraints: **b* is heavier than **g*, and tends to sink below it. This is equivalent to the observation that *q* is rare in English spelling, so its face on a Boggle block should be weighted such that it is unlikely to show face up.

This approach addresses the second fault of rank-fixing – the undergeneration of *b-systems – but critically fails to offer anything more in the way of explanation. Yet as Maddieson and Ohala (2002) both note, the rarity of *b systems with respect to *g systems is easily explained in terms of aerodynamics. Voicing increases air pressure between the glottis and point of oral closure; since there is less oral space for velar stops than for labials, air pressure builds more quickly in velars, and as a result, occlusion or voicing is likely to be lost. In other words, there is a principled reason for the tendency to lose [g] rather than [b], and *b systems are simply less likely to arise out of *random mutations of languages*. Consequently, the principle requires no amendment to a formal theory of consonant inventories: the probability weight of the constraints *b and *g need not be stipulated in the typology of constraints – the likelihood of *g outranking *b follows independently from the aerodynamic nature of voiced velar and bilabial stops.

This is an example of the essential claim of the model of Confluence: that some rankings may be more likely than others to appear in languages of the world, and that such likelihood need not be encoded formally in the nature of constraints.

Note that the power of Confluence to restrict an otherwise zany overgenerative model is actually not limited to Optimality Theory. Similar claims about the role of evidence in typological divergence are found in the non-constraint-based work of Hale and Reiss, Maddieson, and Ohala, among many others. Moreover, the implications of Confluence for Optimality's typological predictions are echoed by Myers (2002), who argues that the rarity of systems which resolve NÇ sequences with epenthesis need not be encoded as an impossibility; rather, no language would ever innovate in that direction.

An alternative restriction on the set of possible grammars is proposed by Archangeli and Pulleyblank (1994) as Optimization. Under Optimization, internally-ranked scales of grammatical factors are integrated in a “trade-off” relationship. This means that as two scales are in an inverse relationship of strength: as one deteriorates, the other improves. Thus, languages that map strong factors of one scale to strong factors of the other, and likewise weak to weak, are not possible. Confluence makes no use of internally fixed scales, but would seek an account for the robustness of such principled ordering.

1.4 *Language, typology, and the evolutionary analogy*

The manner in which languages change and diverge over time often draws parallels to theories of genetic mutation, natural selection, and evolution, most notably in the ‘family tree’ model of divergence in historical linguistics. Even Darwin makes such an analogy, yet linguists now find some discomfort in any pursuit of the analogy beyond branching trees.

To help further illustrate the mechanism of Confluence, I describe in detail the evolutionary analogy, which essentially compares languages with species. The analogy is informative for a simple reason: like genetics, the code of grammar can change randomly over time.

In this section, I discuss some aspects of the evolutionary analogy, to the extent that it helps to inform us about the role of theory in an understanding of linguistic

typology. To that end, although there are commonalities between linguistic and genetic diversity, this need not force a theory of language that precisely reflects a theory of genetics. Nevertheless, there are aspects of genetic diversity that need not be encoded in a formal model of genetics, and likewise, I propose a similar hypothesis for language typology.

Languages may mutate and diverge over time in a manner parallel to genes, and language families are similar to genus and families. One can extend the analogy into the coding of properties: organisms have traits that are determined by genetic codes, while languages have traits which theorists attribute to organized principles like constraints. There is a minor contrast in that for the biological case, scientists can see actual genes, while linguists can only detect principles indirectly. Even so, theories of genetics and biological diversity predate the technological ability to view strands of DNA. In that sense, the study of linguistic typology is like genetics without microscopy.

The innovation of new traits in organisms is attributable to random mutations of genetic codes. Linguistic innovation could also plausibly be seen as random mutation in the organization of principles of grammar. One might object that some linguistic changes are consciously adopted, and thus non-random, but such cases are indeed random in two senses: first, in the arbitrary association of prestige with a particular mutation (which increases its chances of adoption), and second, with the very decision to adopt the mutation.

It may be in the domain of selection that the analogy loses some elegance, for here, languages are not exactly like species. Genetic mutations result in new traits which may be advantageous to the species. Advantageous traits contribute to their own propagation, through generations, by increasing the organism's chances of survival through to reproduction. Disadvantageous traits contribute to their own demise by reducing the likelihood of the organism's survival.

Linguistic innovation is not precisely analogous here because the 'survival' of a language is not analogous to the survival of a species. Languages do not compete with each other or eat each other (though speakers of different languages might). The survival of a language depends on the survival of the culture that uses it, not on the fitness it enjoys from its grammatical traits. Yet there remains some similarity: mutations themselves may 'survive' or not, in the selection sense. The propagation of a new trait is not a function of whether it makes the language more fit, but whether the trait itself is likely to continue being acquired.

Nevertheless, the evolutionary analogy is most informative when we consider the locus and manner of mutation in both domains. Foremost, genetic mutation happens accidentally during cell reproduction. Linguistic mutation happens in the parallel situation of acquisition, where acquisition refers to the broad, 'grammar-setting' sense, so as not to exclude the adult acquisition of innovations. In either case, mutation is a consequence of noise: cells divide imperfectly, or learners make new grammatical generalizations from old systems.

As Blevins (to appear) notes, mutation in either domain is non-optimizing and non-goal oriented: change itself only occurs by chance, and is not itself driven by outside

factors (I return to Blevins' approach in §12.7.1). Outside factors are relevant only inasmuch as they determine whether the change is a good one. The analogy, however, ends here, for the two kinds of systems (genes vs. grammar) are not the same kind of code. Genes offer a program for the form and function of the organism and its parts: in that sense, genes *cause* the organism. Grammar doesn't *cause* language in the same way. In the domain of acquisition, it may be more appropriate to say that language causes grammar; in other words, the learner decides on a proper grammar to account for data she is exposed to (and again, may continue to do so in adult life).

Even so, we can retain the following commonality between languages and species: some changes may be more expected than others, despite the property of non-optimization. This is the crucial aspect of the analogy.

Now, the goal among generativists is to arrive at a theory that accounts for all and only the possible languages of the world. We do not want a theory that predicts some wildly unattested pattern to appear. Imagine, then, that geneticists had a similar goal in their field: to seek a theory of genetic variation that allows all and only the attested species of the world.

For the sake of argument, let us admit that there are no phosphorescent species of monkey anywhere in the world. Is it the task of the geneticist to construct a model of DNA combinations that prevents the emergence of phosphorescence in primates? In fact, genetic variation probably would allow a glow-in-the-dark primate species. Geneticists do not restrict their theory to prevent such a generation – indeed, some of them may relish it – but rather, with the help of zoologists, geneticists have a clear answer as to why such monkeys are unattested. Monkeys that glow in the dark are easier for predators to find, kill, and eat. In other words, a theory of genetics need not bar the possibility of phosphorescent monkeys, but such monkeys are nonetheless the result of mutations that are unlikely to persevere over generations.

Now let us make the analogy a little less absurd: phosphorescence might reasonably accompany some other trait, like gills, which should seem less accidental than a glow-in-the-dark monkey. Even less absurd is the co-occurrence of fins and gills: whatever makes fins advantageous—living underwater—also makes gills advantageous. Note, however, that there is neither anything about genes that says gills must accompany fins (some animals do not have both traits) nor a single gene that controls both.

With Confluence, I claim that there may be similar properties about 'mutation' in language. As we will see in Section 1.5 below, similar claims have been made elsewhere, as in the models of Drift (Sapir 1949, Lakoff 1972, Rehg 1991) and Evolutionary Phonology (Blevins 2003). The notion of Drift suggests that some processes may arise independently in different languages if those languages have similar "pre-conditions" of the change. Blevins pursues an evolutionary analogy of gravity-defiance in lizards, a trait that was innovated five independent times as 'parallel evolution', in arguing that certain phonological processes have a likelihood of arising in unrelated languages.

Confluence adds to this domain an acknowledgement that *collocations* of innovations may exist. In other words, in addition to statements like "A is likely to

outrank B because of specific aerodynamic factors”, Confluence predicts situations of apparently ‘linked’ rankings. For example, with Confluence, one may reasonably account for the co-occurrence of the ranking A » B with C » D, because there may be evidence for both rankings in the set of perceived forms; we will see examples of this in Chapters 6 and 9. Confluence also adds, in its formal mechanism, an opening for explicit explanation of confluent patterns.

1.5 An example

The learning algorithm of Section 1.2.2.1 predicts that learners will eventually converge upon a constraint ranking that matches the hierarchy of the adult language, since the goal of the learner is to achieve the same set of permissible output forms. An example for pre-Chuukese is laid out in Figure (10):

(10) Acquisition of final vowel devoicing in pre-Chuukese

Source grammar	
↓	
“fàti-fátì”	<i>Variants with different stressed vowels are unlikely given cognitive counterbalance: thus no [(fàti)(tì)]</i>
↓	
[(fàti)(fátì)]	<i>Percepts with different stressed vowels are unlikely given cognitive counterbalance: thus no [(fàti)(tì)]</i>
↓	
Acquired grammar	<i>Learner posits /fati-RED/ and creates grammar that devoices final vowels and forbids degenerate feet</i>

The Confluence mechanism combines OT, an abstract theory of constraints and representations, with a learning model and with aspects of performance and perception. As a result, it is not the case that the constraint hierarchy is ever a self-contained entity in some abstract vacuum. Other things can influence the rank of constraints, including (in fact, foremost) the spoken forms of the ambient language.

In other words, a change in the system can happen for various reasons, and crucially, it is not simply the learner’s prerogative to reset her constraints. Instead, an innovation in her constraint ranking could be driven by variation in the ambient forms or by misperception of them, in which case, the learner has evidence for a constraint ranking that differs from that of her caregiver. For example, she may fail to hear the final devoiced vowel, and instead interpret the pattern as final-vowel deletion. If she does so, she will arrive at a different hierarchy than the learner in (10); this process is illustrated in Figure (11).

According to the Confluence mechanism, the learner in (11) has acquired a system with a high rank of the Markedness constraint that forbids voiceless vowels. It

obviates any need to stipulate an upward mobility of such a constraint; instead, its rise is a consequence of the misperception of the ambient form *fàti-fátj*.

(11) Innovation of final vowel deletion in Chuukese

Source grammar ↓	
“fàti-fát ~ fàti-fátj” ↓	<i>Phonetic pressure may induce deletion over devoicing. Variants with different stressed vowels are unlikely given cognitive counterbalance: thus no [fa(tífat)]</i>
[(fàti)(fát)] ↓	<i>Voiceless vowels may go undetected, but percepts with different stressed vowels are unlikely given cognitive counterbalance: thus no [fa(tífat)]</i>
Acquired grammar	<i>Learner posits /fati-RED/ and creates grammar that deletes final vowels and allows degenerate feet</i>

Confluence has the learner generalize a deletion pattern with a formal Markedness constraint. As such, the rank of the constraint is not a random one, but predictable given the nature of the ambient signal. In contrast, the constraint’s rank is random under the Boggle model of OT, which claims that language diversity is simply a function of permutation: without enrichment, this is equivalent to the claim that innovation only happens within the acquired grammar, when the learner sets her own constraint ranking. In fact, this is also the claim of the diachronic OT models introduced in §12.7.3: language changes because constraints rerank.

The claim of Confluence is the opposite: constraints rerank because language changes. Thus the learner’s rank of constraints will not randomly mutate by itself, but other factors may encourage changes in crucial rankings. Moreover, these other factors are based in things like acoustics and aerodynamics—mere physics—and thus release Optimality Theory from having to account for their effects.

1.7 Summary

The chapters that follow offer a test of the claims made in this chapter. In one vein, I test the adequacy of Optimality Theory as a generative model against a diverse but related group of languages, each with its own empirical challenge. In a second, I search for common and similar formal structures to help make sense of common and similar surface patterns. In the third, I search for evidence that supports the Confluence hypothesis.

I begin with a descriptive overview of the Micronesian family, to introduce those phonological traits that are common across the family and those that set individual languages apart. I then review the theoretical tools at our disposal: Optimality Theory

and its machinations, prosodic representation and its intricacies. With these two brands of background established, I pursue thorough accounts of individual languages.

The ordering of languages is principled, beginning with a cluster of more closely related languages and moving outward in the family. I start with the Pohnpeic languages, notably Pohnpeian, Mokilese, and Pingilapese, and then follow a parallel track with the Chuukic languages, in particular Woleaian, Chuukese, and Puluwat. I then discuss some increasingly distant languages, Marshallese and Kosraean.

Wherever possible, I have tried to relate a particular detail to its relevance either to the domain of OT or Confluence. As a general rule, chapters devoted to individual languages offer individual tests of the OT model, while comparative discussions like those of Chapters 6 and 9 are more devoted to a discussion of Confluence. Still, Chapters 10 (Marshallese) and 11 (Kosraean) have implications for both.

An additional note to make is that throughout this work, I use transcriptions of forms that are based on interpretations of the orthographic conventions of individual grammars. That is, almost all of the source data are published in language-specific orthographic representations. Thankfully, it is to the credit of PALI language texts and the Pacific Linguistics series that such conventions are consistent with surface forms, and that each source provides a clear means of determining phonetic representations of orthographic ones.

For the sake of consistency and clarity, I replace all orthographic digraphs with single symbols, so as not to confuse true consonant sequences like *mp* from illusory ones like *sr* (see Kosraean), *ch* (Woleaian), or *hd* (Pohnpeian). Similarly, I adopt the American convention of using [j] and [ç] for palatal affricates instead of the IPA digraphs [dʒ] and [tʃ]. This frees up [y] for use as a front glide, which in turn allows [ü] to represent the high front round vowel. However, I leave other conventions unchanged; thus, *d* is a voiceless stop in Pohnpeian and Mokilese, while *t* is the Pohnpeian palatal stop and *j* the Mokilese palatal stop. For full phonemic descriptions, I refer the reader to primary sources for each language.

A caveat: using orthographic transcriptions and conventions of transcribing them phonetically, I cannot guarantee absolute perfection. I encourage interested readers to consult primary sources wherever possible, and should they find discrepancies between those sources and this, the fault is entirely mine. I certainly hope no such error has altered the course of my arguments, for better or for worse.

2. An overview of Micronesian languages

2.1. *Introduction*

This study is focused on the languages of the Micronesian family, a distinct group within the East Oceanic branch of Austronesian. Each of these languages uses reduplication to a similar end: to indicate some form of continuous aspect or repetitive quality, to attribute some non-eventive property to an argument, or both. I show in later chapters that the phonological realization of reduplicants in Micronesian languages is closely linked to the phonology of each individual language, and that their patterns of reduplication differ from each other in ways that are predictable from the phonology of each language. In this chapter, I provide a survey of numerous grammatical and phonological details that make Micronesian languages distinct within Oceanic, that illustrate patterns of divergence within the Micronesian group, and that bear directly on the form and function of reduplication in each language.

This chapter proceeds as follows. I first introduce the five branches of the Micronesian family in Section 2.2, summarizing research that supports grouping them together as a distinct language family, and discussing several theories of relationships within the group. In Section 2.3, I describe a number of other characteristic traits of Micronesian languages. The phonological traits I discuss are the weakening of stem-final vowels, the assignment of stress, and the tolerance of coda consonants and gemination, while the grammatical traits include syntactic categorization, verbal transitivity, and the functions of reduplication.

Finally, in Section 2.4, I survey the surface forms of reduplication in the family, showing how the variation in reduplicative subpatterns is reflective of other grammatical divergences, and thus follows the Micronesian family tree.

2.2. *The languages of Micronesia*

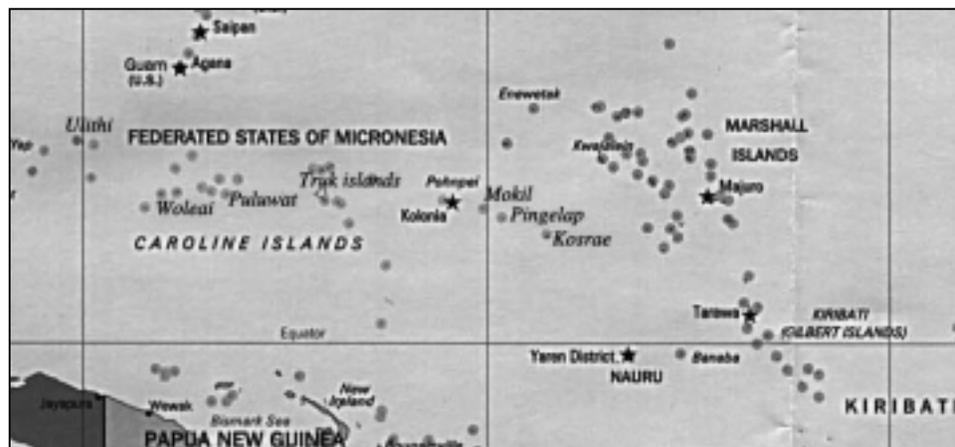
In this section, I introduce the languages of the Micronesian family, and describe evidence for grouping them as a distinct branch of the Oceanic family. I also summarize research that establishes groupings within the Micronesian family.

There are at least three ways of understanding what is meant by the cover term ‘Micronesia’. In the geographic sense, it refers to the chain of islands west of the Philippines and north and west of Papua New Guinea. Physical Micronesia is one of three regions of Pacific Islands, the other two being Melanesia, to the southwest, and Polynesia, farther to the west.

In the political and cultural sense, Micronesia refers to nearly the same region, which until 1978 was the U.S. Trust Territory of the Pacific which included Guam, the Marianas, Palau, the Marshall Islands, Kiribati, and the Caroline Islands. The latter four are now independent nations, with the Carolines adopting the name Federated States of Micronesia.

The linguistic notion of Micronesia refers to a distinct subfamily of languages within the Austronesian family, and is actually coextensive with neither the geographic, political, nor cultural interpretations of the word. For example, languages like Palau,

Yapese, and Chamorro have been spoken in the geographic region of Micronesia for thousands of years, and Yapese is one of five official languages of the Federated States of Micronesia, but none of them is linguistically Micronesian. Similarly, some Micronesian languages, such as Marshallese and Gilbertese, are spoken outside what is now the modern political domain of Micronesia. Henceforth in this study, I use the term Micronesian to refer only to languages of the Micronesian family; thus, Yapese, spoken in the Federated States of Micronesia, is Oceanic but not Micronesian, while Gilbertese, spoken in Kiribati and not political Micronesia, is nonetheless linguistically Micronesian. The notion of linguistic Micronesia is discussed elsewhere as ‘nuclear Micronesian’ (Bender 1971) for the same reason: to exclude geographically proximate but genetically distant languages like Yapese and Chamorro.



The Micronesian family can be divided into five main descendent branches: Kosraean (Kusaeian), Gilbertese (Kiribati), and Marshallese, each of which persists as a single language, and Pohnpeic and Chuukic, both of which are subgroups comprised of numerous variants. The Pohnpeic group includes Pohnpeian, Mokilese, Pingilapese, and Ngatikese. Depending on parameters of classification, the Chuukic group includes between twelve and eighteen members; regardless of the precision with which one divides them, it is clear that the Chuukic group is essentially a continuum of mutually intelligible dialects. In my discussion of the Chuukic languages, which begins in earnest with Woleaian in Chapter 7, I focus on the most well-documented members of the group, which are Woleaian, Puluwat, Chuukese (Lagoon Chuukese), and Ulithian.

2.2.1 *The Micronesian family within Oceanic languages*

There is a body of research which establishes the notion of a distinct Micronesian branch of Oceanic. The integrity of the Micronesian family is supported by the reconstruction of proto-Micronesian and comparison of its forms with reconstructed Proto-Oceanic forms. In this Section, I provide some examples of the arguments that rely on comparisons of reconstructed phoneme inventories, grammatical items, and lexical items. Much of the historical data is compiled in Jackson (1983).

2.2.1.1 Phonological evidence for Proto-Micronesian.

Jackson's (1983) basis for Proto-Micronesian follows from his own research as well as that of Marck (1975, 1977); he cites the work of Pawley (1972) and Blust (1978) for establishing phonological reconstructions of Proto-Oceanic. The Proto-Micronesian segment inventory shows numerous innovations, including phonemic mergers and splits. For example, Proto-Micronesian splits Proto-Oceanic **mp* into **p* and **p^w* and **m* into **m* and **m^w* (although illustrative examples are missing); such innovations are not seen in other Oceanic languages. Furthermore, Proto-Micronesian merges Proto-Oceanic **nt* and **nd* into **d*, another innovation not attested elsewhere in Oceanic. The fact that such mergers and splits are reconstructible from modern Micronesian languages suggests they occurred in a proto-language and were inherited by the modern descendents.

2.2.1.2 Grammatical evidence for Proto-Micronesian

Rehg and Sugita (1975) and Harrison (1978) establish a pronominal system for Proto-Micronesian. Jackson (1983) claims that most of these reflect Proto-Oceanic forms, but several appear to be Micronesian innovations. For example, the 1st singular focus pronoun in Proto-Micronesian is **gau*; Proto-Oceanic apparently shows no cognate form. However, reflexes of it are seen in non-Micronesian languages like Nauran *angnga* and Rotuman *ngou*, which Jackson claims is evidence of a slightly larger grouping.

Less questionable is the appearance in Proto-Micronesian of two 'inalienably possessed locational nouns'. One such form is **faa* 'under, below', a uniquely Micronesian reflex of the Proto-Oceanic **papa*; the other is **ree* 'at', 'with' no clear Proto-Oceanic source.

2.2.1.3 Lexical Evidence for Proto-Micronesian

The lexical innovations cited by Jackson provide more convincing support than phonological and grammatical ones for establishing the existence of a Micronesian proto-language. A number of lexical items can be reconstructed for Proto-Micronesian which differ unexpectedly from Proto-Oceanic. For example, **Tigi* 'fart' appears instead of the predicted **ziki* as a reflex of Proto-Oceanic **ziki*. Proto-Micronesian **taim* 'sharpen' and **ñau* 'delicious, sweet' unexpectedly lose the medial consonants of Proto-Oceanic **tansim* and **ñamu*.

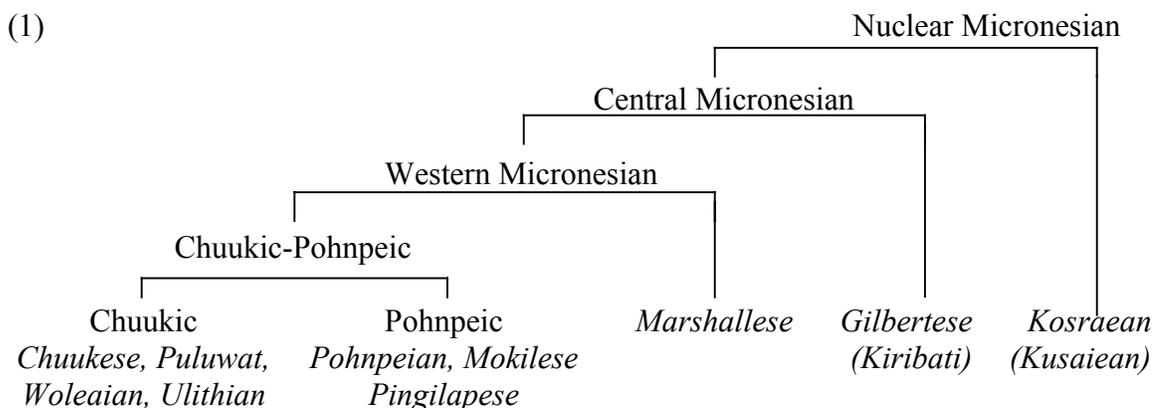
Jackson also provides evidence of Micronesian lexical items with semantic innovations. For example, it is possible to reconstruct Proto-Micronesian **lewe* 'tongue', a reflex of Proto-Oceanic **leqo*, the non-Micronesian reflexes of which refer to 'speech' in other Oceanic languages. Similarly, Proto-Micronesian has a form **lau* 'puddle', whose cognates in all other Oceanic languages mean 'open sea' or 'beach', and a form **m'are* 'lei, garland', which is absent everywhere else. The fact that such innovations are reflected throughout the Micronesian family and nowhere else suggests that they occurred first in a proto-language, ancestral to all of them.

Together, the phonological, grammatical, and lexical reconstructions of proto-Micronesian languages help establish the notion that they share a common linguistic source. In Section 2.3, I describe numerous other traits of Micronesian languages which,

while not necessarily unique to the language family, are nevertheless important for the discussion of reduplication. Before doing so, I survey in the Section 2.2.2 some of the arguments for linguistic relationships within the Micronesian family.

2.2.2 Relationships within the Micronesian family

Bender (1971) argues for the existence of a Micronesian family to include Kosraean, Gilbertese, Marshallese, Pohnpeic, and Chuukic, but makes no internal subgroupings except a Central Micronesian group consisting of the Pohnpeic and Chuukic languages. Jackson (1983) also uses the term Central Micronesian, but to refer instead to the group consisting of all Micronesian languages except Kosraean. Jackson's Central Micronesian is further divided into Gilbertese and Western Micronesian, consisting of Chuukic, Pohnpeic, and Marshallese. Chuukic and Pohnpeic then comprise their own group, the internal structure of which is the matter of lengthy discussion on the part of Jackson. I illustrate Jackson's Micronesian family tree in Figure (1).



Considering the high degree of mutual intelligibility and shared cognates within both Chuukic and Pohnpeic, I consider Woleaian, Puluwat, and Chuukese to be direct daughters of a proto-Chuukic ancestor, and Pohnpeian, Mokilese, and Pingilapese to be direct daughters of a proto-Pohnpeic ancestor. In doing so, I do not mean to ignore any research that motivates a more detailed internal structure of either Chuukic or Pohnpeic.

2.2.2.1 Evidence for a Central Micronesian group

Jackson's arguments for the Central and Western nodes are lexical in nature. For the Central Micronesian grouping, he provides several forms which have reflexes in Gilbertese and at least one other language, but not in Kosraean. For example, Central Micronesian appears to have an innovative form **gii* 'tooth', reflected as Gilbertese *ngii*, Marshallese *giyi*, Chuukic **gii*, and Pohnpeian *ngii*. Only Kosraean *wihs* reflects the Proto-Oceanic form. In addition, Kosraean *fulʔʔol* 'wring, squeeze, express' reflects Proto-Oceanic **poRo*, while Central Micronesian has an innovative form **ogid*, which survives as Gilbertese *ongira*, Pohnpeian *wengid*, and Mokilese *ungud*. Lastly, Central

Micronesian shows a fronting of the first vowel in Oceanic **tolu* ‘three’, as in Gilbertese *teni*, Marshallese *jiliw*, Chuukic **telu*, and Pohnpeian *sili*; Kosraean *tolu* does not.

2.2.2.2 Evidence for a Western Micronesian group

Similar arguments can be made for grouping Western Micronesian separately from Gilbertese. For example, Western Micronesian **kiauw* ‘outrigger boom’ is reflected in Marshallese *kiyey*, Mokilese *kia*, and Chuukic **kiauw*; Gilbertese *kiaro* and Kosraean *kiyes* both retain a consonant from Proto-Micronesian **kiado*. In addition, the Western Micronesian **m’egau* persists as a term for eating and apparently reflects **mangmau* ‘chew’, whereas the Gilbertese form *m’angaungau* ‘gluttony’ instead reflects **ngau*. A third Western Micronesian innovation is a meaning shift in the form **dake* ‘ride’, which is reflected elsewhere in Micronesian and Oceanic as ‘climb, rise.’

2.2.2.3 Problems with the family tree model

The distribution of some features presents a potential contradiction of the groupings proposed by Jackson; notably, the spread of final-vowel weakening and certain verbal idioms. In this subsection, I summarize these other features, and discuss the implications they have for the issue of divergence and contact in the area.

Marck (1991) traces the spread of idiomatic usages of certain verbs through the Micronesian family. For the most part, the innovation of particular idiomatic uses is consistent with Jackson’s groupings. That is, there are some constructions that are unique to Pohnpeic-Chuukic; for example, the verbal prefix *li-* ‘abundant in’ occurs in all Micronesian languages, but its Pohnpeic and Chuukic usage refers to ‘one who engages in.’ Similarly, Chuukic and Pohnpeic languages use a reflex of **mate-sio* (literally, ‘die-down’) to refer to multiple deaths, where Marshallese and Kosraean would use a reflex of **mate-la* (‘die-away’) for the same meaning. Moreover, there are some idioms that are unique to the Western Micronesian group. For example, the reduplicated form of **lapa* ‘to be big’ receives an idiomatic interpretation of ‘to be huge’ in Chuukic, Pohnpeic, and Marshallese only.

However, there are some extensions of meaning for directional affixes that occur in Chuukic, Pohnpeic, and Kosraean, but not in Marshallese or Gilbertese. For example, these groups share an extension of *la* ‘away’ to ‘completion, extinction, or unconsciousness,’ and an extension of *sio* ‘down’ to ‘surface (dot).’ Marck suggests that these uses may have spread areally, since Kosrae is physically proximate to the Chuukic and Pohnpeic island chains (See map, Section 2.2).

In addition, all of the idiomatic constructions and extended uses of directional affixes that Marck discusses are completely absent from Gilbertese. This situation may suggest that Gilbertese diverged from the group earlier than did Kosraean, after which point these idioms would have been innovated. Such a possibility contradicts Jackson’s tree, but Marck acknowledges two other scenarios. First, it may simply be that Gilbertese had the same idioms seen in Kosraean and lost them. Alternatively, Marck suggests that at an earlier stage, the precursors to Kosraean and the Central Micronesian languages were somewhat mutually intelligible, and hence able to experience some innovations in tandem. Gilbertese, spoken on the islands of Kiribati, which are geographically remote

compared to the close proximity between Kosrae, Pohnpe, and the Chuukic chain, could simply have been too peripheral to see these innovations.

Evidence for the peripheral nature of Gilbertese is not limited to lexical or semantic features. In fact, Gilbertese also appears to have missed out somewhat on the process of final-vowel weakening, which I describe in greater detail in Section 2.3.1.1. While there is evidence of stem-final weakening in every Micronesian language, its exact manifestation varies across languages, and not in a manner that reflects the family's historical divergences. The process appears as diachronic deletion in Marshallese and Kosraean, synchronic deletion in Pohnpeic and Eastern Chuukic, but devoicing in Western Chuukic and Gilbertese.

Both the spread of idioms and of final-vowel weakening suggest that a family tree (or 'radiation') model of divergence in Micronesia is too simplistic, and that some incorporation of a wave-theory or areal model of diffusion of innovative features ought to be employed. This is essentially Marck's proposal, and it is nonetheless consistent with Rehg's claims about the diffusion of final-vowel weakening. I return to this issue in Chapter 9, where I discuss the manners in which innovative constraint rankings may be transmitted.

2.3. *Other characteristics of Micronesian languages*

In this section, I describe a number of other features of Micronesian languages which, while not particular to the language family, are nonetheless important for the discussion of reduplication. I first describe a number of pan-Micronesian phonological processes, and then I discuss some morphological and syntactic properties that are relevant to affixation and reduplication.

2.3.1 *Micronesian phonology*

While a full treatment of the phonological characteristics of Micronesian languages is itself an enormous undertaking, a number of phenomena merit at least some description prior to an analysis of any particular language's reduplication pattern. First, Micronesian languages all exhibit a pattern of stem-final vowel lenition; second, they all have strict alternation of stress (whose phonological manifestation is not the prominence of stress-timed languages), and third, they have varying degrees of restriction on allowable coda consonants.

2.3.1.1 *Stem-final lenition*

As mentioned in Section 2.2.2.3, there is evidence of stem-final weakening in every Micronesian language, in the guise of vowel deletion, devoicing, and shortening. Jackson (1983) attributes the diffusion of final-vowel weakening to an innovation of Proto-Micronesian, but the process does not persist in the same manner in all Micronesian languages (Rehg 1991); for example, Pohnpeic languages show synchronic final-vowel deletion, but Woleaian, spoken in the westernmost region of Micronesia, only devoices them. In Kosraean, the process took hold so firmly that final-vowel information has been lost completely from underlying forms.

Rehg (1991) suggests Proto-Micronesian did not innovate final-vowel weakening, but simply transmitted the prosodic ‘pre-conditions’ that made its emergence possible (indeed, likely) at later stages in various languages. Marck (1991), however, points out that the languages without a complete final-vowel deletion processes, Gilbertese and Woleaian, are spoken at the geographic periphery of linguistic Micronesia. It is therefore possible that the innovation of the process occurred some time after the dispersal of Micronesian languages, but spread through continuing contact the Western Caroline and Marshall Islands, thus including Kosraean, but not Gilbertese or Woleaian.

Pohnpeian presents the simplest variant of the synchronic process: stem-final short vowels are deleted, and long vowels are shortened. The synchronic nature of the alternation is clear because the stem-final vowel is not weakened if it is followed by a suffix, as exemplified in (2) below; note that a reduplicative suffix can have the effect of preserving the stem’s final vowel.

(2) Final-vowel lenition in Pohnpeian (Rehg 1991)¹

<i>Unaffixed</i>	<i>gloss</i>	<i>affixed</i>	<i>gloss</i>
kiil	‘skin’	kilin	‘skin of’
rooŋ	‘news’	roŋen	‘news of’
usu	‘star’	usuun	‘star of’
wwa	‘fruit’	wwaan	‘fruit of’
p̄ii	‘sand’	p̄ika-p̄ik	‘sandy’

In none of these cases can the additional vowel of the suffixed form be posited as part of the suffix, since it is not consistent across all forms. For example, it is *i* in *kilin*, *e* in *roŋen*, and *u* in *usuun*. The facts are similar for other Pohnpeic languages like Mokilese and Pingilapese, as illustrated in (3). Again, the alternation is clearly synchronic because vowels are only weakened word-finally, and not if they are followed by some suffix. In (3a), the suffix *n* preserves the stem-final vowel in *p̄ike-n*; a vocalic suffix does the same for forms like *doko* and *in̄oŋe*, but is itself deleted. Unaffixed stems like *ad̄* are realized without their final short vowel, as in *ad* (note the ablaut in *ad̄on*). Stems with underlying final long vowels like *insaa* arise with shortened vowels when unaffixed, as in *insa*.

(3) a. Final-vowel lenition in Mokilese (Harrison 1976: 287)

<i>Unaffixed</i>	<i>gloss</i>	<i>affixed</i>	<i>gloss</i>
ad	name	ad̄on	name of
insa	blood	insaan	blood of
p̄ik	sand	p̄iken	sand of
in̄oŋ	a story	in̄oŋe	to tell a story about
dok	to spear	doko	to spear something

¹ Davis (1997) argues that the vowels in the unaffixed forms *kiil* and *roong* are long only to meet a requirement of bimoraic minimum; word-final consonants are always extrametrical and non-moraic across the language family.

b. Final-vowel lenition in Pingilapese (Good & Welley 1989)

<i>Unaffixed</i>	<i>gloss</i>	<i>affixed</i>	<i>gloss</i>
mweiyaŋ	taro	mweiyaŋæ-la	taro-compl. (158)
wɔl	man	wɔlæ-mæn	man-one (149)
alu	walk	aluu-di	walk-down (137)
kini	pinch	kinii-di	pinch-down (150)
suukæ	stick	suukee-pas	stick-one (161)
wesi	hit	wesii-kin	hit-with (161)

Final vowel deletion is also seen in transitive-intransitive verb pairs, but somewhat disputably. The written grammars of Pohnpeic languages typically characterize the derivation of certain intransitives as the deletion of the stem-final consonants from the corresponding transitive verbs. For example, Pingilapese and Mokilese both have a transitive *pɔdok* and intransitive *pɔd* for ‘plant’; Pingilapese has a transitive *duup* and an intransitive *du* for ‘dive’. The transitives are plausibly analyzable as morphologically complex, consisting of a stem plus a thematic consonant; for example, *pɔdo + k*. The intransitive, lacking the thematic consonant, comes out as *pɔd*, with its final vowel deleted. While this approach requires an appeal to classificatory consonants (some stems have a thematic *p*, others, *n* or *k*), it is consistent with the behaviour of final stem vowels: the final short vowel of *pɔdo* is deleted if the stem lacks the thematic *-k* suffix, while the long vowel of *duu* is shortened if the thematic *-p* is absent. Sohn (1976: 126) presents exactly such a picture of transitives in Woleaian; I return to the question of transitive-intransitive pairs in Section 2.3.2.2.

Among the Chuukic languages, the pattern of stem-final lenition varies. Some languages, like Puluwat and Chuukese, follow the Pohnpeic pattern. In Woleaian, however, final short vowels are only devoiced, not deleted. Again, however, the pattern alternates depending on the presence of suffixes; short vowels are devoiced if word-final, but voiced if followed by a suffix. Final vowels are shortened when not suffixed.

(4) Final-vowel lenition in Woleaian (Sohn 1975)

	<i>Unaffixed</i>	<i>gloss</i>	<i>affixed</i>	<i>gloss</i>
CV#	meya	feel (intr.)	meya-fɨ	feel (trans.)
	firɛ	weave (intr.)	firɛ-gɨ	weave (trans.)
	fato	plant (intr.)	fato-gɨ	plant (trans.)
	perase	splash	perase-rase	scatter
	miʃɨ	fool	miʃɨ-miʃɨ	tell lies
CVV#	wa	canoe	waa-lɛ	his canoe
	peje	foot	pejee-lɛ	his foot

In Marshallese, Bender (1969: 19) acknowledges an ‘erosion from the right’ that resembles Pohnpeian for final short vowels, but long vowels are replaced by vowel-glide sequences. Rehg (1991) suggests that final-vowel deletion is in fact still productive in Marshallese, and given the language’s reanalysis of long vowels as VGV sequences, the

surface replacement of long vowels with vowel-glide sequences is expected. In other words, historical *VV* becomes *VGV* in Marshallese (the glide is predictable from the vowel), and in turn lenites to *VG* if word-final. Rehg's examples are Marshallese *kil* 'skin' from Proto-Micronesian **kuli*, and Marshallese *yijiw* 'star' from Proto-Micronesian **fituu*; in the latter example, the synchronic underlying forms is posited as *yijiwi*. Table (5) includes a few more examples from Bender (1969); the addition of suffixal consonants like *-n* in *wahan* and *-y* in *jerakey* triggers the preservation of a stem-final vowel that is missing from the unaffixed forms.

(5)	Final-vowel lenition in Marshallese			
	<i>Unaffixed</i>	<i>gloss</i>	<i>affixed</i>	<i>gloss</i>
	wah	canoe	wahan	his canoe c.f. <i>lime-n</i> , 'his drink'
	ŋi	tooth	ŋiyih	my tooth
	riyab	tell falsehood	riyabey	tell lies
	kadek	get drunk	kadekey	get drunk from
	jibwin	use a spoon	jibwiniy	use a spoon
	jerak	set sail (intr)	jerakey	set sail for

Many Marshallese verbs have transitive forms ending in diphthongs, while the intransitive version is consonant-final; for example, *jerak* ~ *jerakey* 'set sail.' Such pairs are analyzable as *jerak* ~ *jerak+ey*, in which case there is no stem-final alternation, or *jerak* ~ *jerake+y*, in which case the unaffixed form undergoes a synchronic vowel-deletion process. The non-alternating approach suggests that Marshallese verbs often have no underlying final vowel at all; this is consistent with the fact that its suffixing reduplication does not preserve stem-final vowels, as forms like *jem-jem* 'sharpen', *malet-let* 'smart', and *kketew-tew* 'windy' show. The alternating approach offers an account of the transitive-final diphthong's unpredictable nucleus; some verbs end in *ey*, like *witey* 'rain on', while others end in *ey*, like *lamejey* 'shout' and *kaŋey* 'eat'; still others end in *iy*, as in *wiminiy* 'bake'. Bender suggests that the transitive's diphthong may be harmonic. Marshallese also shows evidence of the so-called thematic consonants that appear in transitive forms, as in *wimwim* ~ *wiminiy* 'shout', *kkal* ~ *kalekey* 'build', and *ppeq* ~ *ppiqtēy*. Nevertheless, even if such consonants were truly suffixes, there is no evidence to suggest that the vowels which precede them are stem vowels and not epenthetic; indeed, they are always identical to the nucleus of the final diphthong.

Gilbertese and Kosraean show an interesting contrast in their reflection of the pattern. Kosraean has so codified final-vowel weakening that such vowels were historically lost, so there is no synchronic variation. That is, unlike in the languages illustrated in (2-5), Kosraean never has vowels that appear only before suffixes. This contrast is illustrated in (6), where the presence of a suffix does not trigger the perseveration of any historically final vowel.

(6) Kosraean (Lee 1975: 185, 189, 193)

<i>Unaffixed</i>	<i>gloss</i>	<i>affixed</i>	<i>gloss</i>
wo	good	wo-kin	to consider good
fi[ɛ]	easy	fi[ɛ]-kin	to consider easy
kæto	pretty	kæto-kin	to consider pretty
ikol	to stop	ikol-yuk	to be stopped
uke	to chase	uke-yuk	to be chased
uni	to kill	uni-yuk	good at killing
ŋuʃok	to smell	ŋuʃok-twen	good at smelling
esam	to remember	esam-twen	good at remembering
kona	to discover	kona-twen	good at discovering

Gilbertese, in contrast, has resisted diffusion of the pattern, and only devoices a subset of vowels in a subset of environments. Rehg (1991) generalizes that short high vowels are deleted word-finally after nasal consonants, and long high vowels are optionally shortened in the same environment. In addition, short high vowels must devoice after *t*, which spirantizes before high vowels, hence the native pronunciation of *Kiribati* ‘Gilbert’ as *kiribasj*—to the non-native ear, *kiribas*. Other environments offer variable devoicing, for example, short high vowels after any consonant, and non-high vowels after geminate nasals. Though examples are scarce, Gilbertese stem-final lenition is quite more restricted than the categorical application of lenition in other Micronesian languages.

Nevertheless, I provide numerous suffixing examples from Groves *et. al* (1978) below in Table (7). Unfortunately, they make no mention of short-vowel devoicing, but these forms should still show a lack of synchronic long-vowel shortening; that is, the final vowels of the unaffixed forms correspond to short vowels in the related affixed forms. In contrast, short final vowels in other Micronesian languages are usually the synchronic reflex of an underlying final long vowel. One odd example is the pair *tenaa~tena-mwaaka*, in which there is a length alternation, but this is converse to the typical morphophonemic alternation that preserves vowel length only in the affixed forms.

(7) Gilbertese lack of final-vowel length alternation

<i>Unaffixed</i>	<i>gloss</i>	<i>affixed</i>	<i>gloss</i>
buti	<i>to travel</i>	buti-mweere	<i>slow</i>
uti	<i>to awaken</i>	uti-mweere	<i>slow to awaken</i>
kiba	<i>to fly</i>	kiba-mweere	<i>slow at flying</i>
uui	<i>mouth</i>	uui-tata	<i>fast at talking</i>
bai	<i>hand</i>	bai-tata	<i>fast at working with hands</i>
oota	<i>to shine</i>	oota-mwaaka	<i>bright</i>
tiki	<i>tight</i>	tiki-buaka	<i>homely, ugly</i>
aŋ	<i>air, wind</i>	aŋi-buaka	<i>a strong or bad wind</i>
mauŋa	<i>mountain</i>	mauŋa-uŋa	<i>mountainous</i>

tano	<i>sand, soil</i>	tan-tano, tano-tano	<i>sandy</i>
ino	<i>maggot</i>	ino-ino	<i>infested with maggots</i>
ika	<i>fish</i>	ika-ika	<i>abounding in fish</i>
man	<i>animal</i>	mani-man	<i>infested with bugs</i>
ran	<i>water</i>	rani-ran	<i>watery</i>
tenaa	<i>to bite</i>	tena-mwaaka	<i>capable of biting hard</i>
taetae	<i>to speak</i>	taetae-buaka	<i>to speak badly</i>
burae	<i>hair</i>	burae-rae	<i>hairy</i>
bwaa	<i>oil</i>	bwaa-bwaa	<i>oily</i>
nii	<i>coconut tree</i>	nii-nii	<i>abounding in coconut trees</i>

Rehg's basic proposal for the source of stem-final weakening is that Proto-Micronesian only had a devoicing pattern much like that seen in modern Gilbertese, and that the presence of such a pattern serves as a plausible precursor for the extension of its application to have occurred independently, several times. In other words, it is likely that proto-Micronesian had devoicing of stem-final high vowels. This pattern, together with the penultimate stress discussed in Section 2.3.1.2 below, makes it *likely* for stem-final lenition to broaden in its target (from high vowels to all vowels) and its application (from devoicing to shortening and deletion). As a result, the modern patterns could have developed somewhat independently.

2.3.1.2 Stress

Rehg (1993) provides a description of the stress patterns of each branch of Micronesian, and shows a number of properties common to all of them. Though Micronesian stress does not clearly have a consistent manifestation of prominence like pitch or loudness, even apparent 'stressless' languages like Pohnpeian appear to use feet and foot-heads in establishing prosodic rhythm and timing. Throughout this discussion, I use the term 'stress' as short-hand for the less wieldy notion of the foot-head.

Primary stress is always attracted to the right edges of words, with secondary stress assigned alternately towards the left. For example, in Pohnpeian *sakànakán* 'bad', stress occurs on alternating vowels. The prosodic level to which stress is assigned and at which stress alternates is actually the mora, which is clear from the way stress-assignment interacts with syllable weight. Stress assignment must not skip a bimoraic syllable; if stress occurs on the mora immediately after a heavy syllable, the first mora of that syllable must also bear stress. For example, Pohnpeian forms like *pampap* and *dundune* are stressed as *pAm.pAm* and *duN.du.nE*. These examples show that the coda nasals are moraic, because they have the effect of making the stress moras of *pampap* non-adjacent. In addition, moraic nasals in Pohnpeian must also be allowed to bear stress themselves. Given that all Micronesian languages use an alternating mora-timed stress pattern, I assume in several analyses that all moraic consonants are relevant to stress assignment.

There is variation in the family, however, as to the locus of primary stress; curiously, it is strongly correlated with the activity of final-vowel weakening. In languages with full deletion patterns, like Pohnpeian, Mokilese, and Marshallese, primary stress occurs on the final surface vowel. In those with an incomplete vowel-weakening process (either as devoicing, or deletion of a subset of vowels), primary stress occurs on the penultimate mora. In other words, it occurs on ‘historically equivalent’ underlyingly penultimate vowels: the reduplicated intransitive of ‘choose’ would be stressed as *pilipil* in Pohnpeian, but *filifili* in Woleaian.

In Kosraean, the loss of stem-final weakening as a synchronic process is correlated with a shift of primary stress away from the ‘historically equivalent’ vowel. Nevertheless, primary stress in Kosraean is assigned to the penultimate surface vowel; as such, it is attracted to the right edge of words.

2.3.1.3 Coda consonants and geminates.

A final phonological characteristic to discuss is the set of allowable medial coda consonants in Micronesian languages. This is another example of a divergent trait that is not consistent with Jackson’s family tree model, but it is not actually contradictory.

All Micronesian languages allow a full range of word-final consonants, but they vary between allowing any medial coda consonant, as in Kosraean and Marshallese, to allowing none, as in Pingilapese. They also vary between allowing no geminates and some subset of geminates. Most of the variation in coda and geminate conditioning is seen in the Chuukic-Pohnpeic subgroup. Some Chuukic languages allow only absolute geminates, as seen in Table (8) below. For example, Puluwat (8a) and Woleaian (8b) both allow initial and medial geminates, but do not allow any other moraic consonant to occur.

(8) Moraic consonants in Chuukic languages

a. <i>Puluwat</i>	<i>gloss</i>	b. <i>Woleaian</i>	<i>gloss</i>
mémmtót	<i>was sitting</i>	bbugo	<i>boiled</i>
mwémmtwéŋé	<i>eating</i>	ffat̩j	<i>to pinch</i>
péppeyiŋak	<i>to have a title to goods</i>	ŋŋüsü	<i>to snort</i>
yalillih	<i>to help</i>	ppaʃj	<i>to stick to</i>
ffal	<i>make (reflexive)</i>	ssawɛ	<i>to go along side of</i>
ffir	<i>cut (reflexive)</i>	mwommwoŋo	<i>to be eating</i>
nné	<i>delicious</i>	pippirafɛ	<i>to be stealing</i>
ŋŋaw	<i>bad</i>	cecaŋj	<i>apply powder</i>
ppar	<i>attached</i>	sessafɛ	<i>to scrutinize</i>
ttef	<i>to tear</i>	tettalɛ	<i>to discuss</i>

An interesting feature of Woleaian is that some geminates cannot occur; for instance, geminated *ʃ* and *r* are realized as *c*, as shown in the morphologically related pairs *ʃaliŋ ~ ceccaliŋ* ‘fill’ and *raŋɛ ~ ceccaŋɛ* ‘yellow powder.’ In addition, *l* is geminated as *n*, as in *liiy ~ ninniyy*, ‘hit him’ while *g* (phonetically a continuant)

geminate as *k*, as in *gematefa* ~ *kekematefa* ‘explain it’. Hence, it seems that geminate continuants are forbidden in Woleaian, with the exception of *ss* and *ff*.

Of the Pohnpeic languages, Pingilapese allows no moraic consonants (and thus no geminate consonants), while Pohnpeian and Mokilese have a restricted set. McClintock (1999) argues that the Pohnpeic group illustrates a very clear continuum of allowable consonant sequences, with Pingilapese being the most restricted, followed by Pohnpeian, Mokilese, and Ngatikese.

Pohnpeian allows only sonorant to be moraic; homorganic nasal-obstruent sequences are licit, as are sonorant geminates, as seen in Table (9a). Mokilese allows both these, as well as homorganic obstruent sequences, as shown by *lolda* ‘become wet’ and *risda* ‘to become dark’ in Table (9b). In both languages, consonant restrictions hold across morpheme boundaries, including those that separate stems from reduplicants. Pohnpeian uses epenthesis if two consonants are heterorganic, but nasalization if they are homorganic. Potentially illicit sequences are avoided only through epenthesis in Mokilese; however, some forms show some optionality: the sequences in *minmin* ‘clean’ and *onopda* ‘ready’ are optionally broken up.

(9) Codas and geminates in Pohnpeic languages

a. <i>Pohnpeian</i>	<i>gloss</i>	b. <i>Mokilese</i>	<i>gloss</i>
lallal	<i>to make a sound (durative)</i>	irrir	<i>preparing</i>
rerrer	<i>to tremble (durative)</i>	onnop	<i>stringing</i>
memmem	<i>sweet (durative)</i>	podipodok	<i>planting</i>
kaŋkaŋ	<i>to eat (durative)</i>	jikijik	<i>make a wake</i>
pampap	<i>to swim (durative)</i>	iŋkoŋ	<i>sharp</i>
dondod	<i>frequent (durative)</i>	andip	<i>spitting</i>
dindil	<i>to penetrate (durative)</i>	lolda	<i>become wet</i>
sinsis	<i>to speak with an accent</i>	kodda	<i>to run aground</i>
pediped	<i>to be squeezed (durative)</i>	pakirikirik	<i>to coax</i>
lopilop	<i>to be cut (durative)</i>	jajjal	<i>winding rope</i>
kereker	<i>to flow (durative)</i>	rosda	<i>become dark</i>

In the more peripheral Micronesian languages, further variation is evident. Gilbertese has nearly the same set of restrictions as Pohnpeian, but only nasals can be geminate. Epenthetic vowels appear between non-homorganic nasals, as in *kanimoi*, but nasal-obstruent sequences are tolerated, as in *kantoka*.

(10) Gilbertese (Blevins and Harrison 1999)

tuaŋa	<i>to tell someone</i>
tuaŋŋa	<i>to tell</i>
anna	<i>dry land</i>
mka	<i>compost</i>
kan+moi → kanimoi	<i>want to drink</i>
kan+toka → kantoka	<i>want to ride</i>

Marshallese is more mysterious given the nature of its records. Its orthographic conventions suggest that it is the most permissive of the family, allowing any consonant to occur as a medial consonant, as forms like *jɛm-jɛm* ‘sharpen’ and *malet-let* ‘smart’ suggest. However, Bender (1969: 4) hints at the existence of epenthesis: ‘You may have noted in your teacher’s pronunciation some short vowel sounds between words or between consonants within words that are not indicated in [either] writing system above’. Later (p. 60) there is more enriched discussion: adjacent consonants are tolerated if they are identical (i.e., geminates, as in *jimettan*, *haddiy* etc.) or ‘closely related ones’ (i.e., homorganic, as in *winteh*, *tiyjembah*). Patterns of English-source borrowing provide additional evidence: non-native clusters are resolved with epenthesis, as the forms in Table (11) show.

- (11) Marshallese borrowings
 tiryep ‘trip’
 jikiwił ‘school’
 yijiteh ‘Easter’

Kosraean presents the curious trait of allowing all consonants as medial codas, but length does not appear to be contrastive for consonants. Adjacent identical consonants may occur, however, as a result of reduplication, as in *rarrari* ‘to shake’. I provide additional examples of medial codas in Table (12); note that such codas may be obstruent and non-homorganic, as in *topkɛkɪn* ‘to turn over’ and *ækfoko* ‘make strong’. So freely may consonants occur, in fact, that Lee places the first syllable boundary in reduplicated vowel-initial bisyllabic stems after a consonant and before a vowel, as in *em.e.ma* ‘to taste’.

- (12) Kosraean coda consonants
- | | | | |
|----------|---------------------|---------------|-----------------|
| katkat | a bird | lɪ.pɛ.roŋ.roŋ | sounds of waves |
| lɔŋlɔŋ | swarming with flies | æk.fo.ko | make strong |
| pəkpək | sandy | æk.mɪ.ni.ni | make thin |
| laʃkækɪn | to pour out | ŋal.ŋa.lis | to bite |
| topkɛkɪn | to turn over | em.e.ma | to taste |
| lɔksækɪ | to stifle | rar.rar | to shale |

Such tolerance of medial codas is otherwise unheard of in the Micronesian family—enough to arouse suspicion that Lee’s transcriptions might leave out excrescent vowels, much like the orthographic conventions of Mokilese and Marshallese do. However, two facts support the accuracy of the Lee’s description: first, Table (12) shows the syllable boundaries exactly as Lee transcribes them, which he does with a careful phonetic transcription, alongside the rather oblique Kosraean orthography. Second, Lee also discusses a verbal truncation pattern that optionally shortens polysyllables, removing

vowels and creating adjacent consonants. For example, *sə.na.kə.nəl* ‘to respect him’ can shorten to *sak.nal*, and *li.pɛ.kə.nəl* ‘to hurl him’ can shorten to *ləp.ŋəl*.

Even so, Kosraean lexical items do not have underlying consonant sequences; such structures are always derived through affixation and truncation. Thus, even this relatively tolerant language shows evidence of restrictions on coda consonants. With the partial exception of Kosraean, then, Micronesian languages tend to have some degree of restriction on the kinds of consonants that can precede other consonants word-internally. Table (13) summarizes the distribution of consonant restrictions throughout the family.

(13) Summary of codas and geminates in Micronesian languages

	Homorganic nasal-obs.	Geminate sonorants	Geminate obstruents	Homorganic obstruents	Heterorganic sequences
Woleaian	no	yes	some	no	no
Puluwat	no	yes	yes	no	no
Chuukese		yes	yes		
Pingilapese	no	no	no	no	no
Pohnpeian	yes	yes	no	no	no
Mokilese	yes	yes	yes	yes	no
Marshallese	yes	yes	yes	no	no
Gilbertese	yes	yes, if nasal	no	no	no
Kosraean	yes	no	no	yes	yes

2.3.2 *Micronesian grammar*

In this section, I describe a number of morphological and syntactic features that are common to Micronesian languages and relevant to the discussion of reduplication. I first describe the plasticity of syntactic categorization, and then discuss the relationships between transitive and intransitive verbs. Each of these is important because the classification of words into syntactic categories tends not to be so clear cut; any word can act in a verbal manner, so any word can plausibly be reduplicated. Furthermore, the role of reduplication is closely linked to the presence of an argument and to transitivity in general. Lastly, I describe the function of reduplication across the family, with a focus on its common functions and on the distribution of prefixing and suffixing reduplication.

2.3.2.1 *The plasticity of syntactic categories*

A common morphological characteristic of Micronesian languages is what we may call the plasticity of syntactic categorization. The characterization of certain lexical items into categories of nouns, verbs, and adjectives is made problematic by flexibility in the use of each. Micronesian languages do not always make strict distinctions of grammatical categories; as a result, they often allow what we would ordinarily expect to be a noun or an adjective to behave as a verb or vice versa. Such plasticity is commonplace enough to have been noticed in many descriptions of Micronesian languages:

Kosraean: ‘The (material adjectives) listed above (sæk ‘wooden’, nuknuk ‘cloth’) can also be used as nouns. Nouns that denote materials can usually be used as material adjectives.’ (Lee 1975: 97)

Marshallese: ‘Adjective-like verbs as post-position modifiers.’ (Bender 1969: 146)

Pohnpeian: ‘A considerable number of words in Pohnpeian function both as nouns and verbs. *Rasaras*, for example, means both ‘a saw’ and ‘to saw.’ (Rehg & Sohl 1981: 100)

Mokilese: ‘Although I know of no test that will unambiguously set off this class (verbs) from the second major class, that of *nouns*, I feel fairly confident that such a division should be maintained. I have uncovered no evidence of any sort, however, to support the existence of a lexical category *adjective* that is distinctive from the category *verb*.’ (Harrison 1973, emphasis in original)

Pingilapese: ‘Adjectival verbs appear in both the assertion of a sentence and in the topic. In the assertion, they can be reduplicated and occur with verbal suffixes and can be preceded by pre-verbs.... In the topic, adverbial verbs occur, uninflected, as adjectives in noun phrases.’ (Good & Welley 1989: 28)

Woleaian: ‘An adjective can function both as a main verb and (secondarily) as a noun modifier.’ (Sohn 1975: 75)

While the smudging of syntactic categorization is not unique to the languages of Micronesia, it is important for the discussion of reduplication, since the process (as discussed in Section 2.3.2.3) operates on verbs. Given the plasticity of categorization, however, we often see such verbal affixes attaching to noun-like or adjective-like stems. For example, Mokilese allows the aspectual progressive prefix to attach to nouns, as in *onnonop* ‘wavy’, from *onop*, ‘wave.’ To explain such occurrences, it is preferable to portray lexical items like *onop* as having semantic content, but no inherently required syntactic category. Treated as a noun, it acts as one; but treated as a verb, its meaning becomes something more like ‘be a wave.’ This is an informal way of appealing to the claims of Distributed Morphology (Halle & Marantz 1993, 1994, Harley & Noyer 1998), in which syntactic categories are interpreted through syntax. To be ‘treated as a noun’ is, more precisely, to be interpreted by the syntax in a nominal position, and likewise for acting as a verb. Such a view of language offers an explanation of why seemingly any lexical item can be reduplicated: as long as it occurs in a verbal position, it can be assigned verbal affixes, including aspectual reduplicants.

While I do not pretend to offer a principled explanation for the plasticity of categorization and its relation to syntactic phenomena here or in any other chapter, I acknowledge it for the following reason: throughout this dissertation, I treat reduplicants as the same morpheme, regardless of the apparent category of the stem. In other words, I consider the aspectual prefix of any language to be the same entity everywhere in that language, regardless of whether it attaches to a noun or a verb, and regardless of any

particular nuance of meaning it might spark when attached to any particular stem. In other words, prefixing reduplication in any given language is the uniform exponence of a single ‘dupleme’ in the sense of Spaelti (1997). I am comfortable with this assumption given my emphasis on reduplicative size and shape, and not function. I still admit the importance of functional phenomena in some arguments, notably, in the positing of two duplemes—a prefix and a suffix—throughout the family, and in the allomorphic reduplicative patterns of the Chuukic sub-group.

2.3.2.2 *Transitivity*

Micronesian languages tend to have a fairly regular relationship between transitive and intransitive verbs. The transitivity of verbs is important for analyses of Micronesian reduplication for several reasons. The process is often used to derive special intransitive verbs, also called denotatives (Harrison 1973) or neutral verbs (Sohn 1976), from transitives. In addition, as mentioned in Section 2.3.1.1, transitive forms often appear with additional thematic consonants, which in turn show alternations that clarify the nature of certain underlying forms.

Independently of analysis or theory, one can observe the following common trait of transitivity in Micronesian grammar: verbs come in pairs, one of which is transitive and one of which is intransitive, and the transitive version often carries an extra ‘thematic’ consonant. For example, Pingilapese and Mokilese both have a transitive *pɔdɔk* and intransitive *pɔd* for ‘plant’; Pingilapese has a transitive *duup* and an intransitive *du* for ‘dive’. In Woleaian, the extra consonant may also appear with an additional final vowel.

Analytically, there are two ways of handling these consonants. In an additive approach, one could presume the intransitive forms are more basic, and transitives are derived with the addition of one of a set of transitivity (or object-agreement) consonantal suffixes. Conversely, a subtractive approach places the transitives as more basic, with intransitives derived by the subtractive operation of final-consonant deletion.

In either approach, there is some amount of unpredictability. For example, Marshallese also shows thematic consonants in some transitive forms, as illustrated in Table (14). It is also clear that not every transitive verb actually has an additional consonant, as seen by pairs like *jerak* ~ *jerakey*. A subtractive approach that derives intransitives from transitives cannot predict which verbs fail to lose their final consonant, while an additive approach cannot predict which thematic consonant a verb receives.

(14) Marshallese transitive-intransitive pairs

<i>Intransitive</i>	<i>Transitive</i>	<i>gloss</i>
kɛwbah	kɛwbahyik <u>i</u> y	add
wimwim	wimwim <u>i</u> y	shout
kkal	kalek <u>e</u> y	build
ppɛq	ppiqɛt <u>e</u> y	look for
jerak	jerakey	hoist, set sail

Sohn (1976: 126) presents an additive picture of transitives in Woleaian, claiming that the additional consonant material is part of a transitivizing suffix, and that verbs fall into different classes depending on which suffix they receive. Table (15) shows some transitive suffixes like *-fi*, as in *meyafi* ‘feel it’, and *-gi*, as in *fatogi* ‘plant it’ (the cognate of Pohnpeic *pɔdok*). Note that the final vowels are visible in Woleaian because stem final weakening arises only as devoicing.

(15) Transitive-intransitive pairs in Woleaian

<i>Intransitive</i>	<i>Transitive</i>	<i>gloss</i>
meya	meya-fi	feel
toro	toro-fi	catch
bisi	bisi-gi	open
fire	fire-gi	weave
fato	fato-gi	plant

One advantage to the additive approach (the claim that transitives are morphologically complex) is that it allows a neater picture of verbs with no thematic consonants: Sohn also posits a ‘y-grade’ class, which includes *teragi~teragiiy* ‘set sail’ (c.f. Marshallese *jerakey*), and a zero-grade class, which includes verbs like *buga* ‘boil’, which has no apparent thematic consonant or transitive suffix.

I think it is ultimately an orthogonal question whether the extra consonants of the transitive forms are analyzed as stem or suffix material. Indeed, in some languages both analyses might be warranted; for example, even if there is a strong case for the suffixing approach in Mokilese, *pɔdok* has a suffixed reduplicated form *pɔdok-dok*, in which the thematic consonant *k* is copied—an intransitive form *pɔd* also exists. Similarly, some reduplicated forms in Woleaian retain their transitivizing suffix, as in *fferagi* ‘spread’, when the operation ought to obviate the need for it. As a result it might be best to say the relationships are now lexicalized.

The important point is that the vowels which precede thematic consonants behave like other stem-final vowels: in the absence of that last consonant, the vowels delete or shorten in Pohnpeic and Marshallese, and devoice in Woleaian. Transitive forms can thus show why a certain vowel appears in a reduplicated form when it is absent (by stem-final lenition) from the unreduplicated surface form. It is also important to acknowledge the phenomenon because of the way reduplication interacts with transitivity. As I discuss in greater detail in Section 2.3.2.3, suffixing reduplication has the general effect of making a transitive’s argument non-obligatory. In later chapters, reduplicated forms may often be cited without the stem’s thematic consonant, whereas their unreduplicated forms might require it.

2.3.2.3 *The role of reduplication*

Throughout this chapter I have made references to the process of reduplication, because every grammatical feature mentioned is either common to all Micronesian languages, relevant to reduplication, or quite frequently, both. I have not, however, used

reduplication as evidence of relationships within or without the Micronesian family, but it is a process found in each language, with fairly consistent functions throughout.

Harrison (1973) surveys the use of reduplication across the family, with some strong generalizations as a result. First, every language shows evidence of prefixing and suffixing reduplication. The suffixing function creates stative adjectival verbs from nouns, such as Pohnpeian *pika-pik* ‘sandy’ and Mokilese *kadip-dip* ‘treacherous’, c.f. *kadip* ‘lie’. The suffix also derives intransitive verbs, or what Harrison refers to as *denotatives*, from transitive verbs, as in *pile-pil* ‘pick with a pole’. For this second function, Harrison claims that it makes arguments non-obligatory: denotatives ‘name the activity without reference to a goal or object’; thus, Mokilese *ŋɔ pile-pil* means ‘I am engaged in picking’. Not every intransitive verb is reduplicated, however; Harrison points out Mokilese intransitive forms like *widiŋ* ‘shy’, from transitive *widiŋe* ‘to fool’, and suggests that only telic verbs may reduplicate.

Rather than say there are two suffixing functions, I will presume there is a single reduplicative suffix whose exact function depends on the kinds of words it attaches to; in some cases, it will not sensibly attach at all. In fact, this is typical throughout the family; suffixing reduplication appears in each language with similar functions. I provide examples of adjectivals in Table (16) and intransitives in Table (17).

(16) Adjectivals

Woleaian	<i>bata</i>	<i>low tide</i>	<i>bata-bata</i>	<i>thirsty</i>
	<i>fati</i>	<i>corner</i>	<i>fati-feti</i>	<i>be angular</i>
Chuukese	<i>pisek</i>	<i>goods</i>	<i>pisek-sek</i>	<i>wealthy</i>
	<i>seniŋ</i>	<i>earlobe</i>	<i>seniŋe-niŋ</i>	<i>hear only what one wants to hear</i>
Marshallese	<i>kewet</i>	<i>hair</i>	<i>kewet-wet</i>	<i>hairy</i>
	<i>diy</i>	<i>bone</i>	<i>diy-diy</i>	<i>bony</i>
Gilbertese	<i>mauŋa</i>	<i>mountain</i>	<i>mauŋa-uŋa</i>	<i>mountainous</i>
	<i>burae</i>	<i>hair</i>	<i>burae-rae</i>	<i>hairy</i>
Kosraean	<i>læs</i>	<i>coral</i>	<i>læs-læs</i>	<i>lots of corral</i>
	<i>fiye</i>	<i>grey hair</i>	<i>fiye-yε</i>	<i>grey-haired</i>

(17) Reduplicated intransitives

Woleaian	<i>fiyaa</i>	<i>to squeeze</i>	<i>fiya-fiye</i>
	<i>maŋjiy</i>	<i>to remember</i>	<i>maŋji-menji</i>
Chuukese	<i>fəwiw</i>	<i>to weave</i>	<i>fəwi-fəw</i>
	<i>kina</i>	<i>to find</i>	<i>kine-kin</i>
Marshallese	<i>bahat</i>	<i>to smoke</i>	<i>bahat-hat</i>
	<i>jek</i>	<i>to chop</i>	<i>jek-jek</i>
Kosraean	<i>mutul</i>	<i>to blink</i>	<i>mutul-tul</i>
	<i>kıpat</i>	<i>to break</i>	<i>kıpat-pat</i>

The use of the prefixing process varies somewhat. In the Pohnpeic/Chuukic group, the prefix has a consistent (nearly inflectional) interpretation of habitual aspect, alternately called continuous in Pingilapese, progressive in Woleaian and Mokilese, or durative in Pohnpeian. Harrison characterizes the Gilbertese prefix as having an iterative interpretation, but Groves *et al.* label it as a continuous aspect marker. Kosraean, the prefix is somewhat more derivational, having an iterative interpretation as in *ful-fule* ‘to twist little by little’ and *tæf-tæfoŋ* ‘to make lots of mistakes’. Still, regardless of functional regularity, the prefix always seems to imply some notion of repeated action.

Marshallese appears to have lost the full prefix, but retains a process of ‘initial consonant doubling’, which can occur by itself as an alloduple of the denotative suffix, as in *qqiŋ* ‘extinguish’, c.f. transitive *qiney*. Initial doubling can also occur in conjunction with the suffix, as in *ppaniq-niq* ‘to pile carelessly’, from *paniq* ‘to pile up’; in this case it assumes an iterative meaning somewhat like the Kosraean prefix. The Marshallese double consonant is considered by Bender and others as a diachronic reduction of a full prefix. However, some languages show evidence of both a full prefix and consonant doubling. For example, Woleaian uses doubling pervasively as an allomorph of the denotative, as in *fferagi* ‘spread’, yet retains a productive use of the prefix. Other Chuukic languages also retain both a full prefix and an initial gemination pattern. Pohnpeian and Mokilese have fossilized remnants of the double consonant, seen in forms like *nsa* (Pohnpeian) and *insa* (Mokilese) ‘blood,’ but like Woleaian, they both use the full prefix productively.

It should be clear that the function of reduplication is similar across the Micronesian family. Each language has a prefix and a suffix, each with consistent functions within each language, and with common interpretations across the family. In the next section, I introduce a few details of the form of reduplicants across the family.

2.4. *The forms of reduplication*

An interesting trait of reduplicative subpatterns in the Micronesian family is that their phonological realization correlates very tightly with the familial groupings proposed in Jackson (1983). That is, one can see a ‘typically Pohnpeic’ prefix, a ‘typically Chuukic’ one, and so on. In this section, I offer some descriptive introductions to the reduplicants of each Micronesian subgroup. The descriptions here are cursory, but later chapters provide detailed descriptions of each subpattern.

The Chuukic and Pohnpeic subgroups both have a consistently bimoraic prefix. In the Pohnpeian continuum, the prefix is typically CVC, and is offset from the stem by an excrecent vowel if the two consonants are not homorganic, as in Pohnpeian *sipi-siped* ‘shaking out’, Mokilese *pɔdi-pɔdok* ‘planting’, and Pingilapese *ræpæ-ræpaaki* ‘finding’. No such vowel appears if the consonants are homorganic, as in Pohnpeian *pam-pap* ‘swimming’, Mokilese *kak-kak* ‘bouncing’, and Pingilapese *paa-pap* ‘swimming’. Numerous other subpatterns exist, notably if the stem has a long vowel, as in Pohnpeian *duu-duupek* ‘starved’ and Mokilese *jaa-jaak* ‘bending’, or is vowel-initial, in which case the prefix (basically) arises as VCV, as in Pohnpeian *ami-amas* ‘raw’.

The Chuukic family also has a bimoraic prefix, but invariably it takes the form CVC-, where the second consonant is part of a geminate that also includes the first consonant of the stem, as in Woleaian *mim-mili* ‘to be staying’ and Chuukese *fif-fini* ‘dist. of choose’. There is also a clear parallel to Pohnpeic VCV prefixing, as in Chuukese *am^wa-am^waat* ‘be noisy while walking’ from *am^waat* ‘coconut floor’.

Abstracting away from the Chuukic-Pohnpeic group, Marshallese appears to have lost the prefix, but Gilbertese has a similar form (Groves *et al* 1978): it is always CVV for shorter stems, as in *nii-nima* ‘drinking’ and *kaa-kare* ‘throwing’, as well as for some longer stems, as in *kee-keewati* ‘withdraw’, but is CV for other longer stems, as in *ki-kiitauti* ‘to be stingy’ and *ki-kiree* ‘to flirt’. Like Pohnpeian, Gilbertese also uses a VCV prefix for vowel-initial stems, as in *utu-uti* ‘awakening’. Harrison (1973), following Goodenough (1963), suggests that the CV variant in Gilbertese is a reflex of Marshallese and Chuukic consonant doubling.

Kosraean shows further variation; it too varies between longer and shorter prefixes, as forms like *fo-fo* and *fal-falis* show, but more predictably than Gilbertese. Regardless, at a pan-Micronesian level of description, the prefix is never more than two moras in quantity.

A similar line of description is possible for the form of the denotative suffix, but this morpheme shows much less variation across the family. In short, it is sensitive to the shape of the stem and to the manifestation of stem-final lenition. Thus, in languages with a Pohnpeian/Chuukese kind of synchronic deletion pattern, the suffix arises as CVC for CVCV-final stems, as in *pika-pik* ‘sandy’, and as CV for stems that end in long vowels, as in Pohnpeian *daŋaa-ŋa* ‘lazy’. In non-deleting languages, the facts are a little different; Woleaian’s suffix is CVCV for CVCV-final stems, as in *perase-rase*, and CV for stems with final long vowels, as in *ŋii-ŋi*. Gilbertese simply reflects the final CV(C)V, as in *mauŋa-uŋa*, and Kosraean doubles the last syllable, as in *fiye-yε* and *mutul-tul*. Still, as with the prefix, the denotative suffix is never more than two moras.

Despite minor differences in form and function, Micronesian languages can be seen to have the common trait of having multiple patterns of reduplication, which might not be so widely attested elsewhere in the Austronesian world. In the chapters that follow, I use reduplication as a looking-glass with which to peruse the phonological systems of each Micronesian language. The product of such analyses is a set of formal constraint grammars, the comparison of which provides an opportunity to test the Confluence hypothesis. Before doing so, I introduce in the next chapter the theoretical constructs necessary for the arguments.

3. Theories, models, and representations

3.1 Introduction

This dissertation uses reduplication as a window through which to study divergence and diversity in human language. As such, it relies on a number of representational and theoretical tools for its arguments, since as any fanatic of reduplication will surely point out, the operation is more than the simple re-creation of a string of segments. Theories of reduplication can be deeply detailed in their manners of deriving and representing reduplicants, but sometimes a discussion of reduplicative theory can be quickly clouded by misunderstanding or under-representation of those foundational details. We often work with differing sets of assumptions—I therefore believe it is crucial to describe first how I make use of constraint evaluation and of representations of phonological structure. I try as much as possible to subscribe to a bare-bones model of Optimality Theory, in the hopes that the vanilla beans I use can still generate strawberries.

This chapter will proceed in the following manner. I first introduce the notion of reduplication, and move to an introduction to some basics of Optimality Theory, including its means of modeling reduplicative systems. I then present key concepts of prosodic phonology before discussing the mechanisms specific to the model used for Micronesian languages.

3.2 Reduplication as morphology

At a basic level of observation, reduplication is something that languages do to derive complex words. A reduplicated form is one in which part or all of the stem is doubled, resulting in some modification to the meaning of the root. Thus, reduplication is obviously a morphological process, but what is less clear is whether it truly adds a *piece* in the ‘piece vs. process’ opposition within morphological theory.

Piece-based theories of morphology like Distributed Morphology (Halle & Marantz 1993, 1994, Harley & Noyer 1998) consider all morphemes to exist at some level of representation as isolatable (even if phonologically null) elements: roots, stems, prefixes, and suffixes, which combine to create morphologically complex words. Processual theories (Aronoff 1994, Robins 1959, Matthews 1972, 1974, Anderson 1982, 1992) use processes to create morphologically complex words, but the building blocks are sometimes less clear. For example, in English irregular verbs, past tense is indicated with a process of vowel ablaut, as in *run* → *ran*. In such a case, it is difficult to remove some piece of the derived form and say that it ‘is’ the past tense morpheme. Nevertheless, there is an exponent of the past tense, in that the verb is clearly phonologically distinct from its root and its present-tense form.

Reduplicative morphemes, or what we call reduplicants, are open to debate on this issue: is reduplication a piece, or a process? Empirically, we cannot deny the exponents of the process: clearly, there is a morpheme to indicate DURATIVE in Pohnpeian and DISTRIBUTIVE in Chuukese. We know it is there because it has an exponent. Derivational templatic theories of reduplication suggest that the reduplicant is both a

piece and a process: a template morpheme (piece) that associates to a copy of the root melody (process).

The same is true of the post-templatic Optimality Theory concept of reduplication: the reduplicant has a lexical entry, devoid of phonemic content—a segmentally empty piece. This element requires an exponent, realized by the operation Gen as a substring of the output, which is evaluated by constraints on segmental and prosodic structure, as well constraints requiring faithfulness between the reduplicant and base substrings. The process of reduplication is thus blended into the entire input-output process, one that occurs in a single step. I return to the tools that Optimality Theory uses for modeling reduplication in Section 3.4; before doing so, I provide in the next sections a basic outline of the OT model, as well as a discussion of some of the more crucial aspects prosodic representation.

3.3. *Optimality Theory*

The analyses in later chapters use the mechanisms of Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1993 *et seq.*) to account for language-internal subpatterns of reduplicative phonology. Optimality Theory is a model that predicts surface forms of words by measuring various competitors, or *candidates*, against a fixed hierarchy of formal constraints. In this section, I describe how such evaluations work, and introduce the kinds of constraints that appear in formal accounts.

A beginning premise is that every underlying representation has a unique output form. The basic machinery then works as follows: the function GEN creates a set of competing candidates, the size of which is potentially infinite. Each candidate is evaluated by the function EVAL against the same set of ranked constraints CON. Given the nature of constraints, no candidate can satisfy all of them, so better candidates are ones that violate lower-ranked constraints. From the candidate set thus emerges the optimal form—the output—which is the one candidate that is bested by no other candidate.

In other words, EVAL predicts the best possible output form for any given input representation, and does so with a consistent set of criteria in mind. I will illustrate this mechanism first with a very basic model.

Constraints measure *Markedness*, the well-formedness of output structure, and *Faithfulness*, the degree of likeness between inputs and outputs. Consider then the basic Markedness constraint *PROPERTY-A:

- (1) *PROPERTY-A The output does not have Property A.

“Property A” could be any phonological feature or structure that languages tend to avoid. A language that never allowed Property A to be true of its spoken forms would rank *PROPERTY-A very highly: so highly, in fact, that it would outrank (or *dominate*) any constraint to the contrary. However, in a language that allows Property A, something must outrank *PROPERTY-A, to prevent it from incorrectly predicting an intolerance for the feature. This can be handled with a constraint requiring Faithfulness to Property A:

- (2) FAITHFULNESS-PROPERTY-A An input Property A is retained in the output.

Now we can illustrate the model. Suppose we had an input that had Property A underlyingly: if FAITHFULNESS-PROPERTY-A outranks *PROPERTY-A, then it is better to retain the feature than to delete it. I illustrate this in the following evaluation, a Tableau with constraints ranked. Higher-ranked, or “dominant”, constraints are on the left, while lower-ranked constraints are on the right.

(3)	Input ABC	FAITHFULNESS PROPERTY-A	*PROPERTY-A
a.	candidate BC	*!	
b.	☞ candidate ABC		*

With such a simple set of constraints (two), the model may seem overly circular. One might wonder about the point; why not simply assign every output form an identical input form? The basic answer is that the study of phonology identifies and models distributional regularities and alternations in surface forms. Thus, wherever a particular underlying form has alternating surface forms, violations of Faithfulness must sometimes occur. One can imagine an analogy from the rules of spelling: all letters are lower-case unless initial. These requirements are formalizable as constraints: *CAPITAL and CAPITALIZE-FIRST.

- (4) *CAPITAL Letters are lower-case.

CAPITALIZE-FIRST Phrase-initial letters are capitalized.

(5)	puck	CAPITALIZE- FIRST	*CAPITAL
a.	candidate puck	*!	
b.	☞ Puck		*
c.	PUck		**!

The conflict between two Markedness constraints thus handles a distributional fact. We need not stipulate that all words underlyingly have an initial capital letter; instead, any underlying sequence of upper-case and lower-case letters (e.g., *Puck*, *pUck*, *PUCK*, *puck*, *PuCk*) will be optimal as *Puck*. In other words, a surface generalization is captured with constraints on surface forms.

Even so, the case for output constraints is not compelling unless we can show that Faithfulness violations *necessarily* do occur. This is true of morphologically-induced alternations; for example, in the spelling analogy, *Puck* is capitalized when by itself, but not when preceded by another word, as in *Frozen puck*. In this case, we have lost our ability to stipulate that *p* is underlyingly upper-case, for now it is not always true of the

output. Thus, in our capitalization grammar, FAITH-CASE, as defined in (6), is dominated by *CAPITAL.

(6) FAITH-CASE Output letters have the same case as their input correspondents.

This ranking relationship is necessary because right now we cannot be sure of whether the *p* is underlyingly upper-case or lower-case; we are only sure of its surface form. However, given a low rank of FAITH-CASE, even an underlying capital *P* would surface as a lower-case *p* when not word-initial.

(7)	Frozen Puck	CAPITALIZE-FIRST	*CAPITAL	FAITH-CASE
a.	frozen puck	*!		**
b.	 Frozen puck		*	*
c.	Frozen Puck		**!	

A real constraint grammar for natural-language data will be much more complicated, since the number of possible phonological properties is large: it includes the set of phonetic features, plus prosodic elements like syllables and feet. In the next sections, I discuss a variety of Markedness and Faithfulness constraints in more detail.

3.3.1 *Markedness*

Optimality Theory is in many ways a theory of Markedness, but we must take some care in the use of the term. There are marked structures that are so called only because they are rare across the world's languages; there are other concepts that can be considered marked only because they violate some principle or other. Markedness in the OT sense refers only to constraints on the structure of competing candidates, of potential outputs. The evaluation must be able to detect everything there is about each competitor: each segment, the arrangement of features, the organization of prosody. The evaluation simply of structure, regardless of morphological or lexical structure, is carried out by Markedness constraints. The following subsections present some types of output Markedness, grouped by the kinds of structures they detect.

3.3.1.1 *Constraints on structure*

The most basic kind of Markedness constraint is a simple forbiddance of a particular element, often referred to as *STRUCTURE. It is a brute force way of forcing surface inventories; *STRUCTURE constraints can take forms like **u*, forbidding a particular vowel or combination of features, or * σ , forbidding syllables. While a single *STRUCTURE constraint might not have anything substantive to say about phonology, it contributes by having a role among other crucially ranked constraints. In later chapters I appeal to *VOWEL constraints, and in one case, a constraint HIGHVOWEL, which is really a conglomeration of Markedness constraints against every combination of vowel features except those that combine to form the segment *i*.

3.3.1.2 Constraints on Association

The kinds of constraints mentioned so far really only refer to segmental phenomena. If we also consider the notion of organizing segments into higher orders of constituents, other relationships, and constraints over them, should easily be imaginable. Such constraints can be seen to hold over two featural specifications within a single segment, or over the association between segmental and prosodic elements. Restrictions on associations between elements are also referred to as co-occurrence restrictions. Co-occurrence restrictions that have a clearly substantive phonetic motivation are referred to as groundedness conditions (Archangeli & Pulleyblank 1994).

For featural co-occurrence, one could imagine a constraint against a segment being specified as both [+back] and [-round]; in other words, the co-occurrence of these features, or association of both of them to the same segment, is forbidden. Prosodic co-occurrence restrictions are similar, and could rule out the association between a consonant and a coda position, or between a consonant and a mora. Each such restriction has a plausible phonetic motivation; for example, [+round] enhances the perception of [+back] (Stevens 1989), while place features are harder to detect in coda position than in onset position (Benki 2002, Boothroyd & Nittrouer 1988, Ohala 1990).

A very particular kind of associational constraint requires *binarity*; for example, that feet have two constituents (Lieberman & Prince 1977, Prince 1980, Hayes 1981, 1995, Itô 1986). I classify this as an association constraint because it is satisfied by the association between a foot and some other pair of elements, like moras or syllables.

In typical prosodic theory, feet dominate syllables and syllables dominate moras—a dominance relation known as the Prosodic Hierarchy (Selkirk 1980, 1984, McCarthy & Prince 1986). Later in this chapter I suggest a reinterpretation of the Prosodic Hierarchy, along the lines of Everett (1996), who suggests that moraic feet conceivably may be parsed irrespectively of syllable boundaries.

3.3.1.3 Constraints on Adjacency

The use of feet as prosodic elements helps model structures with alternating degrees of prominence. The alternation of strong and weak elements is achieved with additional precision through the use of constraints against lapses and clashes of adjacent stress-bearing units. For example, *LAPSE (Nespor & Vogel 1989, Kager 1993, 1994, Elenbaas & Kager 1999, Green & Kenstowicz 1995) is used to prevent unstressed elements from occurring adjacently, while *CLASH (Nespor & Vogel 1989, Kager 1994, Pater 1995) rules out the adjacency of stressed elements. An early construal of clash avoidance is seen in the structural description of the English Rhythm Rule (Lieberman & Prince 1977), which operates on adjacent strong feet to arrive at alternations of weak and strong elements. For example, the rule applies to compounds like *Árizóna législature*, whose foot structure is *w-s-s-w*, and derives a *s-w-s-w* sequence, yielding *Árizòna législature*.

The use of such principles of adjacency-avoidance dates to the Obligatory Contour Principle (Leben 1973, Goldsmith 1976), which forbids identical elements from occurring adjacently. The OCP is another constraint that predates Optimality Theory, but

finds a happy home in a theory of ranking and violability, as in Suzuki (1997). In its earliest conception, the OCP was a constraint that handled language-specific phenomena, tackling adjacent identical tones in some languages but identical features in others.

Other phenomena are clearly situations of avoiding particular adjacencies, but exact identity is not critical. For example, we might encounter constraints against particular sequences of consonants, but these sequences need not be of identical consonants. Instead, some sequences of consonants that are only somewhat similar might be avoided: those that share features, or those that are close to each other on a scale of sonority.

Adjacency arises in this dissertation mainly in Pohnpeian, where sequences of similar heavy syllables and of stress-bearing moras are avoided. In addition, an unrelated example appears in Woleaian, in which sequences of low vowels are avoided, but I leave that pattern aside in my treatment of that language's reduplicative paradigm.

3.3.2 *Alignment*

In the previous subsection I characterize Markedness constraints as principles that hold over the presence of structural elements as well as their adjacency and association. There is another manner of evaluating structure in the measurement of the linear coincidence of elements. McCarthy & Prince (1993a,b) appeal to edge-orienting principles like AFFIX-TO-FOOT, RIGHTMOSTNESS, and LEFTMOSTNESS, and survey a wide range of research that points to the special status of the edges of constituents like morphemes and prosodic units. There exists, on one hand, a preference for morpheme-boundaries to be well-aligned (or coincide) with the boundaries of syllables and feet, and on the other hand, for affixes to be attracted to the beginnings and ends of words. Such preferences are modeled with the formal mechanism of Alignment, whose general definition is given in (8) below.

- (8) ALIGN (VCat1, E1, 3Cat2, E2): For all elements of the kind Cat1, the edge E1 (right or left) must coincide with the edge (right or left) of an element Cat2.

Alignment introduces much power into a constraint-evaluation system. For example, it can be used to require stems to have initial or final feet, to require affixes to be prefixes or suffixes, to require feet to be parsed iteratively from a specified edge of a word, or to require features to spread throughout a word. Examples of such formulations are provided in (9).

- (9) ALIGN (Stem, R; Foot, R): The right edge of every stem is aligned to the right edge of a foot.
Thus $\sigma(\sigma\sigma)]_{STEM}$ is preferred over $(\sigma\sigma)\sigma]_{STEM}$.

- ALIGN(Affix, L; PrWd, L): The left edge of every affix is aligned to the left edge of a Prosodic Word.
Thus AFFIX-STEM is preferred over STEM-AFFIX
- ALIGN([-ATR], L; PrWd, L): The left edge of every [-ATR] is aligned to the left edge of a Prosodic Word.
Thus [pɛlɪka] is preferred over [pelika].
- ALIGN(Foot, R; PrWd, R): ALLFEETRIGHT
 The right edge of every foot is aligned to the right edge of a Prosodic Word.
Thus is $\sigma(\sigma\sigma)(\sigma\sigma)]_{PRWD}$ preferred over $(\sigma\sigma)\sigma(\sigma\sigma)]_{PRWD}$

While Alignment provides much explanatory and formal power, its place in phonological theory is controversial in three ways. First, it risks language-specificity in a theory of universality; second, it lacks restraint on its application, and third, its interpretation seems to vary between categorical and gradient evaluation. Each issue is problematic because of the potential of *overgeneration* of possible grammars: yet such problems stem partly from the manner in which phonologists exploit Alignment in formal accounts of phonological patterns.

The introduction of Alignment into Optimality Theory creates a problem for the notion of the universality of constraints. For example, Prince & Smolensky (1993) appeal to ALIGN-*um* to model the placement of a left-oriented affix in Tagalog, but this constraint cannot plausibly be universal. Less implausible would be the claim that *um* in Tagalog is simply subject to a more general constraint like ALIGN-PAST-TENSE or ALIGN-AFFIX, both of which are more acceptably universal. Even so, the nature of categories over which Alignment can hold sway remains a contentious issue. I rely on as simple a construal of Alignment as possible: in the analyses of later chapters, I appeal only to the alignment of morphemes in general, of feet within words, and in the case of the Trukic languages, of the placement of lexical stress within words.

Not only is Alignment unrestricted in the categories it can command, but in the edges one can use in its formula. There is a common practice of requiring the two edges of the formula to be the same; that is, that Alignment can only require the matching of right edges with right edges, and of left edges with left edges. Whether this needs to be an inherent property of Alignment is an open question, but I abide by it in hopes that my own use of Alignment remain uncontroversial.

A final issue for Alignment is the notion of gradience of violation. In forms in which two elements are poorly aligned, it is not always agreed whether the relevant Alignment constraint is violated in a categorical or gradient manner. If violation is categorical, then the misalignment simply incurs a single violation. However, in the case of gradient violation, the constraint is able to discern among *degrees* of misalignment. That is, two misaligned candidates can be distinguished in terms of how misaligned they

are—this is the interpretation put forth in McCarthy & Prince (1993a,b). Categorical violation has the advantage of computational simplicity, whereas gradient violation offers greater power, and is at times empirically motivated.

As an example of the computational difficulty of gradient violation, suppose a language requires the right edge of every morpheme to be aligned to the right edge of a foot. Then consider the hypothetical construction *pulafe* + *ta*, in which other constraints result in *(pu.la)(fe.ta)* being the optimal form. The stem in this case, *pulafe*, is clearly misaligned, as its right edge does not coincide with any foot’s right edge. However, formal definitions of Alignment will not be able to pick out *which foot* the stem-morpheme ought to be aligned to, and thus will not be able to tell us how far off the morpheme is from being well-aligned. Arguably, and arbitrarily, one could fathom that a locus from which to measure gradience may be predictable; for example, a morpheme’s misalignment could be measured from the “nearest” appropriate foot boundary. Alternatively, misalignment to the right could be measured in terms of how much farther to the right an element would need to be to achieve good alignment.

A simpler interpretation of Alignment would simply mark the form categorically as incurring one violation, since the stem’s right edge does not coincide with a foot boundary. McCarthy (2002) argues for a ‘quantized’ categorical interpretation of Alignment, as in (10), on the basis that constraints like ALLFEETRIGHT overpredict, whereas Kager (2001) shows their effects can be subsumed by a combination of quantized Alignment and *LAPSE constraints.

(10) ALIGN-BY-SYLL No syllable intervenes between a foot and the right word-edge.

*LAPSE Unstressed moras must not be adjacent

Nevertheless, there are special cases in which Alignment does need to have a gradient interpretation. One such example that appears in this work is Foot-to-Word alignment (ALLFEETRIGHT), defined in (10). In the Ponapeic and Trukic languages, a reduplicative suffix can only be monomoraic, in violation of FOOTBINARITY. I achieve this by ranking ALLFEETRIGHT over FOOTBINARITY. The result is that *(pika)(pik)*, whose first foot is misaligned by one mora, is preferred over *(pika)(piik)*, whose first foot is off by two.

(11)	pika + suffix	*LAPSE	ALLFEETRIGHT	FOOTBINARITY
a.	(pikà)(pík)		**!	
b.	 (pika)(pík)		*	*

If ALLFEETRIGHT had a categorical interpretation, it could not distinguish between *pika-pik* and **pika-piik*; each form would violate it once. Moreover, as I show in Chapter 4, other circumstances lead to the conclusion that the incorrect form cannot be ruled out by *LAPSE, nor on account of its lengthened reduplicant vowel. As a

consequence, FOOTBINARITY would choose the wrong form; this result is avoided only with the gradient interpretation of ALLFEETRRIGHT.

In this case, the target of alignment is the absolute edge of the form. We may then salvage a uniform distinction among alignment constraints: they are interpreted categorically if they require a relationship between two specified elements, but can be gradient if they simply require elements to align to the absolute edge of the form. More generally, perhaps Alignment is gradient only where the universally-quantified unit (the antecedent in any formal instantiation) is a subset of the existential element: for example, feet are subsets of words, features are subsets of syllables or (in the case of harmonic patterns) words.

A caveat for readers of later chapters is that ALLFEETRRIGHT throughout this dissertation counts moras, as Tableau (11) suggests ought to be the case. In addition, this interpretation of ALLFEETRRIGHT is consistent with the nature of Micronesian feet, which directly dominate moraic nodes. Such structures are motivated in individual languages; I expand on this notion at length in Section 3.5.2.

3.3.3 *Correspondence: a formal theory of structure preservation*

Wherever morphemes have segmental exponence, they are subject to the requirements of Correspondence, a formalization of Faithfulness. Correspondence, in a technical sense, is a relationship that holds between strings of segments, where each string represents some morphological entity. Typical correspondence relationships hold between input and output, and between base and reduplicant. Strings that are in a correspondence relationship are under pressure to resemble each other, through the formal constraints of MAXIMIZATION, DEPENDENCE, and IDENTITY, each of which is generally defined in (12) below. A more formal set of definitions is available in McCarthy & Prince (1995).

- | | |
|-------------------------|--------------------------------------------------------------------------------------|
| (12) MAXIMIZATION[E]-AB | Each element E in string A has a correspondent in string B. |
| DEPENDENCE[E]-AB | Each element E in string B has a correspondent in string A. |
| IDENTITY[E, F]-AB | Elements of strings A and B in correspondence have the same value for the feature F. |

In its debut (McCarthy & Prince 1993a), MAXIMIZATION was a constraint that held between base and reduplicant, and was violated by both added and deleted segments. Following the elaboration of Correspondence theory (McCarthy 1995, McCarthy & Prince 1995), however, MAXIMIZATION requires that every element in String A have a correspondent in String B; in other words, MAX only forbids deletion. For example, if String A is an input string and String B an output string, MAX requires all elements of the

input to be present in the output. MAX, in a general sense, holds over segments, but some MAX constraints can hold over subsegmental features like nasality or place.

DEPENDENCE is the converse of MAXIMIZATION: it requires elements of String B to have correspondents in String A. As such it forbids insertion: every element in the output must be present in the input. In a sense, DEP and MAX perform the same function, but with opposite focus.

A third kind of constraint is that of IDENTITY, which requires elements in correspondence to share some value for a particular feature. For example, IDENT-MANNER would require two segments in correspondence to have the same specification for manner of articulation. Originally, IDENTITY was posited as an inviolable property of the function GEN, such that correspondents had to be identical (McCarthy & Prince 1994), but like other principles once considered inviolable, IDENT under OT has assumed a cloak of violability. As a result, IDENT allows segments to be maximized without being precisely faithful: for example, in Pohnpeian, nasal segments appear in the reduplicant whose base correspondents are non-nasal, as in *pam-pap*. The nasal segment satisfies MAX-SEGMENT-BR, but violates IDENT-NASAL-BR.

I introduce additional correspondence constraints in Section 3.4, particularly constraints over Base-reduplicant relationships, and constraints of linear Faithfulness. These are important for the OT mechanism of modeling reduplicative paradigms, which require an understanding of the conflict between Markedness and Faithfulness.

3.4. Basic OT reduplication

In this section I introduce the basic OT model of reduplication, with a focus on two aspects of reduplication: base-reduplicant identity and size requirements. I also acknowledge the reduplicative phenomena of overapplication and the Emergence of the Unmarked, both of which are easily captured in a model that encodes both string identity and output markedness. I close with a discussion of residual issues in the mechanism, some of which are critical enough to guide a reconsideration of the basic model.

3.4.1 Reduplication and correspondence

To return to the basic notion of reduplication, a reduplicative morpheme is one that carries some function or meaning, but its realization is manifest through doubling the base to which it attaches. Thus, imagine a language in which reduplication indicates continuing action for verbs: if a verb *fato* means ‘plant’, *fato-fato* means ‘planting’; likewise, if *pili* means ‘choose’, *pili-pili* means ‘choosing’.

Obviously, there is great regularity in such a language, but formalizing the process is important. One might simply list all reduplicated and unreduplicated pairs, in which case there is no formal statement that captures the regularity of the pattern. That is, there is no explanation for why *fato* is related to *fato-fato* and not to *pili-pili*.

Thus, phonologists and morphologists appeal to formal mechanisms that make one member of the pair predictable from the other. Thus, a speaker need only know the simple form and a rule or generalization, and can easily arrive at both the form and meaning of the reduplicated word.

The Optimality-Theoretic mechanism for doing so is through Correspondence: the strings in correspondence are the Reduplicant and the Base, where *reduplicant* means some substring of the entire output that acts as the output exponence of the morpheme RED. The resemblance between Base and Reduplicant is guaranteed by the activity of MAXIMIZATION, DEPENDENCE, and IDENTITY constraints which hold over the correspondence of the two strings.

- (13) MAX-BR Every segment in the Base has a correspondent in the Reduplicant.
- DEP-BR Every segment in the Reduplicant has a correspondent in the Base.
- IDENT-BR Segments in Base-Reduplicant correspondence are identically specified.

At first glance, it may seem that MAX-BR is the most crucial constraint in the model, and in many ways it acts as a copying function, as Tableau (14) shows. All else being equal, the optimal candidate is one in which the reduplicant *maximizes* the base.

(14)	RED + fato	MAX-BR
a.	fato -fato	
b.	fa -fato	to!
c.	fato	fato!

True faithfulness, however, cannot be achieved without DEPENDENCE and IDENTITY. For example, MAX-BR cannot prevent the reduplicant from containing more than a fully-maximized string. Only DEP-BR can do so, as Tableau (15) shows.

(15)	RED + fato	DEP-BR	MAX-BR
	fato -fato		
	fatopu -fato	pu!	
	fatopuki -fato	puki!	

Furthermore, neither MAXIMIZATION nor DEPENDENCE can prevent inaccurate reduplication, where the reduplicant might be exhaustively correspondent with the base, but with an altered segmental profile. Only IDENTITY can do so, as Tableau (16) shows; note that to clarify the point of this example, segments in correspondence are represented with the same subscript value.

(16)	RED + fato	IDENT-BR	DEP-BR	MAX-BR
a.	f₁a₂t₃o₄ -f ₁ a ₂ t ₃ o ₄			
b.	f₁a₂k₃i₄ -f ₁ a ₂ t ₃ o ₄	**!		
c.	p₁u₂k₃i₄ -f ₁ a ₂ t ₃ o ₄	****!		

3.4.1.1 Advanced correspondence

Now these kinds of correspondence actually have nothing to say about the ordering of segments in the reduplicant: additional functions of correspondence are needed for languages to be able to rule out prefixes like *fota*, *otaf*, and some more bizarre possibilities, all of which make reference to relationships among more than one segment of corresponding strings.

There are three relationships that hold over strings in correspondence which refer to more than one pair of corresponding elements. Aside from having their own correspondents, elements in a string have clearly delineated relationships of linear precedence, adjacency, and autonomy. That is, in a particular string AB, segment A precedes segment B, is adjacent to it, and they comprise separate segments. One can imagine the corresponding string A'B', in which the same properties are true. Each such property can be attributed to formalisms requiring their similarity.

Thus, we can propose that it is necessary for the reduplicant's linear order to correspond to the linear order of the base. This is measurable in the following manner: for each 2-segment substring of the base, the corresponding segments in the reduplicant reflect the same linear order. This requirement is formalized in (17) as the constraint LINEARITY (McCarthy & Prince 1994).

- (17) LINEARITY: For each pair of ordered segments in the base, their correspondents are similarly ordered.

This constraint would be violated by a form like *otaf-fato*, since the prefix's segments are not in the same linear order as their correspondents in the base. However, there are cases in which the apparent segmental linearity (in a descriptive sense) does not seem to be respected, but formal LINEARITY is still satisfied. For example, in a partially reduplicative system, competitors like *fa-fato* and *fo-fato* both satisfy LINEARITY, since in both cases, the two segments of the prefix occur in the same relative order in the base. A full discussion of partial reduplication is found in Section 3.4.2.

As a result, we may distinguish these forms only with some other constraint, one that requires the base and reduplicant to have similar relationships of adjacency. This can be formalized by requiring that adjacent pairs of base consonants have reduplicants that are similarly adjacent. I define such a requirement as CONTIGUITY (or MAX-CONTIGUITY) in (18).

- (18) CONTIGUITY: For each pair of adjacent segments in the base, their correspondents are also adjacent. (i.e., every adjacency in the base has a corresponding adjacency in the reduplicant).
or, The reduplicant is a contiguous substring of the base.

This constraint is a reformalization of the 'no-skipping' condition of melodic association in McCarthy & Prince (1986); I expand on melodies and associations in Section 3.4.2. Something to keep in mind for CONTIGUITY is that it can only make sense

when both strings have the same pairs of adjacent constraints. For example, in a form like *fa-fato*, there is an adjacency of *at* in the base that is absent from the reduplicant, but CONTIGUITY is not violated (it would be if *a* and *t* were both in the reduplicant but occurred non-adjacently). This result is consistent with the formal phrasing of ‘the reduplicant is a contiguous substring of the base’. Another way of thinking about it is to make the reduplicative adjacencies antecedent in the formalism: thus, *for each pair of adjacent segments in the reduplicant, their correspondents in the base are also adjacent*.

This formalism is more precisely called MAX-CONTIGUITY, because it requires the adjacencies of the base to be maximized in the reduplicant. The converse would be DEP-CONTIGUITY, which requires the base to be a contiguous substring of the reduplicant. Such a distinction is of little consequence in this work.

One could imagine rolling LINEARITY and CONTIGUITY together into a single massive constraint (as often happens anyway in the minds of young phonologists), but I leave them separately active as they make differing empirical predictions: only LINEARITY dislikes *otaf-fato*, and only CONTIGUITY dislikes *fo-fato*.

A third string-level relationship concerns the potential of coalescence, which would happen if two or more segments of the base *shared* a corresponding segment of the reduplicant, as in, say, *f^{1,2}f₁at₂o*. In this form, LINEARITY is satisfied, as is CONTIGUITY, since there is but one segment in the reduplicant, and thus no relationships of adjacency or precedence to evaluate. Such a form, then, can only be ruled out with a constraint against multiple correspondence, defined as UNIFORMITY (Lamontagne & Rice 1995, McCarthy 1995, McCarthy & Prince 1995, Pater 1995).

- (19) UNIFORMITY: Every segment in a correspondence relationship has exactly one correspondent.

3.4.1.2 Anchoring

A final correspondence concept is the notion of Anchoring, which is a term that unfortunately has become associated with two interpretations. ANCHOR constraints come in two varieties: those that require prosodic constituents at particular edges of morphemes (such as ALIGN-L, McCarthy & Prince 1993a), and those that require specific edgmost segments to be in correspondence. An example of the former variety is provided in (20a) below. It is, in fact, an instantiation of Alignment, as the translation in (20b) shows.

- (20) a. ANCHOR (Word, Head-Foot-R): Every word has a final foot.
 b. ALIGN (Word, R; Head-Foot, R). The right edge of every word is aligned to the right edge of a foot.

The correspondence variety of ANCHOR, called ANCHORING in McCarthy & Prince (1993a), is important for Base-Reduplicant relationships. This version of ANCHOR, formally, requires that for any two strings in correspondence, the edgmost

(initial or final) segment of one is in correspondence with the edgmost segment of the other.

- (21) ANCHOR-L The leftmost segments of String A and String B are in correspondence.

An effect of ANCHOR is that in partial reduplication, an affix will have an edgmost segment that corresponds to an edgmost segment of the stem. Ideally, a prefix will be anchored on its initial segment (beginning with a segment that corresponds to the first segment of the stem), while a suffix will be anchored on its final segment (ending with a segment that corresponds to the final phoneme of the stem). This, in fact, is the general tendency from Marantz (1982) known as “Edge-in” copying. ANCHOR, however, overpredicts: it is not prevented from requiring the final-segment anchoring for prefixes, or initial-segment anchoring for suffixes, Tableau (22) shows, yet languages with such patterning seem exceedingly rare.

(22)		ANCHOR-LEFT	ANCHOR-RIGHT
a.	☞ pulafeta- pu		*
b.	pulafeta- ta	*!	

Though remedies exist for this overgeneration, I do use ANCHOR in its basic formalization, in the hopes that my arguments can remain consistent with a more restricted sense of the constraint.

3.4.1.3 Some consequences of formal correspondence

With the notion of correspondence established, we can now turn to two empirical phenomena that the output-oriented model of OT handles with elegance: the Emergence of the Unmarked and reduplicative overapplication.

First, the Emergence of the Unmarked refers to the tendency for phonological systems to observe a higher degree of restrictedness in reduplicative affixes. That is, a language may tolerate a particular marked pattern generally, but not in its reduplicative paradigm. A classic example is in Tagalog, where complex onsets are generally tolerated, but not in the reduplicative prefix. Thus, *plato* is acceptable, but reduplicates as *pa-plato* rather than **pla-plato*. Such emergent patterns are easily modeled in Optimality Theory with the ranking schema provided in Figure (23):

- (23) The Emergence of the Unmarked:
MAX-IO » PHONO-CONSTRAINT » MAX-BR

Given that the Phono-constraint outranks MAX-BR but not MAX-IO, it is only high enough to have a role in the form of the affix, and not of the base. In the Tagalog case, the phono-constraint would be something like *COMPLEX (avoid clusters). We refer to the property as *emergent* because languages come in three varieties: ones in which the

Phono-constraint only outranks MAX-BR, ones in which it outranks MAX-IO, and ones in which it outranks neither. Only in the first case is there an emergence; in the others, bases and reduplicants are subject to the same phonological restrictions. There is no possible case where a property emerges only in the base of a reduplicated form but not in unreduplicated forms.

However, this leads to the second reduplicative phenomenon, that of *overapplication*. This is a property of reduplicative systems in which some substring of a reduplicated form undergoes a phonological process even when it does not actually contain the triggering environment. Such a situation can occur, say, if the base contains a trigger, and thus experiences the process, and the reduplicant then copies the result of the process, but not the trigger. A canonical example of overapplication is found in Madurese nasal harmony, which spreads a [+nasal] specification rightward from a nasal segment to any following vowel or glide. (Stevens 1968, 1985; Mester 1986, McCarthy & Prince 1995).

(24) Overapplication in Madurese nasal harmony

- a. /RED + neat/ → ṽāt-nēṽāt ‘intentions’
 b. /RED + soon/ → ɔn-sɔɔn ‘request (noun)’

There are two important things to say about these forms. First, nasality cannot spread to or through obstruents, yet is realized on the prefix in ṽāt-nēṽāt, which has no nasal consonant to trigger the nasality of its vowels. Second, nasality clearly only spreads rightward, as no vowel nasalizes in ɔn-sɔɔn to harmonize with following nasal consonants.

Overapplication processes like this one are predicted by the primacy of base-reduplicant identity constraints. In this case, IDENT-BR for [nas] and *NV (which requires rightward harmony) both outrank *NASALVOWEL. The identity constraint ensures that the reduplicative and base strings of *yat* have the same nasality profile, which given the presence of the nasal consonant *only in the base* still forces nasality in both strings.

A converse of overapplication is underapplication, in which a particular process is resisted in spite of the presence of the trigger. McCarthy & Prince (1995) claim that this is hardly different from overapplication; both phenomena follow from a high rank of base-reduplicant identity.

Each of these kinds of patterns are difficult to encode without a formal mechanism of correspondence and identity. Note, however, that correspondence constraints easily predict both empirical puzzles of this subsection: for both The Emergence of the Unmarked and overapplication, base-reduplicant identity critically outranks some other Markedness constraint. Further, in the case of overapplication, B-R identity also outranks I-O identity. In the next section, we will encounter a particularly problematic gap in the typology of reduplicative overapplication.

3.4.2 *Size requirements*

With the exception of the Tagalog and Madurese examples in Section 3.4.1, I have only discussed hypothetical examples of reduplication in which the entire base is doubled. However, languages that use reduplication in a functional way very often copy only some of the base; this is certainly true of every member of the Micronesian family. Reduplicative theory therefore requires an elaboration of the principles that restrict reduplication to partiality.

The use of tiers of representation in phonology allows for a straightforward way of constraining the size of outputs. For example, McCarthy (1979) uses skeleta of Consonant and Vowel (CV) slots to capture the root-and-pattern phenomenon of Semitic morphology; likewise, Marantz (1982) uses the same mechanism to represent reduplicative morphemes. The act of reduplication combines the skeleton with a copy of the base's segmental tier. Later advancements in representational phonology replace CV skeleta with a more tightly restrained set of prosodic constituents. McCarthy & Prince (1986) argue for a special relationship between reduplicative morphology and prosodic constituents like syllables and feet. In doing so, they direct reduplication theory away from the use of CV-slot skeleta for deriving reduplicative shapes.

Templatic morphology invokes prosodic constituents as morphemes: in this light, the morpheme represented by a reduplicant 'is' a syllable or some such element in a lexically-specified sense. In a derivational framework, the appearance of a template is one of several steps: the reduplicative morpheme is added to the stem, and triggers the complete copying of the stem's segmental melody, which associates to the prosodic morpheme. Unassociated or 'leftover' segments are deleted, and the effect is a reduplicated form with an additional prosodic unit which is filled in with segments copied from the stem. Additional processes may then take place, like resyllabification or segmental phenomena.

In OT, CV and prosodic templates need not exist as lexical entries, and reduplication need not be the two-step process of copy and associate. Instead, the size requirement can simply be an output requirement on the shape of the affix: not a template, but a template constraint (McCarthy & Prince 1993a). Rather than prespecified as a unit of prosody, then, the reduplicative morpheme is phonologically empty, and acquires its prosodic shape through the satisfaction of an output-oriented template constraint. The reduplicant therefore 'is' a syllable in terms of its output form: the templatic constraint requires both edges of the affix to be aligned to a particular prosodic element. In other words, it can be construed as two-sided alignment. Conceptually, phonologists are not limited in their potential templates, as the plausible constraints in (25) show:

- (25) RED = CVC
 RED = CVCV
 RED = C
 RED = CCCC
 RED = σ

However, the target of reduplication is typically a prosodic constituent; practitioners who use such templatic size restrictions do so to subscribe to a simpler (yet certainly powerful) constraint typology. Regardless, the construal of the size restriction as an output requirement obviates the need for lexical entries composed of empty templates waiting to be filled. Instead, one may posit phonologically empty affixes, simply labeled as RED, which are subject to output constraints. Partial reduplication is the result of a size restriction outranking MAXIMIZATION, as Tableau (26) illustrates.

(26)	RED + fato	RED = σ	MAX-BR
a.	fato -fato	*!	
b.	fa -fato		to

3.4.3 Issues

Templatic constraints, however, are problematic in an output-oriented model. Some languages with apparent templatic effects actually have some muddiness in their surface satisfaction of templates—details that are handled in a derivational model by post-association rewrite rules. Sometimes one boundary of a reduplicant seems a little off-kilter, as in Mokilese vowel initial forms like *an.d-an.dip*, in which the reduplicant (traditionally analyzed as a heavy-syllable template) extends beyond the requisite heavy syllable. Numerous means exist for allowing such structures to satisfy templates (or alignment); I return to the issue in Section 3.5, as well as in Chapter 5.

In addition to problems of misalignment, templates cannot handle the full range of reduplicative morphology; some languages seem to use reduplication in a way that does not make use of prosodic constituents. Other cases, like the Pohnpeian durative and the Kosraean iterative, cannot be templatic in an output-oriented sense, because of a ranking paradox that arises in any attempt to do so.

These problems, along with the morpheme-specific nature of templatic constraints—RED=FOOT is hardly any different from ALIGN-*um*—lead me to avoid their use altogether. In fact, I have been able to model a wealth of reduplicative shapes and sizes in Micronesian languages, without ever using any templatic constraint, and even in languages with multiple reduplicative morphemes.

A last problem for the use of templatic constraints is an overgenerative one, known among phonologists as the ‘Kager-Hamilton Problem’, also known as a Conundrum, so named for the two phonologists who, independently of each other, brought it to light.

3.4.5.1 Template Satisfaction and the Kager-Hamilton Conundrum

The Kager-Hamilton problem is a typological puzzler that follows from the interaction of template constraints and the theory of correspondence. In particular, the templatic model predicts the existence of languages that overapply the template, resulting in the base reflecting the reduplicant’s size requirement. Templatic-backcopy, as the

phenomenon is otherwise known, is predicted by the ranking schema in (27), which fits the general profile of a relationship of overapplication.

(27) Templatic back-copy: MAX-BR » RED-SIZE-REQUIREMENT » MAX-IO

McCarthy & Prince (1999) illustrate this with the hypothetical language Diyari' ("Diyari-prime"), using a foot-sized requirement. With the ranking MAX-BR » RED=FOOT » MAX-IO, a language that generally allows stems to be longer than single feet suddenly truncates its base in the reduplicative context:

(28)	tilkarpu	MAX-BR	RED=FOOT	MAX-IO
a.	tilkarpu -tilkarpu		*!	
b.	tilkar -tilkarpu	pu!		
c.	 tilkar -tilkar			pu

This is only a problem because such a system has not yet been found. We are thus stuck with the task of explaining the absence of the phenomenon; one option is to claim that such languages are simply unlikely to develop—this is an approach I use in later chapters to explain other gaps, but only small gaps within a restricted typology of a single language family. Global gaps are more difficult to treat with the same deflection; instead, McCarthy & Prince (1999) propose a means of avoiding the prediction of templatic backcopy by abandoning the template constraint. This approach is known as Generalized Template Theory, and I return to it in Section 3.6; may it suffice for now that Generalized Template Theory replaces the morpheme-specificity of the template with general requirements like ALIGN-MORPHEME-FOOT, which in turn only emerge in the reduplicative context. Strategies for limiting the size of the reduplicant without templates include prosodic alignment (Spaelti 1997, Walker 1998) and Compression (Hendricks 1999). Thus we trade the risk of ill-gotten overapplication for the elegance of a prosodic Emergence of the Unmarked.

3.4.5.2 Other issues

The template is not the only theoretical tool to be questioned. Indeed, the morpheme-specificity of templates is also something that is held against many other tools of OT, spawning a trend toward pruning the theory of extraneous theoretical constructs. Thus, one may come across attempts at pruning the model of the special category RED; distaste for its special status may be an unintended consequence of its use as a cover term for whatever morpheme a particular language uses reduplication to indicate. Still, one could allow a category RED, but forbid constraints that require Alignment of it, Anchoring of it, Templatic Satisfaction of it, or Correspondence to it.

Some of these constructs are, in fact, disposable; for example, the use of Templatic Satisfaction is avoided altogether throughout this dissertation. Other constructs are less easily forgotten. Alignment is a tricky one, especially in languages that use more than one reduplicative morpheme. Nevertheless, it is possible to derive

morpheme ordering in some cases as a function of well-formedness rather than of morpheme-specific alignment, as I argue for the Trukic languages, notably Woleaian in Chapter 7. Moreover, there are morphologists who would prefer that we phonologists leave that work to them. The alignment of reduplicants specifically to prosodic categories like feet or syllables, however, is something that I avoid, on the same grounds as for avoiding templates.

Correspondence relationships that directly invoke the reduplicant seem the most difficult to relinquish. There are hints of it, as in the model of Existential Faithfulness (Struyke 2000) and similar approaches suggested by Fitzgerald (1998). In addition, Nelson (1999) offers a means of restricting Anchor's application. In this work, I adhere to the notion of Base-Reduplicant Correspondence, in the form of Maximization, Dependence, and Identity. I also rely on a basic correspondence notion of edge-anchoring. Nevertheless, I do not rule out the possibility that my analyses may conform to an existentialist approach.

3.5. *Prosody and representation*

Though reduplication is the focus of later chapters, a great deal of argument relies on a very precise interpretation of phonological representations: not simply of segments and their sequencing, but their association to prosodic elements like syllables and feet. Indeed, the most important element throughout is the mora, a prosodic constituent that represents rhythmic weight; in other words, quantity. The representations I use are not to be considered arbitrary; instead, each is the result of compromise among competing constraints on the organization of output structure. In this section, I introduce the constraint mechanisms that drive the organization of strings of segments into higher orders of prosody, beginning with the mora.

3.5.1 *Moras and representation*

The prosody of Micronesian languages is quantity-sensitive, where the relevant measure of quantity is the mora. This may seem like a sweeping generalization at this point, but the mora is crucial to the analysis of each language throughout this dissertation. Indeed, I would have nothing to say were the mora not a concept.

Early characterizations of the mora (Jakobson 1969, McCauley 1972, Halle & Vergnaud 1979, Clements & Keyser 1983)¹ construe it as formal unit of prosody, a sub-syllabic element, of which “light syllables have one, and heavy syllables have two”. Its place in representational theories predates the Prosodic Hierarchy, which one must keep in mind when one recalls that Clements & Keyser do not place the mora as a daughter of the syllable node.

Such a relationship arises later as part of the Prosodic Hierarchy. Selkirk (1980, 1984), Itô (1986, 1989), and Hayes (1989) situate the mora within this hierarchy, which places elements in increasing order of dominance: segments are dominated by moras,

¹ The earliest reference to the mora in the Micronesian literature I have found is in Sohn & Bender (1973), a grammar of the western Trukic language Ulithian.

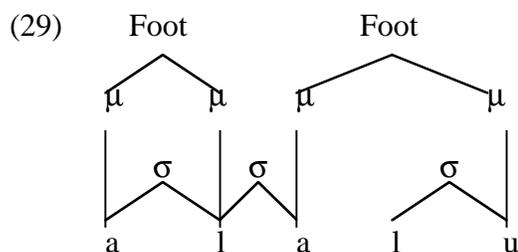
moras by syllables, and syllables by feet. From this hierarchy follows the principle of Syllable Integrity: since elements can only branch downward, foot boundaries must co-occur with syllable boundaries. In other words, a syllable cannot “belong” to more than one foot. A hard line of thought exists for this matter, holding that even in a world of constraint violability, Syllable Integrity is inviolable. Nevertheless, there are situations in which I argue for a relaxation of Syllable Integrity and the Prosodic Hierarchy. In particular, I argue that feet in any Micronesian language can be represented as composed strictly of moras, independently of syllable structure.

3.5.2 *Moras and feet*

The notion of representing a moraic tier separately from a syllabic tier does arise in Clements and Keyser (1983), whose model of syllable structure includes the σ -tier, the CV-tier, and the nucleus tier. They propose that the nucleus projection is “not a subconstituent of the syllable, but an independent prosodic unit on a separate plane of representation” (p. 17). Elsewhere, they define *mora* as “any member of the CV tier dominated by the node ‘nucleus’ on the nucleus display” (p. 80; where *display* refers to a set of associated tiers).

Measuring the foot binarity in terms of moras is motivated in Arabic prosody (McCarthy & Prince 1990, Ussishkin 2000), but given the Arabic respect for Syllable Integrity, the notion of strictly moraic feet is not necessary. However, there are numerous facts, in Micronesian and elsewhere, which suggest that moraic feet, freely of syllables, should be representationally possible. For example, Pohnpeian (Rehg 1993) and Gilbertese (Blevins & Harrison 1999) build moraic stress feet in polysyllabic words, but regardless of syllable boundaries: this could only be so if the intermediacy of syllables between moras and feet is relaxed.

Moreover, Halle & Vergnaud (1987) suggest that such a situation is inherently and logically possible, but only in situations where feet are directly parsed from moras, that is, where moras are the relevant timing unit and foot-binarity is met with moras and not with syllables. Everett (1996) finds support for this claim in the Amazon language Banawá. As an Austronesian example, I offer in Figure (29) a representation of Mokilese *allalu*, built with moraic feet. Since syllables in this case are not subsidiary to feet, it is possible to construe good alignment of morphemes to feet in this form. The geminate *ll* can still be ambisyllabic, but even serving as the onset of the second syllable, it need not associate to the second foot.



The representation in Figure (29) is inconsistent with the Prosodic-Hierarchical principle of Syllable Integrity, which holds that syllables cannot associate to more than one foot. In (29), the second syllable is associated to two segments, *l* and *a*, that belong to different feet. Notice, however, that the syllables of this representation do not associate directly to feet; it is thus not the case that any foot boundary ever actually occurs “within” a syllable, because no syllable branches upward to two different feet. Even so, syllable boundaries and foot boundaries are misaligned in this representation—which suggests that a violable formalization of Syllable-Integrity is certainly possible, such as ALIGN-FOOT-SYLLABLE, defined in (30).

- (30) ALIGN-FOOT-SYLLABLE The edge of every foot is aligned to the edge of a syllable.

In later chapters, I provide more representations like Figure (29), but with syllable nodes placed on a tier below the segmental tier. I do so only to reduce the visual clutter of such figures, and do not intend to imply that syllables are sub-segmental in a representational sense.

There is an additional consequence of representations with strictly moraic feet: logically, gradient alignment constraints like ALL-FEET-RIGHT and ALL-FEET-LEFT, in languages with moraic feet, should be evaluated in terms of moras and not syllables. That is, the degree of foot-misalignment should be measured by the number of moras between the foot boundary and word edge. This is the interpretation I use in the analytical chapters that follow. Further, though Everett (1996) does not appeal to foot-alignment constraints of this kind, the iterative left-to-right footing in Banawá suggests that the same interpretation is warranted there.

3.5.2 *Moras and syllables*

Now while I argue for a relaxation of the Prosodic Hierarchy, and for strictly moraic feet, I do not reject the syllable as a relevant unit in Micronesian phonology, and as a relevant predictor of segment moraicity. I have introduced the mora as a measure of phonological quantity. In the pre-Hierarchy sense, ‘heavy syllables have two’ moras; alternatively, in the moraic-feet languages of Micronesia, *binary feet* have two moras, while unary feet have one. Only some segments project moras, however, and syllable position bears directly on this.

All vowels contribute weight, and thus project moras. Wherever vowel length is contrastive, it must also be the case that at least some moras are specified underlyingly. The underlying moraic specification of short vowels is something I am not concerned with, and their monomoraic surface form could easily be something that follows from constraints.

Consonants, however, only sometimes contribute weight. As a Micronesian generality, coda consonants tend to project moras, while onsets tend not to. I portray this as a generality since there are non-moraic word-final codas in many Micronesian languages, and moraic geminate onsets—particularly in the Trukic subgroup. Both

should be considered marked cases, driven by overriding concerns; for example, final extrametricality is a consequence of final vowel deletion, while initial gemination is a necessary morphological exponent. Otherwise, consonant moraicity is a direct function of coda position. Thus it should be clear why, even if feet are strictly moraic, syllable structure remains important, for a consonant must know if it is a coda to decide whether (independently of other factors) it ought to project a mora.

The formal relationship between coda position and moraicity is captured by the principle of WEIGHT-BY-POSITION (Hyman 1985, Zec 1988, Hayes 1989), defined in (31). Though the notion predates Optimality Theory, it is easily incorporated as a violable, rankable constraint.

(31) WEIGHT-BY-POSITION Consonants in coda position are moraic.

Thus in the Mokilese form *andip*, the *n* is necessarily a coda, and therefore must be moraic, or it violates WEIGHT-BY-POSITION. In Micronesian languages, medial coda consonants are nearly always moraic, which can be attributed to the activity of WEIGHT-BY-POSITION. An alternative way for forms like *andip* to satisfy WEIGHT-BY-POSITION would be to avoid parsing the *n* as a coda—but this results in **a.ndip*, with an illegal onset cluster. Medial consonant sequences thus force the creation of codas, and in turn encourage the projection of moras.

Restrictions on moraic consonants are commonplace in Micronesian languages, and though I often refer to *coda* restrictions, they are actually restrictions on the features that can associate to moraic consonants. One such constraint is CODACONDITION (Itô 1986); despite the fact that its true locus of application is *moraic* consonants, it still uses the syllabic notion of the onset.

(32) CODACONDITION Moraic consonants with their own [place] are forbidden.

For the Micronesian languages that respect CODACONDITION as formalized in (32), the only coda consonants that may freely have their own place features are word-final ones. Consonants can only do this if they are immune to CODACONDITION, which can come about in at least three ways. First, word-final consonants could simply be an exception to CODACONDITION, in which the case the constraint would only evaluate non-final coda consonants.

Two other analytical options both involve extrametricality, by preventing word-final consonants from projecting moras: either through direct requirement or independently motivated extrametrical structures; in either case, final consonants satisfy CODACONDITION by virtue of not being moraic. The required-extrametricality approach amounts to the use of a constraint forbidding moraic final consonants, which must outrank WEIGHT-BY-POSITION to achieve final extrametricality. McCarthy & Prince (1990) and Ussishkin (2000) use this for modeling the extrametricality of Arabic final consonants. Alternatively, some independently motivated constraint might force

extrametricality. I use this approach, for it attributes violations of WEIGHT-BY-POSITION to constraints which are otherwise active in the grammar—including CODACONDITION.

In fact, non-moraic coda consonants violate WEIGHT-BY-POSITION not only out of respect for CODACONDITION, but also to satisfy the lenition constraint FREE-VOWEL, defined in (33). FREE-VOWEL is suggested by Prince & Smolensky (1993) as a means of formalizing the deletion of final vowels in Lardil nominatives. Though it may seem arbitrarily descriptive, I return to a fuller discussion of FREE-VOWEL in Chapter 9, a discussion of its manifestation across the Trukic subgroup, but acknowledge it now as a constraint that motivates post-tonic deletion of word-final short vowels and shortening of word-final long vowels.

(33) FREE-VOWEL Word-final vowels are deleted.

We can now witness how these constraints can motivate moraicity for medial codas, and not for final ones. Consider again the Mokilese form *andip*, whose underlying stem is something like *andipi* (c.f. *andipi*, its transitive variant). With no suffix to preserve the underlying final vowel, the output must undergo word-final lenition to satisfy FREE-VOWEL.

However, for the segmental string *andip*, I can imagine four ways of assigning moras to the coda consonants *n* and *p*: to one or the other, to both, or to neither. In fact, no representation in which *p* is moraic is tolerable, since this would violate CODACONDITION—there is no following consonant for it to share [place] features with.

This leaves two plausible structures: one with a moraic *n*, and one in which neither coda consonant is moraic. Now WEIGHT-BY-POSITION can emerge to choose the proper output, the one with a moraic *n*, which violates it less. I summarize this in Tableau (34); the candidate (34c), devoid of moraic codas, loses to (34d), which violates WEIGHT-BY-POSITION minimally.

(34)	andipi	FREEVOWEL	CODACONDITION	WEIGHT-BY-POSITION
a.	$\begin{array}{cccc} \mu & \mu & \mu & \mu \\ & & & \\ a & n & d & i . p & i \end{array}$	i!		
b.	$\begin{array}{cc} \mu\mu & \mu\mu \\ & & & \\ a & n & d & i & p \end{array}$		p!	
c.	$\begin{array}{cc} \mu & \mu \\ & \\ a & n & d & i & p \end{array}$			np!
d.	$\begin{array}{c} \text{☞} \\ \begin{array}{ccc} \mu\mu & \mu \\ & & \\ a & n & d & i & p \end{array} \end{array}$			p

Not all moraic consonants attain their quantity through the default activity of WEIGHT-BY-POSITION, however. There are some instances of word-initial gemination, notably in the Trukic languages. Chuukese words like *ffal* and *ccih* have long initial consonants, and such forms are not subject to a vowel lengthening augmentation that apparently achieves a bimoraic minimum (compare *fuur* ~ *furon*). It thus seems that the initial consonants in words like *ffal* provide a mora towards the bimoraic minimum, since the vowels can remain short and monomoraic.

I represent such forms as having moraic consonants, even though they are not in coda positions. Such a representation is fine by WEIGHT-BY-POSITION since the constraint is a requirement on consonants in coda position: as such it is vacuously satisfied by any moraic onset consonant. Nevertheless, such onsets are subject to the formal CODACONDITION, which holds strictly over moraic consonants. Even so, they satisfy CODACONDITION, since their place features *are* associated to an onset position.

A last issue with initial geminates is actually the converse of WEIGHT-BY-POSITION. In fact, there is a case for formalizing not only that coda consonants be moraic, but that moraic consonants be codas. While this may seem like a redundant addition, it would certainly arise in the Marshallese reflex of initial gemination, where stem-initial geminates are relieved with excrescent vowels, as in *yebbeweli* ‘expand’.

3.5.4 *Moras and morpheme boundaries*

Part of the rationale for the details of constraint definition in the previous subsections lies in the relationship between prosodic quantity, as represented by the mora, and the structure of geminate consonants. When we turn to specific cases of reduplication, we will encounter a very general requirement holding over the association between morphemes and feet. While the generality of this relationship is a great strength, it requires great deftness to ensure the account is consistent with reduplicative instances of gemination.

The hurdle lies in the non-morpheme-specific nature of the morpheme-foot requirement, for while it helps drive many reduplicative size requirements, it also holds over non-reduplicative morphemes. As a consequence, wherever morpheme boundaries appear to fall anywhere but at a prosodic boundary, an explanation is justifiably expected.

In fact, such apparent misalignment is typically coincidental with consonant gemination. There are numerous situations in which gemination appears to obscure the placement of morpheme boundaries with respect to prosodic ones. In Trukic languages, initial morphological gemination, as in *fala* → *ffal*, makes it appear as if affixation forces misalignment, as does prefixing, which creates a curious medial geminate, as in *faffal*. Likewise, Mokilese offers two funny cases: CVC- prefix reduplication in which the consonants are homorganic, which produces forms like *kak-kak*, and vowel-initial prefixing, which produces forms like *allalu*.

Each case can be understood as having segment-level morpheme boundaries, and given claims of the association between segments and prosodic elements like syllables, moras, and feet, we can evaluate the alignment of these forms with each such constituent

type. I elaborate on each subpattern in individual chapters, but as a preview I propose here that each of these reduplicated forms is well aligned.

Such an interpretation is possible when we tease apart the notions of *morpheme* and *morpheme boundary*. All morphemes have some phonological exponence, but not all such exponence is segmental. Conversely, throughout this dissertation I claim that every segment, in a sense, “belongs” to a morpheme. In other words, every segment is morphological, but not every morpheme is segmental. For the sake of simplicity in the argument, even epenthetic segments are represented as belonging to morphemes: I assume this to allow morpheme-initial or –final epenthetic segments to exist without risk of misaligning the morpheme. For example, imagine a reduplicative morpheme (*pod-*), which comprises an exact foot, and whose final segment is an epenthetic vowel. I analyze such morphemes as being well-aligned to feet, at both ends. This good alignment is possible if the final segment “belongs” to the morpheme, a sensible assumption given the notion of B-R correspondence. That is, DEPENDENCE is violated by any segment in the reduplicant that has no correspondent in the base. If an epenthetic segment were not to be considered part of the reduplicative morpheme, then there would be no way of preventing violations of DEPENDENCE.

Regardless, I adhere to a model of prosodic organization in which morpheme boundaries exist only on the segmental tier, while the boundaries on higher-order tiers are, inherently, syllable boundaries and foot boundaries. Wherever a particular constraint invokes the notion of a morpheme boundary, it only has a substantial effect if that morpheme has segmental exponence. Thus, any morpheme whose exponence is strictly suprasegmental is considered not to have true morpheme boundaries that can be evaluated by edge-sensitive constraints. Consequently, initial geminates like in Chuukese *ffal* are well-aligned.

In addition, the non-hierarchical composition of moraic feet allows medial geminates also to be well-aligned. In the case of Chuukese *faf-fal* and Mokilese *kak-kak*, the morpheme boundary falls within a two-root geminate, and is well aligned. In Mokilese *all-alu*, the morpheme boundary follows an onset, but this onset is not footed, and so this form is also well-aligned. The significance of this result will arise in Chapter 5, in which I expand on the role of alignment in Mokilese. However, before diving into particular analyses, I offer in the next section an overview of a generalized means of deriving reduplicative prosody.

3.6. *The generalized prosody-morphology interface*

All our tools, I hope, are laid out. In the chapters that follow, I characterize the reduplicated words of Micronesian languages as morphologically complex entities, represented with strings of segments organized into syllables on one tier and into feet (via moras) on another. I use constraints to predict the best realization of such strings and the best means of parsing them into prosodic constituents. In this section, I offer a preview of the generalized prosody-morphology interface.

3.6.1 Generalized templates

In Section 3.4.5, I introduce the Kager-Hamilton problem, and use it (along with morpheme-specificity) as grounds for abandoning template constraints. I add here that replacing two-sided templates with Alignment, as suggested in Kennedy (2000) and Crowhurst (2002), is not a sufficient means of avoiding either theoretical problem. The following tableau illustrates the problem; it repeats Tableau (28), but with an alignment constraint ALIGN-RED-FOOT (a one-sided template) instead of the traditional double-sided template.

(35)	RED + tilkarpu	MAX-BR	ALIGN-RED-FOOT	MAX-IO
a.	(tilkar)(pu-til) (karpu)		*!	
b.	(tilkar) -(tilkar)pu	pu!		
c.	 (tilkar) -(tilkar)			pu

The one-sided template constraint still makes the typological prediction of the Kager-Hamilton problem, since the base in this case reflects the reduplicant-specific size requirement. Moreover, the undesirable specificity of the constraints remains, putting it in the same league as ALIGN-*um*.

The alternative model is to replace ALIGN-RED-PCAT with a general ALIGN-MORPHEME-PCAT. The reduplicative segmental string will still be subject to this requirement, since it represents a morpheme. As a result, the ‘special relationship’ between reduplicants and prosody is more simply a case of the emergence of ALIGN-MORPHEME-FOOT in the reduplicative context.

(36)	RED + tilkarpu	ALIGN-MORPHEME-FOOT
a.	(tilkar)(pu-til) (karpu)	*!
b.	 (tilkar) -(tilkar)pu	

We may characterize this as an Emergence of the Unmarked kind of relationship since languages that have apparent templatic effects, like Pohnpeian, do not have a global respect for ALIGN-MORPHEME-FOOT. That is, non-reduplicative concatenations need not satisfy it; as a result, its position is crucially below MAX-IO and above MAX-BR.

In addition, the flip side of size requirement—size restriction—can also be handled in a general sense; by restricting the overall size of any complex word. Devices like ALLFEETRIGHT can be used for this purpose: if a language has an emergent respect for ALIGN-MORPHEME-FOOT, and minimizes violations of ALLFEETRIGHT, it will never reduplicate more than one foot. Imagine a two-foot stem *pulafeta*: single and double foot reduplicants can both satisfy ALIGN-MORPHEME-FOOT, but the choice between them is made by ALLFEETRIGHT.

(37)	RED + pulafeta	ALIGN- MORPHEME-FOOT	ALLFEET RIGHT
a.	(pula)(feta) -(pula)(feta)		***!
b.	 (pula) -(pula)(feta)		**

A last point to be made is to show how this approach avoids the Kager-Hamilton problem. In the general model, reduplicant-specific requirements are replaced with the tandem of ALIGN-MORPHEME-PCAT and ALLFEETRIGHT. If we then replace the template in the Kager-Hamilton overapplication schema with these two constraints, an interesting thing happens. Yes, a stem like *tilkarpu* will reduplicate as ***tilkar-tilkar***, as Tableau (38) shows:

(38)	RED + tilkarpu	MAX-BR	ALIGN- MORPH-FOOT	ALLFEET RIGHT	MAX-IO
a.	(tilkar)(pu-til) (karpu)		*!	**	
b.	(tilkar) -(tilkar)pu	pu!		**	
c.	 (tilkar) -(tilkar)			*	pu

What is critical is that *tilkarpu* could never appear unreduplicated in this system, given the rank of ALLFEETRIGHT over MAX-IO. Unlike a true Kager-Hamilton situation, this language simply restricts *all* morphemes to single feet. In contrast, the templatic conundrum is that a language could allow *tilkarpu* unreduplicated, but overapply its reduplicative template. Tableau (38) more accurately illustrates normal application; the unwanted typology of templatic back-copy is avoided by the removal of reduplicant-specific size requirements from the theory. This is the exact mechanism by which I model the prosodic realization of reduplicants in Micronesian languages, beginning with the Pohnpeian durative in the following chapter.

4. A stress-based approach to Pohnpeian (Ponapean) reduplication

4.1. Pohnpeian

This is the first of three chapters which together provide an opportunity to test the Confluence hypothesis in the Pohnpeic subgroup of the Micronesian family. This chapter focuses on the reduplicative paradigm of Pohnpeian, itself a complex pattern and one that is for phonologists perhaps the most well-known of the languages in this work. An immediate goal is simply to develop a coherent constraint hierarchy for the Pohnpeian system, a challenging task given a number of phonological traits found in the language. For completeness, I leave no subpattern untreated, but in the larger picture, what is important in this chapter is simply the set of crucial constraint rankings that make Pohnpeian distinct from its sisters and cousins—as well as those that they share. The following chapter develops an account of the paradigms of two other Pohnpeic languages, Mokilese (Harrison 1976) and Pingilapese (Good & Welley 1989). Chapter 6 wraps the analyses together with a discussion of unique phonological traits of each language, with the specific goal of illuminating how the findings of each analysis support the claims of Confluence identified in Chapter 1.

Pohnpeian, usually called Ponapean in the literature, uses a reduplicative prefix on verbs to express repeated action, and a suffix to derive intransitive forms, as is typical of Micronesian languages. Rehg and Sohl (1981) refer to the prefix's function as the *durative* aspect, and its bimoraic form and aspectual function resemble the progressive prefix of its sister languages Mokilese (Harrison 1976) and Pingilapese (Good & Welley 1989). The prosodic shape of the prefix in these languages is suggestive of a templatic operation; Mokilese and Pohnpeian comprise the entirety of the argument for using the heavy syllable ($\sigma_{\mu\mu}$) as a target of reduplication in pre-Optimality Theory Prosodic Morphology (McCarthy & Prince 1986); Pingilapese is not included in their argument since the data were not yet published.

A number of analyses have been proposed for the Pohnpeian durative, with particular attention its interaction with “Quantitative Complementarity” (Levin 1985, Itô 1986, McCarthy & Prince 1986, Richards 1995) and a process of nasal substitution (Blevins and Garret 1993, Spaelti 1997, Lombardi 1996, Takano 1996, Davis 1997, 2001). Many of these works are struck with the problem of attempting to use a prosodic template to model the shape of the prefix, which is particularly problematic in Optimality Theory.

The notion of the prosodic template survives in early Optimality Theory as the template constraint (McCarthy & Prince 1993). In this chapter, I present an Optimality-Theoretic account of the Pohnpeian prefix without reference to any morpheme-specific prosodic template, similar to models proposed by Spaelti (1997) and McCarthy & Prince (1999). The shape of the reduplicant is shown to follow from independent constraints of stress assignment, allowable coda consonants, and foot structure. Since these constraints are not specific to the reduplicative morpheme, the pattern is a prosodic example of the Emergence of the Unmarked. I also show how the same grammar predicts the form of the reduplicative suffix. An advantage to the use of a non-templatic approach is that we

can characterize all reduplication in the Micronesian family as a function of the same set of general constraints; in contrast, templatic approaches need different templates for each language in the family.

This chapter is organized as follows. In Section 4.2, I establish some general facts about Pohnpeian phonology and provide some informal generalizations about its reduplicative system which are highly suggestive of the requirements of principled constraints. Several of these generalizations are lacking in previous treatments of the pattern. In Section 4.3, I present an Optimality-Theoretic approach that capitalizes on the stress-driven characterization of the pattern. In this approach I first analyze consonant-initial forms to achieve a basic framework, and then apply the account to stems with internal hiatus, with initial vowels, and with syllabic nasals. I then show in Section 4.4 how a templatic account is not possible without resorting to serial devices like multiple evaluations or Sympathy Theory. I conclude by applying the constraint hierarchy to the reduplicative suffix, showing that its shape follows from the same system without amendment.

4.2. *Pohnpeian phonology*

Several general aspects of Pohnpeian phonology require some comment before discussing the language's reduplication pattern. These include the moraicity of consonants, the assignment of stress, and the global deletion of stem-final vowels.

Medial coda consonants are moraic, whereas final consonants are not, as suggested by several facts. First, medial coda consonants provide quantity to reduplicative suffixes. As we will see in Section 4.2.1, word-final codas do not add any quantity to the form.

Second, there are restrictions for Place and sonority on medial coda consonants, but not on final ones, which is consistent with an analysis that requires all and only non-final codas to be moraic. Medial coda consonants must be either a homorganic nasal or the first member of a sonorant geminate. Hence, we see forms like ***dun**-dune* 'attaching' and ***pam**-pap* 'swimming' with homorganic medial nasal codas, and ***rer**-rer* 'sawing' with a sonorant geminate. However, ***din**-dilip* 'mending thatch' (not ****dil**-dilip*) shows that oral sonorants cannot be moraic if they are not part of a geminate, and ***kaŋ**-kak* 'be able' (not ****kak**-kak*) shows that only nasals may precede obstruents, which simply cannot be geminated. Word-final consonants, however, show no such restrictions, as the stems *pap*, *kak*, *dilip*, and *rer* all show. As a result, we can attribute the restrictions on medial codas actually as restrictions on moraic segments; final consonants, by virtue of being non-moraic, are immune to these restrictions.

Given that Pohnpeian obeys these restrictions on moraic consonants irrespective of reduplication or any other particular morphological domain, it is possible to formalize them at this point as phonological constraints. I attribute the restrictions of sonority and place to two separate constraints, CODA CONDITION (Itô 1989) and *MORAIC OBSTRUENT, which are both defined in (1) below. Crucially, each applies to moraic consonants, not simply to any coda.

(1) CODACONDITION Moraic consonants must not have their own (place) specification. (Rules out *m.n*, *m.t*, *l.d*)

*MORAICOBSTRUENT (*OBS/MORA) Moraic elements must be sonorant.
Rules out *t.t*

The claim of extrametricality for word-final consonants is not merely a stipulation on structure; it can follow from formal constraints. In addition to CODACONDITION, the distribution of moraic consonants is also a function of the constraint WEIGHT-BY-POSITION, defined in (2), which requires coda consonants to be moraic, as I show in Tableau (3).

(2) WEIGHT-BY-POSITION Coda consonants are moraic.

CODACONDITION rules out any form of **pam-pap* that has a moraic final consonant, such as the form (3a). A second version is possible in which neither coda is moraic; this fully satisfies CODACONDITION, but incurs two violations of WEIGHT-BY-POSITION, whereas the optimum *pam-pap* violates it only once. Because of this result, I consider all medial codas to be moraic and all final ones not to be.

(3)	pap	CODA CONDITION	WEIGHT-BY- POSITION
a.	$\mu \mu \mu \mu .$ $(\underline{\text{pam}})(\text{pap})$	p!	
b.	$\mu \mu .$ $(\underline{\text{pam}})(\text{pap})$		mp!
c.	$\mu \mu \mu .$ $(\underline{\text{pam}})(\text{pap})$		p

There are formal and empirical reasons for appealing to two separate constraints. On formal grounds, each is simply a co-occurrence restriction, forbidding the association of a kind of segment to a mora. In contrast, a constraint that combines the effect of the two seems heavy-handed and difficult to formalize—it would forbid all but placeless sonorants in mpraic positions. On empirical grounds, however, unreduplicated forms in Pohnpeian show a flexibility with respect to *MORAICOBSTRUENT, but not to CODACONDITION. For example, *MORAICOBSTRUENT is violated in borrowings such as *nappa* ‘Chinese cabbage’ (Japanese) and *kiassi* ‘catcher’ (Japanese, from English) (Rehg & Sohl 1981: 37). Furthermore, some derived native forms allow violations of *MORAICOBSTRUENT; for example, *weiddi* ‘walk downwards’ > *weid* ‘walk’; *sautte* ‘just filthy’ > *saut* ‘filthy’. Such forms have variants with intervening vowels, as in *weididi* and *sautete*. In contrast, CODACONDITION does not show the same flexibility; the borrowings and derived forms just shown respect it, but affixation must also. For

example, the prefix *nan* ‘in’ assimilates to a following consonant, as in *nampar* ‘trade wind season’ and *nankep* ‘inlet’.

An understanding of Pohnpeian stress is also of importance for any analysis of the pattern, given its sensitivity to syllable weight, and thus potentially to foot structure. A common assumption of footing in Pohnpeian is that feet may contain up to two syllables, only one of which may be heavy (e.g., McCarthy & Prince 1986). Thus, a form like *du-duup* would comprise a single foot, (*du-duup*).

However, the distribution of stress in Pohnpeian eliminates this as a possible footing of this form. According to Rehg (1993), stress in Pohnpeian works in the following manner: primary stress falls on the last mora of a phrase, and secondary stress strictly on preceding alternate moras, where only vowels and glides may be moraic. The form *du-duup* would thus comprise two feet, as in (*du*)-(*duup*). The present analysis relies on the additional claim, corroborated in subsequent treatments of Pohnpeian rhythm (Rehg 2003), that non-final coda consonants (which can only be sonorant) may also be moraic, and must be counted in the assignment of stress. It is unclear at this point how a stress-bearing moraic nasal would sound in comparison to a non-stress-bearing one, but Rehg’s argument is that a number of rhythmic processes make use of moraic feet at an abstract level; in other words, some moraic nasals behave phonologically as if they bear stress, even if there is no clear acoustic correlate.

In formal terms, I will attribute the strict alternation of stress to the constraint *CLASH (Nespor & Vogel 1989, Kager 1994, Pater 1995), as defined in (4) below. A high rank of *CLASH will ensure that stressed moras never occur adjacently. Additional means are needed to ensure that *unstressed* moras also not occur adjacently, particularly in forms with three or more moras. I attribute this to the constraint *LAPSE (Nespor & Vogel 1989, Kager 1993, 1994, Elenbaas & Kager 1999, Green & Kenstowicz 1995), also defined in (4). To account for the rightward pressure of footing, I also introduce ALLFEETRIGHT, which ensures feet will occur at the right edge of words, and adjacently before the final foot.

(4) *CLASH Stressed moras must not be adjacent.

*LAPSE Unstressed moras must not be adjacent.

ALLFEETRIGHT The right edge of every foot is aligned to the right edge of a word.

Assess a violation for every mora occurring between the right edge of every foot and the right edge of the word.

I illustrate the effect of these two constraints in Tableau (5). Their primary effect is ensure a strict alternation of stressed and unstressed moraic elements – in this case, only the vowels. They do not distinguish forms with final stress, as in (5a) *sakànakán*, from forms with penultimate stress, as in (5b) *sàkanákan*. This distinction follows from ALLFEETRIGHT.

(5)	sakanakan	CLASH	LAPSE	ALLFEET RIGHT
a.	sa(kàna)(kán)			*
b.	(sàka)(nákan)			**!
c.	(sàka)na(kán)		*!	**
d.	sa(kà)(nákan)	*!		**

A last aspect of Pohnpeian to acknowledge is the deletion of stem-final vowels. More specifically, stem-final short vowels are deleted, and stem final long vowels are shortened. I attribute this to the constraint FREE-VOWEL, defined in (6). Prince & Smolensky (1993) use a similar FREE-VOWEL in their analysis of Lardil, where the constraint is restricted nominative forms. In Pohnpeian and other Micronesian languages, FREE-VOWEL has a more global effect, applying regardless of morphological categories.

(6) FREE-VOWEL The vowel following the primary stress is not voiced.

Although it formally requires devoicing, FREE-VOWEL will have the effect of deleting word-final short vowels and shortening word-final long vowels in Pohnpeian. I define the constraint in terms of devoicing because some languages satisfy it by devoicing final vowels; this is true of Woleaian. Languages like Pohnpeian, however, satisfy FREE-VOWEL more vacuously by deleting final vowels rather than devoicing them. I return to a discussion of FREE-VOWEL in Chapter 9, where I provide a plausible account of its genesis and its formalization.

FREE-VOWEL is critical mainly in Section 4.5, where I discuss the denotative suffix. I assume all forms summarized in the following section satisfy FREE-VOWEL at the surface. Further, in Section 4.3, where I analyze the durative prefix, I do not consider competitors that violate FREE-VOWEL.

4.2.1 *The durative: descriptive summary*

We are now in a position to examine the Pohnpeian durative in greater detail. I organize the data first as it is presented in Rehg & Sohl (1981) and McCarthy & Prince (1986); that is, forms are grouped by number and weight of syllables in the stem. This allows for several immediate generalizations to be made, for it appears at first that the shape of the reduplicant depends on the heaviness of nearby syllables. Because of the role of syllable weight in the pattern of quantitative complementarity, it is important to clarify that syllables are heavy if they have a long vowel or are closed by a medial coda consonant, which will always be sonorant and moraic.

Table (7) provides examples of the various shapes of the Pohnpeian prefix for monosyllabic stems. The generalization for monosyllables is fairly simple: they receive reduplicative prefixes of the opposite weight of the stem prefixes. That is, heavy syllables like *duup* have monomoraic prefixes, while light syllables like *pa* and *dod* have

bimoraic. This is the phenomenon of Quantitative Complementarity; a similar pattern of complementarity is found in Sanskrit.

Note that a light-syllable stem like *pa* is probably *paa* underlyingly, and shortens because of the inviolability of FREE-VOWEL. Indeed, as acknowledged in the previous section, I assume that all stems obey FREE-VOWEL, and as a result, each stem in (7) is derived from a lexeme that is one vowel longer. Regardless, it is the surface weight that matters in the observance of Quantitative Complementarity.

(7)	The Pohnpeian durative for monosyllables: * $\underline{\mu}$ -L, * $\underline{\mu}\underline{\mu}$ -H		
	$L \rightarrow \underline{\mu}\underline{\mu}$ -L	pa → paa -pa	‘weave’
		dod → don -dod	‘frequent’
		tep → tepi -tep	‘begin’
	$H \rightarrow \underline{\mu}$ -H	duup → du -duup	‘dive’
		miik → mi -miik	‘suck’
		pei → pe -pei	‘fight’

Stems consisting of single light syllables show three means of achieving bimoraicity, depending on the form of the stem. Forms ending in short surface vowels achieve bimoraic reduplicants by lengthening their vowel, as in *paa-pa*. Consonant-final light syllables present the risk of creating illicit medial consonant sequences in their reduplicated forms. Such sequences are avoided in two possible ways: if the reduplicant’s final consonant is homorganic with the stem’s initial consonant, a process of nasal substitution occurs, as in *don-dod* and *din-dil* ‘penetrate’. However, if the consonants are not homorganic, the bimoraic prefix surfaces as CVCV, separating the second consonant from the stem with an epenthetic vowel, as is the case for *tepi-tep*.

There are thus three means of achieving bimoraicity: with long vowels, moraic nasal consonants, and epenthetic vowels. All three patterns are also attested in polysyllables that have light initial syllables. For example, homorganic consonant sequences can occur as long as the first consonant is nasal, as in *din-dilip*; otherwise, a non-homorganic sequence is avoided with epenthesis, as in *sipi-siped*; note that the second prefix vowel is epenthetic and not a copy of the second stem vowel. Vowel lengthening is seen in stems with adjacent vowels, as in *lii-liaan*; as with *sipi-siped*, this form does not copy the second stem vowel. I provide more examples of reduplicated polysyllables in Table (8).

(8)	The Pohnpeian durative for light-initial polysyllables: * $\underline{\mu}$ -LL, * $\underline{\mu}$ -HL		
	$LL \rightarrow \underline{\mu}\underline{\mu}$ -LL,	dune → dun -dune	‘attach in a sequence’
	<i>subject to CODACOND</i>	dilip → din -dilip	‘mend thatch’
		siped → sipi -siped	‘shake out’
	$LH \rightarrow \underline{\mu}\underline{\mu}$ -LH...	liaan → lii -liaan	‘outgoing’
		riaala → rii -riaala	‘to be cursed’
		katoore → kati -katoore	‘to subtract’

Polysyllabic stems with initial heavy syllables are more complicated, since Quantitative Complementarity seems to consider only the weight of second syllable, a sort of “Long-Distance Quantitative Complementarity.” If the second syllable is light, as in *duupek*, the reduplicant can be heavy, as in ***duu***-*duupek*. If the second syllable is heavy, however, the reduplicant must be light, as in ***to***-*tooroor*. I provide examples of heavy-initial polysyllables in Table (9).

(9) The Pohnpeian durative for heavy- σ -initial polysyllables:

<i>*$\mu\mu$-HH, *$\mu\mu$-HLL, *μ-HL</i>		
<i>HL</i> → $\mu\mu$ - <i>HL</i>	<i>duupek</i> → <i>duu</i> - <i>duupek</i>	‘starved’
	<i>meelel</i> → <i>mee</i> - <i>meelel</i>	‘true’
	<i>nɔɔrok</i> → <i>nɔɔ</i> - <i>nɔɔrok</i>	‘greedy’
<i>HH</i> → μ - <i>HH</i>	<i>waantuuke</i> → <i>wa</i> - <i>waantuuke</i>	‘count’
	<i>tooroor</i> → <i>to</i> - <i>tooroor</i>	‘be independent’
	<i>maasaas</i> → <i>ma</i> - <i>maasaas</i>	‘cleared of vegetation’
<i>HLL</i> → μ - <i>HLL</i>	<i>soupisek</i> → <i>so</i> - <i>soupisek</i>	‘be busy’

An apparent exception to the generalization of long-distance Complementarity, however, is seen in trisyllabic stems like *soupisek*, which are sequences of a heavy syllable followed by pairs of light syllables—sequences of vowels with falling sonority are syllabified together as heavy syllables. Such forms receive light-syllable prefixes, as in ***so***-*soupisek*. If the reduplicant’s weight is opposite to the weight of the stem’s second syllable, we should expect **sou-soupisek*, just like ***duu***-*duupek*. This suggests that the weight of the second syllable is not actually what determines the reduplicant’s quantity for polysyllabic stems.

In fact, the reduplicant is short in exactly the following circumstances: wherever the stem has syllables of the form H, HH, or HLL. In each case, there is an initial heavy syllable and an even number of moras in the stem; it is therefore enlightening to organize the data by number of moras rather than by syllable weight. Table (6) is organized in this manner, and the extra generalization becomes clear: monomoraic prefixes appear only with some even-numbered stems. The system does avoid sequences of adjacent heavy syllables, but only among a subset of stems. If the stem has an odd number of moras, it always has a bimoraic prefix.

(10)	<i>1 mora</i>	<i>2 moras</i>	<i>3 moras</i>	<i>4 moras</i>
<i>2-mora prefix</i>	<i>paa</i> .pa	<i>dun</i> .du.ne	<i>duu</i> .duu.pek	<i>rii</i> .ri.aa.la
	<i>tepi</i> .tep	<i>din</i> .di.lip	<i>mee</i> .mee.lel	<i>kati</i> -katoore
	<i>don</i> .dod		<i>lii</i> .li.aan	
<i>1-mora prefix</i>		<i>du</i> .duup		<i>to</i> .too.roor
				<i>so</i> .sou.pi.sek

The relevance of both syllable weight and word length (measured in moras) for predicting the reduplicant’s quantity suggests that a higher order of prosody is relevant.

In particular, the distinction of odd-numbered and even-numbered stems suggests a role of foot structure, and in fact, a motive for the bimoraic prefix can be found in the Pohnpeian stress system, which assigns stress to alternating moraic segments. Table (11) shows how the stress rule applies to each of the different kinds of reduplicated forms. There is now another generalization which is missing in previous approaches: the reduplicant always includes exactly one stressed mora. (Stress-bearing nasals are capitalized).

(11)		<i>1 mora</i>	<i>2 moras</i>	<i>3 moras</i>	<i>4 moras</i>
	<i>2-mora prefix</i>	pàa .pá tèpi .tép dòn .dód	duN .du.né diN .di.líp sipi -sipéd	dùu .dùu.pék mèe .mèe.lél li .li.aán	rii .ri.àa.lá kati -katòoré
	<i>1-mora prefix</i>		dù .duúp		tò .toò.roór sò .soù.pi.sék

It is important to note that the distinction between 1-mora and 2-mora prefixes here relies on Rehg's characterization of Pohnpeian rhythm (Rehg 2003), which allows non-final sonorant coda consonants to be moraic, and counts them in the assignment of alternating stress, even to the point of allowing stress to associate to a nasal consonant. As mentioned in Section 4.1, it is not clear how a stress-bearing moraic nasal would sound in comparison to a non-stress-bearing one, but reduplication is an example of how moraic nasals behave phonologically as if they bear stress.

Furthermore, the generalizations predict stress to occur on excrescent vowels, as in *sipi-sipéd*. I will make the additional claim that the assignment of alternating stress skips medial moraic nasals and excrescent vowels – this claim is borne out in the analysis in Section 4.3. It offers the advantage of characterizing all feet in Ponapean as left-headed. It also predicts all reduplicative prefixes to have stress on their initial moraic segment. Table (12) shows how this additional claim of stress placement affects the forms of Table (11); subsets that are unaffected are shaded out.

(12)	Adjusted stress placement	<i>1 mora</i>	<i>2 moras</i>	<i>3 moras</i>	<i>4 moras</i>
	<i>2-mora prefix</i>	pàa .pá tèpi .tép dòn .dód	dùn .du.né dìn .di.líp sipi -sipéd	dùu .dùu.pék mèe .mèe.lél li .li.aán	rii .ri.àa.lá kati -katòoré
	<i>1-mora prefix</i>		dù .duúp		tò .toò.roór sò .soù.pi.sék

The observations about the mora count and stress pattern allow for a characterization of the data with a pair of potentially conflicting generalizations. First, the reduplicant and stem each include at least one stress-bearing mora, and second, stressed moras cannot be adjacent. For odd-numbered stems, then, some stress will necessarily occur on the initial mora of the stem; a single-mora prefix for *pa* and *duupek*

would have to be either unstressed, as in **pa-pá* and **du-dùu.pék*, or non-alternating, as in **pà-pá* and **dù-dùu.pék*. The only way to assign stress to the reduplicant and maintain the alternating stress pattern is thus to create a bimoraic reduplicant, even if the result is a pair of adjacent heavy syllables, as in *dùu.dùu.pék*.

For even-numbered stems, there is no risk of creating non-alternating stress, since the initial mora of the stem will necessarily be unstressed. Even so, bimoraic prefixes still appear, as long as the first stem syllable is light, as in *dùn-du.né* and *ri-ri.àa.lá*. The bimoraic prefix in these cases cannot be attributed to the pressure for alternating stress seen in odd-numbered stems, since **dù-duné*, for example, has alternating stress *and* a stressed mora for the reduplicant. It is therefore necessary to appeal to some other motivation for bimoraic prefixes with even-numbered stems, such as a requirement for binary feet. This requirement is not met if the result would be adjacent heavy syllables, so forms like *(dù)-(duúp)* appear with monomoraic feet.

In the following section, each of these generalizations will be shown to follow from the activity of formally defined Optimality-Theoretic constraints.

4.3 A stress-driven OT account

In this section I formalize the generalizations of Section 4.2 as a set of violable Optimality-Theoretic constraints. I first treat odd-numbered consonant-initial stems to illustrate the avoidance of stress clash, then treat even-numbered stems to show the emergence of weight-clash avoidance and foot binarity. I then apply the analysis to stems with internal hiatus, with initial vowels, and with initial syllabic nasals, treating the complications of each in turn.

The generalizations in Section 4.3 suggest that the Pohnpeian reduplicant is best characterized as the consequence of constraints whose priorities are ranked. The alternating stress pattern follows from *CLASH, but the requirement of initial stress for the reduplicant is not as clearly deriveable from a single constraint. I attribute the assignment of stress to the reduplicant to the constraints ALIGN-MORPHEME-FOOT and PARSE- μ , as defined in (13). For a discussion of Alignment, see §3.3.2.

- (13) ALIGN-MORPHEME-FOOT Morpheme boundaries are aligned to foot boundaries. (McCarthy & Prince 1993)
(Where morpheme boundaries are measured at the segmental level)

PARSE- μ Moraic segments are footed.

ALIGN-MORPHEME-FOOT requires morpheme boundaries to line up to the edges of feet. Note that a morpheme's right and left edges need not align to the *same* foot; the effect of ALIGN-MORPHEME-FOOT is just that feet cannot branch across morpheme boundaries, so the reduplicant is parsed as its own foot and thus with its own stressed mora. Note that I do not specify a direction of alignment here; it would be redundant to do so since poor rightward alignment for a precedent morpheme would necessarily co-

occur with poor leftward alignment of a subsequent one. In other words, we could pick ‘left’ or ‘right’ as a direction and it would predict the same results. The constraint more generally is intended to detect morpheme boundaries that occur within feet; particularly, between the two moraic segments of a binary foot.

Another way of guaranteeing stress for the reduplicant would be to appeal to the MORPHEME-TO-STRESS principle (Fitzgerald 1998), but unlike ALIGN-MORPHEME-FOOT, this would not differentiate *(du-du)(ne) from (dun)(dune).

PARSE- μ serves the additional role of preventing the reduplicant to go unfooted, which would allow a vacuous satisfaction of ALIGN-MORPHEME-FOOT. For example, in a form like *pa-(pá), the morpheme boundary does not occur within a foot; only PARSE- μ can rule such a form out.

With these two constraints, it will not be possible to generate a monomoraic, unstressed reduplicant. PARSE- μ will not allow an initial unfooted mora in the reduplicant, such as in *pa-(pá) or *te-(tép), and ALIGN-MORPHEME-FOOT will not allow a reduplicant’s footed mora to occur in the same foot as the stem. I illustrate this effect first for monomoraic stems in Section 4.3.1.

4.3.1 Stems with odd numbers of moras

Treating odd-numbered stems first, ALIGN-MORPHEME-FOOT, PARSE- μ , and *CLASH are sufficient to predict *paa-pa*, as shown in Tableau (14). The only possible parsing of the output is (14c) (paa)(pa), in which the reduplicant is a bimoraic syllable. The vowel lengthens not to achieve a binary foot, but to avoid the stress clash that (14a) *(pà)(pá) incurs. Note that this analysis allows monomoraic feet like (pa) to appear, which suggests a low ranking of FOOTBINARITY.

(14)	pa + DURATIVE	CLASH	PARSE- μ	ALIGN MORPH-Ft
a.	(pà).(pá)	*!		
b.	<u>pa</u> .(pá)		*!	
c.	(<u>pa</u> .pá)			*!
d.	 (pàa).(pá)			

These constraints predict a similar result for other monomoraic stems like *tep* and *dod*; in both cases the optimal form is one with a bimoraic prefix. However, instead of lengthening the vowel, parallel to *paa-pa*, the second consonant is copied. Bimoraicity is then achieved with epenthesis in *tepi-tep*, but nasal substitution in *don-dod*. Nevertheless, the system is not rich enough to distinguish different kinds of bimoraic prefixes, such as (tepi)(tep), *(tep)(tep), and *(tee)(tep). CODACONDITION, motivated in (1) to handle Pohnpeian restrictions on moraic consonants, will rule out forms like *(tep)(tep), but not *(tee)(tep). As a result, it is necessary to add several Correspondence constraints to the set, which are defined in (15). For a discussion of Correspondence, see §3.3.3 and §3.4.1.

- (15) MAX-BR Every segment in the Base must have a correspondent in the Reduplicant.
- DEP-BR Every segment in the Reduplicant must have a correspondent in the Base.

The role of CODACONDITION and MAX-BR is illustrated in Tableau (16). Various non-bimoraic prefixes like *te-* and *teepi-* are ruled out by *CLASH and ALIGN-MORPHEME-FOOT, while CODACONDITION and MAX-BR ensure that (16d) *tepi-tep* is chosen over its bimoraic competitors. The rank of MAX-BR over DEP-BR will choose *tepi-tep* over (16e) **tee-tep.*, while (16f) **tep-tep* is prevented by the rank of CODACONDITION over MAX-BR.

(16)	tep + DURATIVE	CLASH	PARSE- μ	ALIGN MORPH-Ft	CODA COND	MAX BR	DEP BR
a.	(tè).(tép)	*!				p	
b.	te.(tép)		*!				*
c.	(te.tép)			*!		p	
d.	 (tè.pi).(tép)						*
e.	(tèè).(tép)					p!	
f.	(tèp).(tép)				*!		

The same hierarchy can correctly rule out **(doo)(dod)* with MAX-BR, and **(dodi)(dod)* with DEP-BR, but not **(dod)(dod)*, which has an obstruent geminate that satisfies CODACONDITION. To achieve the pattern of Nasal Substitution, I appeal to *MORAIC-OBSTRUENT, which is seen in Section 4.2 to be necessary to prevent medial moraic obstruents. Spaelti (1997) and Davis (2001) assert that Nasal Substitution is actually quite complicated; it is avoided if the consonants are coronal and the first is obstruent while the second is nasal, as in *nete-net*. Spaelti's approach is to develop finer degrees of Base-Reduplicant identity, whereby *t* can nasalize before another *t* but not before *n*. Davis adopts a Sympathy-Theoretic account to capture the same exceptionality. At face value, *MORAIC-OBSTRUENT cannot handle the substitution-resistant forms like *nete-net*, but I assume that its use is compatible with both approaches to such forms.

At this point, it is important to point out that DEP-BR and *MORAICOBSTRUENT outrank any constraint that would prevent Nasal Substitution. I formalize such a constraint with Correspondence in (17) below.

- (17) IDENT-NASAL: Segments in correspondence have identical nasal specification.

The effect of *MORAICOBSTRUENT in ruling out **dod-dod* is illustrated in Tableau (18); ranked above IDENT-NASAL, it ensures that Nasal Substitution occurs.

Furthermore, the rank of DEP-BR over IDENT-NASAL prevents the epenthetic vowel of (18d) **dodi-dod*.

(18)	dod + DURATIVE	*OBS/ MORA	MAX BR	DEP BR	IDENT NASAL
a.	(dòd).(dód)	*!			
b.	(dòo).(dód)		*!		
c.	\mathcal{F} (dòn).(dód)				*
d.	(dò.di).(dód)			*!	

An additional complication is that (18b) **doo-dod* need not actually violate MAX-BR, if it is possible for the initial reduplicative consonant to correspond to both consonants of the stem. This is exactly the situation I propose in Chapter 5 for Pingilapese. The form can still be ruled out in Pohnpeian by WEIGHT-IDENT, which is violated by vowels in correspondence that differ in their length. WEIGHT-IDENT can rank lower than DEP-BR and allow *paa-pa*. We will see below in Sections 3.4 and 6.2 that such a low rank is preferable.

The introduction of Nasal Substitution as a means of satisfying *MORAICOBSTRUENT requires some care so as not to allow the process to over-apply. In particular, it must only be able to apply with homorganic sequences; it is then necessary to prevent Nasal Substitution from resolving potential non-homorganic sequences. The hierarchy in (18) does not yet prevent *tep* from reduplicating as **ten-tep*, which satisfies both CODACONDITION and *MORAICOBSTRUENT. This form can be prevented with IDENT-PLACE-BR as in (19), which ensures that nasal substitution only occurs where adjacent segments are homorganic.

(19) IDENT-PLACE-BR: Segments in correspondence have identical [place].

The form **ten-tep* violates IDENT-PLACE-BR only if the *n* and *p* are in correspondence; an alternative candidate in which they are not would be ruled out by MAX-BR. I illustrate the role of IDENT-PLACE-BR in Tableau (20); ranked over DEP-BR, it rules out the place-changing prefix of **ten-tep* in favour of the epenthetic form *tepi-tep*.

(20)	tep + PROGRESSIVE	IDENT PLACE	*OBS/ MORA	CODA COND	MAX BR	DEP BR	IDENT NASAL
a.	\mathcal{F} (tè.pi).(tép)					*	
b.	(tèe).(tép)				p!		
c.	(tèp).(tép)		*!	*			
d.	(tèn).(tép)	*!					*

The system thus works as follows for monomoraic stems: the prefix is always bimoraic, in order to guarantee alternating stress. Wherever the prefix can copy a second consonant, it does so, as in *tepi-tep* and *don-dod*. If the prefix's second consonant is not homorganic with the following consonant, an epenthetic vowel appears, as in *tepi-tep*. Otherwise, Nasal Substitution applies, as in *don-dod*.

The bimoraic quantity of the prefix follows from the constraints *CLASH, PARSE- μ , and ALIGN-MORPHEME-FOOT. They have the same effect on trimoraic stems like *duupek*: a monomoraic prefix would either violate *CLASH, as in (21a) *(dù)(dùu)(pék), or ALIGN-MORPHEME-FOOT, as in (21b) *(du.dù)(u.pék). A trimoraic prefix, as in (21d) *(duù)(pe.dù)(u.pék), would also violate ALIGN-MORPHEME-FOOT. The best candidate is thus (21c) (duu)(duu)(pék), with a bimoraic prefix, as summarized in Tableau (21).

(21)	duupek + DURATIVE	CLASH	PARSE- μ	ALIGN MORPH-Ft
a.	(<u>dù</u>).(dùu).(pék)	*!		
b.	<u>du</u> .(dùu.pék)		*!	
c.	(<u>du</u> .dù)(u.pék)			*!
d.	☞ (<u>duù</u>).(dùu).(pék)			
e.	(<u>duù</u>).(pe.dù)(u.pék)			*!

The rank of *CLASH, PARSE- μ , and ALIGN-MORPHEME-FOOT forces the output of Tableau (21) to contain a pair of adjacent heavy syllables. Thus, any constraint against such an adjacency must be ranked below this set, and as the next section shows, may only emerge in stems with even numbers of moras.

4.3.2 Stems with even numbers of moras

Turning to an account of the reduplication of even-numbered stems, two challenges emerge: first, we will need a means of preventing adjacent heavy syllables, and second, we will need to limit the size of the reduplicant to a single foot. For example, reduplicated forms like *(duù)(duúp) and *(duù)(pì)(duúp) need to be prevented, since both fully satisfy CLASH, PARSE- μ , and ALIGN-MORPHEME-FOOT, as does the actual (dù)(duúp). The three-foot form can be ruled out by AllFeetRight, but I introduce a constraint to prevent adjacent heavy syllables in (22).

(22) *HH Heavy syllables must not be adjacent.

The constraint *HH will forbid adjacent heavy syllables like those in *(duù)(duúp); this is the constraint to which we can attribute the phenomenon of Quantitative Complementarity. It resembles other constraints against adjacent similar elements, such as the Obligatory Contour Principle (Goldsmith 1976, McCarthy 1986, Myers 1993) and the Generalized OCP (Suzuki 1997), but rather than hold over features or segments, it holds over a unit of prosody. Yip (1995) proposes NOECHO, a syllable-

level avoidance of adjacent identical syllables for Javanese, and a similar pattern is evident in Tawala (Hicks Kennard 2002), a distant Austronesian relative of Pohnpeian.

The constraint *HH is preferable to a constraint against syllable-level stress clash because *HH clearly distinguishes between *du-duup* and **duu-duup*. It is not clear that a syllable-clash constraint, ruling out adjacent stressed syllables, could do the same, without duplicating the heavy-syllable component of the adjacency.

It remains an open question whether *HH applies specifically to heavy syllables or more generally to identical feet. This second interpretation is possible given the moraic foot structure of Pohnpeian, by which only vowels and moraic consonants are footed. In **duu-duup*, then, the feet are actually just *(uu)(uu)*, and are clearly both identical and adjacent.

Aside from parsing a monomoraic reduplicant, another alternative would separate heavy syllables with additional reduplicative material, as in **(dùu)(pì)(duúp)*, which satisfies *HH. This form can be ruled out with ALLFEETRIGHT, which holds over the entire form, but its emergent effect is to maintain a single foot for the reduplicant. This is only possible if ALLFEETRIGHT is given a gradient interpretation, for if it were categorical, **(dùu)(pì)(duúp)* and the attested *(du)(duup)* would equally violate it.

The rank of PARSE- μ over ALLFEETRIGHT ensures that more than one stress can occur in a polysyllabic form. Since *HH can be ranked below the undominated set of constraints, it is low enough not to spoil the output of Tableau (21) above, *(dùu)(dúu)(pék)*, which violates it.

The inclusion of ALLFEETRIGHT and *HH in the system thus accounts for the light prefix of even-numbered stems like *duup*, as summarized in Tableau (23)¹. Unlike odd-numbered stems, *duup* can receive a monomoraic prefix without violating *CLASH, and *HH forces just such a result. The ranking of ALLFEETRIGHT over MAX-BR is motivated by (23d) **(dùu)(pì)(duúp)*.

(23)	duup + DURATIVE	PARSE- μ	ALLFEET RIGHT	*HH	MAX BR
a.	du .(duúp)	*!		*	p
b.	(dùu) .(duúp)		**	*!	p
c.	(dù) .(duúp)		**		p
d.	(dùu) .(pì).(duúp)		*****!		

¹ An odd candidate not included in Tableau (19) is the form **dupi-duup*, which satisfies both *HH and MAX-BR. I rule out this form with a version of CONTIGUITY, formalized as follows:

QUANTITATIVE CONTIGUITY: Strings in correspondence are quantitatively contiguous.

This constraint rules out structures in which corresponding strings have pairs of segments that differ by their intervening quantity. For example, the *d* and *p* of the prefix *dupi-* are separated by a monomoraic vowel, and are thus closer together than their correspondents are in the stem *duup*, so the form *dupi-duup* violates QUANTITATIVE CONTIGUITY. Ranked above *HH, QUANTITATIVE CONTIGUITY also prevents forms like **dupi-duupek*.

A similar effect of *HH is shown for the heavy-initial polysyllable *tooroor* in Tableau (24). Since the stem has an even number of moras, the prefix may occur as a light or heavy syllable and carry stress without incurring a stress-clash violation. As a result, *HH can emerge to rule out the heavy prefix.

(24)	tooroor + DURATIVE	LAPSE	ALLFEET RIGHT	*HH	MAX
a.	<u>to</u> .(toó).(roór)	*!	**	*	roor
b.	☞ (tò).(toó).(roór)		****	*	roor
c.	(toò).(toó).(roór)		****	**!	roor
d.	(tò).(roò).(toó).(roór)		12!	**	r

Interestingly, the situation is exactly parallel for *soupisek*: the prefix could be monomoraic without violating *CLASH. Moreover, since sequences of vowels with falling sonority are syllabified together as heavy syllables, a bimoraic prefix is avoided: *HH emerges to rule out the heavy prefix of **soo-soupisek* or **sou-soupisek*. In other words, for polysyllables, the weight of the second syllable does not matter; what is crucial is the number of moras in the stem. This result is shown in Tableau (25).

(25)	soupisek + DURATIVE	LAPSE	ALLFEET RIGHT	*HH	MAX
a.	<u>so</u> .(soù).(pisék)	*!	**	*	upisek
b.	☞ (sò).(soù).(pisék)		****	*	upisek
c.	(soò).(soù).(pisék)		****	**!	upisek
d.	(sò).(u.pì).(soù).(pisék)		12!	**	sek

The fact that *HH can have an effect in *to-tooroor* and *so-soupisek* but not in *duu-duupek* follows from its rank below *CLASH and ALIGN-MORPHEME-FOOT. Thus, the apparent phenomenon of Long-Distance Quantitative Complementarity, in which the prefix is sensitive to the second stem syllable's weight, is better characterized as an emergence of *HH in even-numbered stems. In other words, the prefix is sensitive to the weight of the first syllable and to the number of moras in the stem. As a consequence, the form *so-soupisek* is not exceptional to Long-Distance Quantitative Complementarity. Because of the stem's four moras and initial heavy syllable, its prefix must be monomoraic.

As we turn to light-initial bimoraic stems like *siped* and *dune*, we face another problem: we will need a means of guaranteeing a bimoraic prefix for both forms, while restricting the amount of copied material, as neither *sipi-siped* nor *dun-dune* faithfully reduplicates its second stem vowel.

The constraints used so far do prevent some unwanted candidates; for example, although *(du-du)(né) satisfies ALLFEETRIGHT better than the actual form (duN)(duné)

does, it has two morphemes in the same foot, violating the higher-ranked ALIGN-MORPHEME-FOOT. Meanwhile, ALLFEETRIGHT prevents $*(\underline{si})(\underline{pe.d\grave{i}})-(si.p\acute{e}d)$, which fully satisfies MAX-BR, but which has one more foot than the optimal output.

The system is not rich enough to choose between $(\underline{si\pi i})-si(p\acute{e}d)$, with a default vowel, and the more faithful $*(\underline{sipe})-si(p\acute{e}d)$. In fact, MAX-BR predicts the faithful copying of the second vowel; hence, $*(\underline{si.pe})-(si.p\acute{e}d)$ would emerge over $(\underline{si.\pi i})-(si.p\acute{e}d)$, and $*(\underline{d\grave{u}ne})(dun\acute{e})$ would emerge over $(\underline{d\grave{u}n})(dun\acute{e})$. To prevent the more faithful form from being chosen, there must be an intervening constraint that helps restrict the size of the reduplicant. Such a constraint is defined in (26) as ALL- σ -RIGHT, which is violated by each non-final syllable.

(26) ALL- σ -RIGHT All syllables are final.

Crucially, I will show that the optimal form $(\underline{si\pi i})-si(p\acute{e}d)$ incurs fewer violations of ALL- σ -RIGHT than $*(\underline{sipe})-si(p\acute{e}d)$. Abstractly, the true optimum is represented with three syllables. Furthermore, we can formally prevent a similar structure in the more faithful representation, forcing it to have four syllables.

That is, there are two possible representations of $*(\underline{sipe})-si(p\acute{e}d)$. In one representation, each vowel is the nucleus of a syllable, and as a result, the form contains four syllables. The other representation contains only three syllables: the reduplicative sequence *pe* is not syllabified. I rule out this representation with the constraint PARSE-VOWEL, as defined in (27).

(27) PARSE-VOWEL All correspondent vowels are syllable nuclei.

Only epenthetic vowels can resist syllabification and satisfy PARSE-VOWEL. Consequently, the default vowel in $\underline{si\pi i}-siped$ can be non-syllabic, which reduces the form to three syllables. As long as PARSE-VOWEL and ALL- σ -RIGHT outrank MAX-BR, the less-faithful form $(\underline{si.\pi i})-si(p\acute{e}d)$ will be chosen instead of $*(\underline{si.pe})-si(p\acute{e}d)$. I summarize this in Tableau (28).

(28)	siped	PARSE VOWEL	ALL- σ - RIGHT	MAX BR
a.	$\begin{array}{c} (\mu \quad \mu) \quad \mu \quad (\mu) \\ \quad \quad \quad \\ \text{s i p i} - \text{s i p é d} \\ \backslash \quad \backslash \quad \backslash \quad \backslash \\ \sigma \quad \sigma \quad \sigma \quad \sigma \end{array}$		**	ed
b.	$\begin{array}{c} (\mu \quad \mu) \quad \mu \quad (\mu) \\ \quad \quad \quad \\ \text{s i p e} - \text{s i p é d} \\ \backslash \quad \backslash \quad \backslash \quad \backslash \\ \sigma \quad \sigma \quad \sigma \quad \sigma \end{array}$		***!	d
c.	$\begin{array}{c} (\mu \quad \mu) \quad \mu \quad (\mu) \\ \quad \quad \quad \\ \text{s i p e} - \text{s i p é d} \\ \backslash \quad \backslash \quad \backslash \quad \backslash \\ \sigma \quad \sigma \quad \sigma \quad \sigma \end{array}$	e!	**	d

An interesting thing occurs in the form *dune*, since the first and second consonants are homorganic. The durative of *dune* is *dun-dune*, which ALL- σ -RIGHT evaluates equally with **du-duné* and **duu-dune*, because they all have the same number of syllables. Now MAX-BR can have an emergent effect, since *dùn-duné* is the most faithful of the three. In addition, DEP-BR can rule out an epenthetic form like *(*dùni*)-*du(né)*, since the reduplicant can have a moraic nasal consonant. These effects are summarized in Tableau (29).

(29)	dune + DURATIVE	ALL- σ - RIGHT	MAX BR	DEP BR
a.	(<i>dù</i>)-(duné)	**	ne!	
b.	(<i>dùu</i>)-(duné)	**	ne!	
c.	(<i>dùni</i>)-(duné)	**	e	*!
d.	\leftarrow (<i>dùn</i>)-(duné)	**	e	
e.	(<i>dùne</i>)-(duné)	***!	e	

It ought to be noted that including ALL- σ -RIGHT in the system will not spoil the result for *tepi-tep* in Section 4.3.1, which it evaluates as equal with **tee-tep*, since both forms incur single violations of it. The form *tepi-tep* can be represented with two syllables, in satisfaction of PARSE-VOWEL, in the same way that *sipi-siped* can have three. The competitor **tee-tep* can then be thrown out by a lower-ranked MAX-BR.

Turning to four-mora light-initial polysyllabic stems, an additional constraint is needed to round out the pattern. Examples of such stems include *riaala* and *katoore*,

both of which reduplicate with a bimoraic prefix, as in *kati-katoore* and *rii-riaala*. The prefix for *kati-katoore* is predicted by the same system that nets *sipi-siped*. However, the bimoraicity of the prefix for *rii-riaala* cannot be attributed to MAX-BR, as was the case for *dun-dune* and *sipi-siped*, because the monomoraic candidate, **ri-riaala*, satisfies MAX-BR to the same extent as the actual form *rii-riaala*. I illustrate this in Tableau (30).

(30)	riaala + DURATIVE	ALIGN MORPH-FT	PARSE- μ	ALL- σ RIGHT	MAX-BR
a.	(<u>ri</u> -ri)(àa)(lá)	*!		***	aala
b.	(<u>rii</u> -ri)(àa)(lá)	*!		***	aala
c.	(<u>ri</u>) (<u>rii</u>)-ri)(àa)(lá)		*	***	aala
d.	(<u>ri</u>)-ri)(àa)(lá)		*	***	aala
e.	(<u>ria</u>)-ri)(àa)(lá)		*	****!	la

ALIGN-MORPHEME-FOOT limits the viable candidates to those in which the prefix comprises its own foot; only those that minimally violate ALL- σ -RIGHT (by copying a single stem vowel) can emerge. However, MAX-BR does not choose between the attested *rii-riaala* and its rival **ri-riaala*, and we might even expect a constraint requiring weight-identity, not included in Tableau (32), to ultimately choose the wrong form. Some constraint other than MAX-BR, then, must be responsible for the appearance of the bimoraic prefix here. If we appeal to FOOTBINARITY, as defined in (33), the desired results will follow.

(33) FOOTBINARITY (FOOTBIN): Feet are bimoraic.

This constraint's rank is not immediately clear except that it must be placed below *HH, in order to allow the monomoraic feet that arise in forms like (*du*)(*duup*). Regardless of where it ranks against ALL- σ -RIGHT and MAX-BR, though, FOOTBINARITY will ensure that *rii-riaala* will emerge instead of **ri-riaala*. This result is summarized in Tableau (29). Note that the rank of ALIGN-MORPHEME-FOOT ensures the prefix is footed by itself, leaving the initial *ri* of the stem unfooted.

(34)	riaala + DURATIVE	ALIGN MORPH-FT	PARSE- μ	FOOT BINARITY	ALL- σ RIGHT
a.	(<u>rii</u>)-ri)(àa)(lá)		*	*	***
b.	(<u>ri</u>)-ri)(àa)(lá)		*	**!	***

We can summarize the system's treatment of bimoraic stems as follows: the prefix is bimoraic because of the pressure of MAX-BR and FOOTBINARITY, as shown by the preference of *dun-dune* over **du-dune*. However, bimoraic reduplicants are avoided wherever they would create adjacent heavy syllables, as seen by the choice of *du-duup*

over ***duu**-*duup*. The same generalization holds of four-mora stems like *tooroor*, *souprisek*, and *riaala*. Adjacent heavy syllables are avoided by using a light prefix for **to**.*too.roor* and **s***o*-*souprisek*, while **rii**.*ri.aa.la* can have a bimoraic prefix without violating *HH.

The hierarchy developed in Sections 4.3.1 and 4.3.2 fully captures the pattern for most consonant-initial forms. Described informally, the system produces bimoraic prefixes for two reasons: to avoid stress clash with odd-numbered stems, and to achieve binary feet in even-numbered stems; sequences of heavy syllables are avoided only in the latter case. The phenomenon of Long-Distance Quantitative Complementarity is thus the accidental result of the ability of *HH to emerge only in even-numbered stems. In the following subsections, I show that the same generalizations hold of stems with internal vowel hiatus, initial vowels, and initial syllabic nasals.

4.3.3 *Stems with internal hiatus*

Stems with internal hiatus in Pohnpeian are relatively easy to fit into the system; indeed, the form *riaala* discussed at the end of Section 4.3.2 already shows how such stems follow from the system in its current state. Examples of reduplicated forms of hiatus stems are provided in Table (35); I follow the Pohnpeian spelling convention of separating *u* from a following vowel with *w*, as in *luwak*. It is not clear to me whether these are phonemically *luak* or *luuak*.

Each of the examples has a stem-initial light syllable, and as one might expect, the reduplicated forms thus all have bimoraic prefixes. The system predicts a bimoraic prefix for odd-numbered stems like *liaan*, since a monomoraic prefix would create a stress-clash; bimoraic prefixes occur in even-numbered forms like *riaala* to achieve binary feet.

(35)	Stems with internal hiatus		
	<i>liaan</i>	lii - <i>liaan</i>	<i>outgoing</i>
	<i>riaala</i>	rii - <i>riaala</i>	<i>to be cursed</i>
	<i>luwak</i>	luu - <i>luwak</i>	<i>jealous</i>
	<i>luwet</i>	luu - <i>luwet</i>	<i>weak</i>

A critical point about the forms in (35) is that the system avoids copying vowels in hiatus, and prefers to lengthen the reduplicant's first vowel instead. While this fact might seem to follow from a requirement that syllables have onset consonants, we can simply attribute it to ALL- σ -RIGHT, which indirectly has the effect of preventing the reduplicant from having a second vowel. This is illustrated for *liaan* in Tableau (36), where a bimoraic prefix serves to avoid stress clash. Of the two candidates that have a bimoraic prefix, (36d) (**lii**).(li).(aán) is preferred over (36c) *(**lia**).(li).(aán) since it incurs fewer violations of ALL- σ -RIGHT.

(36)	liaan + DURATIVE	CLASH	ALIGN MORPH-FT	ALLFT RIGHT	ALL- σ RIGHT	MAX BR
a.	(<u>li</u>).(li).(aán)	*!		*****	**	an
b.	(<u>li</u> .li).(aán)		*!	**	**	an
c.	(<u>li</u> .a).(li).(aán)			*****	***!	n
d.	☞ (<u>li</u>).(li).(aán)			*****	**	an

Stems with internal hiatus differ on the surface from diphthong forms only by the ordering of high and non-high vowels. The hiatus cases all have a sequence in which the high vowel is first; in such cases, only the high vowel is copied. Diphthong cases, however, act a little differently.

Sequences of vowels with falling sonority are syllabified together in Pohnpeian; however, it is not always obvious whether the low-sonority portion of the diphthong is moraic or not. Rehg and Sohl discuss a distinction between the durative forms *pe-peí* and *pei-peí*. Rosenthal (1996) claims that the stem diphthong in *pe-peí* is bimoraic, composed of two vowels, and so a bimoraic prefix would violate *HH. I illustrate this in Tableau (37). A minor quibble is that Rosenthal claims this form has a final vowel (whereas *pei-peí* has a final glide). I claim instead that the underlying form of *pe-peí* is *peii*, whose final vowel is shortened in satisfaction of FREE-VOWEL.

(37)	peii + DURATIVE	CLASH	ALLFT RIGHT	*HH	FTBIN	ALL- σ RIGHT	MAX BR
a.	(<u>pei</u>)(peí)		**	*!		*	
b.	(<u>peè</u>)(peí)		**	*!		*	i
c.	☞ (<u>pè</u>)(peí)		**		*	*	i

The stem-final diphthong in *pei-peí*, however, contains a non-moraic glide, which could be a means of satisfying FREE-VOWEL. In other words, whereas *peii*'s final long vowel shortens, *pei*'s final short vowel becomes non-moraic, and stress in this case occurs on the *e* of the stem. In this case, the base is monomoraic, and the prefix may be bimoraic without violating *HH. In fact, the prefix must be bimoraic for the same reason as all monomoraic stems: to guarantee alternating stress. Moreover, even if the second moraic element of the prefix *pei-* is interpreted as a vowel (by being moraic), it does not violate ALL- σ -RIGHT. I show this in Tableau (38).

(38)	pei + DURATIVE	CLASH	ALLFT RIGHT	*HH	FTBIN	ALL- σ RIGHT	MAX BR
a.	☞ (<u>pei</u>)(peí)		*		*	ee	
b.	(<u>peè</u>)(peí)		*		*	ee	i!
c.	(<u>pè</u>)(peí)	*!	*		**	ee	i

Rising and falling sequences thus differ only by whether they can copy both vowels. In rising-sonority cases like *lii-liaan*, only the first vowel is copied, because the second vowel cannot occur in the same syllable. In falling-sonority cases, the first vowel and second vowels can both be copied since they can occur in the same syllable, minimizing the violation of ALL- σ -RIGHT. Still, both are copied only if there is no violation of *HH.

Forms with hiatus thus behave like other stems: the prefix is bimoraic in part to ensure alternating stress, as well as to maintain binarity of feet. However, adjacent heavy syllables are avoided, as the form (*pe*)(*pei*) illustrates. In the next section, I show the same generalizations in the durative of vowel-initial stems.

4.3.4 Vowel initial forms

In vowel-initial forms, the apparent pattern becomes more complicated, but ultimately will follow from the same system. Examples of vowel-initial monosyllabic stems are given in Table (39). Light and heavy forms both have an unexpected twist, which I treat below.

(39)	Vowel-initial monosyllables					
	<i>el</i>	<i>eleel</i>	<i>to rub or massage</i>	<i>aan</i>	<i>aiaan</i>	<i>to be accustomed to</i>
	<i>it</i>	<i>itiit</i>	<i>stuffed</i>	<i>eed</i>	<i>eieed</i>	<i>to strip off</i>
	<i>uk</i>	<i>ukuuk</i>	<i>fast</i>	<i>oon</i>	<i>oioon</i>	<i>hungover</i>
	<i>us</i>	<i>usuus</i>	<i>to pull out</i>	<i>iik</i>	<i>iyiik, ikiik</i>	<i>to inhale</i>
	<i>up</i>	<i>upuup</i>	<i>to shield from the weather</i>	<i>iir</i>	<i>iyiir, iriir</i>	<i>to string</i>
				<i>uuk</i>	<i>uyuuk, uwuuk,</i>	<i>to lead</i>
					<i>ukuuk</i>	

For light stems, it appears that the stem vowel lengthens, as in *uk* → *ukuuk* ‘fast’, unlike in any other set of forms in the language. To handle this, I follow McCarthy & Prince (1986) in claiming that morphologically, such forms are actually parsed as *ele-el*, and *uku-uk*, in which the second vowel is epenthetic and part of the reduplicant morpheme, but homorganic to the following (base) vowel. Since this epenthetic vowel assumes the place features of what follows, it does not incur an additional violation of ALL- σ -RIGHT, even if it is not [+hi]. In addition, because of the placement of morpheme boundary, it is now the case that vowel-initial monomoraic stems like *el* and *uk* take bimoraic prefixes.

When we move to heavy vowel-initial stems, we see the effect of Quantitative Complementarity. Bimoraic vowel-initial stems take light prefixes, but with an epenthetic glide rather than a copy of the base final consonant, as in *aan* → *aiaan* ‘be accustomed to’.

Some heavy syllables variably do seem to copy the base consonant, as both *iyiir* and *iriir* are possible durative forms of *iir*. I handle the variation of *iyiik* and *iyiir* with

ikiik and *iriir* by allowing for two competing lexical entries.² For example, underlying *ir* or *iri* would surface unreduplicated as *iir* if a noun because of a bimoraic noun requirement, but would be reduplicated as *iri-ir*, just like *it* → *iti-it*. Underlying *iir(i)*, however, would reduplicate as *i-yiir*, parallel to *oon* → *o-ioon* and *aan* → *a-iaan*. In other words, this optionality does not affect the generalization that for vowel-initial monosyllables, light stems receive bimoraic prefixes, while heavy stems receive monomoraic prefixes.

Moving to vowel initial polysyllables, duratives of such forms have qualities of both vowel-initial monosyllables and consonant-initial polysyllables. For example, *alu* reduplicates like *siped*, by separating copied material from the base with an epenthetic vowel, as in *ali-alu*. In *urak*, however, there is an apparent lengthening of the base vowel to yield *uruurak*, much like in *ukuuk* above. As with *uku-uk*, I assume that *uruurak* is morphologically *uru-urak*.

(40)	Vowel-initial polysyllables		
	<i>alu</i>	<i>alialu</i>	<i>to walk</i>
	<i>amas</i>	<i>amiamas</i>	<i>be raw</i>
	<i>arekarek</i>	<i>ariarekarek</i>	<i>gritty</i>
	<i>inen</i>	<i>iniinen</i>	<i>straight</i>
	<i>urak</i>	<i>uruurak</i>	<i>to wade</i>
	<i>uutoor</i>	<i>uuuutoor</i>	<i>independent</i>

There is variability which supports this claim that *uruurak* and *iniinen* are parsed as *uru-urak* and *ini-inen*. In some forms, the epenthetic vowel may variably occur as assimilated or unassimilated. For example, *amas* ‘be raw’ can reduplicate as both *ami-amas* and *ama-amas*, which indicates that a clearly epenthetic vowel can occur in the same position as the one I claim to be assimilated to the following vowel; other forms like *ukuuk* simply do not vary.

The only remaining unexpected reduplicated form *uuuutoor*, since it seems to contain a violation of *HH. However, its high vowels allow for a reorganization of some segments as non-moraic glides, which lets it parse as *(uwi)(uu)(toor)*, satisfying *HH. Were the stem *aatoor* instead of *uutoor*, we would expect a monomoraic prefix, as in *(a)(iaa)(toor)*.

Forms like *uku-uk* are quite consistent with the constraints established in the previous sections. For example, since its epenthetic vowel is assimilated to the following vowel, it shares a place specification; as a result, it does not incur any additional violation of ALL-σ-RIGHT. Moreover, since the epenthetic vowel and its neighbour are separate segments, *uku-uk* still satisfies ALIGN-MORPHEME-FOOT, which evaluates the alignment of morpheme boundaries (which occur between segments) to the edges of feet.

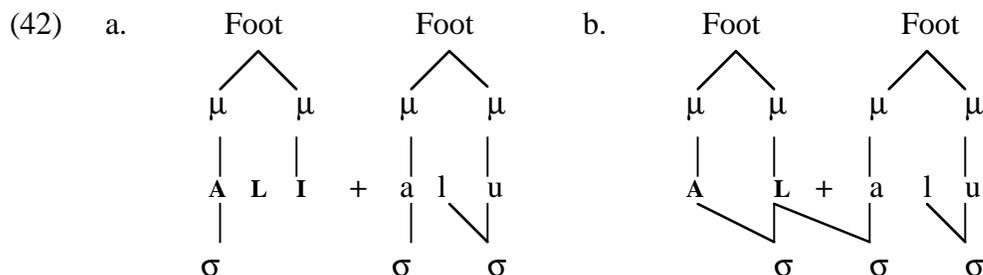
² I avoid a system of optional ranking that would allow either *iriir* or *iyiir* from the same input, for the risk that the same optionality might allow variation like *tepi-tep* ~ **teyi-tep*.

Having established where the morpheme boundaries occur in forms like *uku-uk*, we can now organize the data by the mora-count of the stems. I do so in Table (41), where it should become clear that the vowel-initial forms behave in a manner parallel to the consonant-initial ones. Odd-numbered stems receive a bimoraic prefix, while even-numbered stems do so only if their first syllable is light, as in *ali-alu* and *ari-arekarek*. Otherwise, if the stem is a heavy monosyllable, Quantitative Complementarity applies, and the prefix is monomoraic, as in *a-yaan*. I should acknowledge that Rehg & Sohl cite this last form as *iaaan*, but they also note elsewhere that intervocalic *i* acts as a glide. They retain the symbol *i* to be consistent with Pohnpeian orthographic standards.

(41) Vowel-initial forms by mora count; italic forms are unattested but predicted

	<i>1 mora</i>	<i>2 moras</i>	<i>3 moras</i>	<i>4 moras</i>
$\mu\mu$ -prefix	<u>è.le</u> -él <u>ì.ti</u> -ít <u>ù.ku</u> -úk <u>ù.su</u> -ús	<u>ami</u> -amás <u>a.li</u> -a.lú <u>ini</u> -inén <u>urù</u> -urák	<u>àmi</u> -àmetás	<u>a.ri</u> .a.rè.ka.rék
μ -prefix		<u>à</u> .i-aán <u>ì.y</u> -iír, <u>ì.r</u> -iír		<u>à</u> .iaàkaák

Since these forms pattern like those in Sections 4.3.1-4.3.3, it is not surprising that the system nearly predicts the correct form for *alu* as it stands already. ALIGN-MORPHEME-FOOT forces the prefix into its own foot. However, the geminated form **aL-la.lú* remains a viable candidate: it satisfies ALIGN-MORPHEME-FOOT, since each morpheme at the segmental level is well-aligned to foot boundaries. This is possible because feet in Pohnpeian are built from moras, on a separate tier from syllables and onsets, and ALIGN-MORPHEME-FOOT is violated only when a morpheme boundary occurs between two *moraic* segments. In addition, the forms are tied by All- σ -Right; abstractly, each is three syllables in the same way that *sipi-siped* is. Figure (42) illustrates this.



The representation in (42a) corresponds to the attested *ali-alu*, in which the morpheme boundary (indicated by the + sign) occurs between two foot. However, in (42b), the morpheme boundary also occurs between two feet; no foot branches across it. ALIGN-MORPHEME-FOOT cannot prevent **aL-la.lú* from emerging, which *OBS/MORA allows. In addition, as we will see in Chapter 5, this is how Mokilese would reduplicate

this stem. The problem is laid out in Tableau (43); note that ultimately, DEP-BR chooses the wrong candidate.

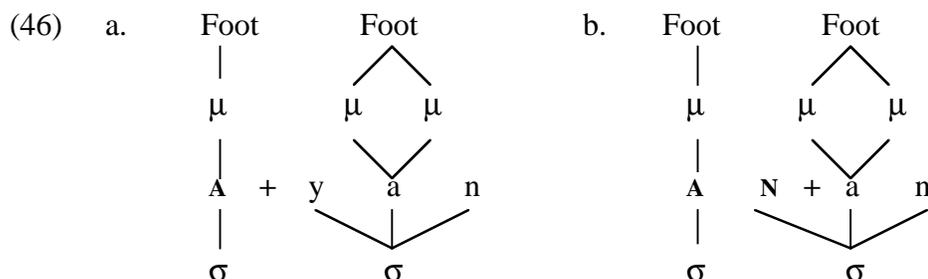
(43)	alu + DURATIVE	ALIGN-MORPHFT	ALLFT RIGHT	FTBIN	ALL- σ RIGHT	DEP BR
a.	(<u>à</u>).(<u>l</u> a.lú)		**	*!	**	
b.	(<u>aL</u>).(<u>l</u> a.lú)		**		**	
c.	(<u>ɸ</u>) (<u>a.l</u> ̣i).(<u>a</u> .lú)		**		**	*

A resolution to this exists in the appeal to a second alignment constraint. While both *al.l-alu* and *ali-alu* are well-aligned to feet, only the optimum is also well-aligned to syllables. I therefore introduce the constraint ALIGN-MORPHEME-SYLLABLE in (44), and illustrate its role in Tableau (45). Because of the separation of syllables and feet illustrated in Figure (42), ALIGN-MORPHEME-SYLLABLE cannot be combined with ALIGN-MORPHEME-FOOT; indeed, in Kosraean and Mokilese, they have crucially different rankings.

(44) ALIGN-MORPHEME-SYLLABLE Morphemes are aligned to syllable boundaries

(45)	alu + DURATIVE	ALIGN-MORPH-FT	ALIGN-MORPH- σ	ALLFT RIGHT	FTBIN	ALL- σ RIGHT	DEP BR
a.	(<u>à</u>).(<u>l</u> a.lú)		*!	**	*	**	
b.	(<u>aL</u>).(<u>l</u> a.lú)		*!	**		**	
c.	(<u>ɸ</u>) (<u>a.l</u> ̣i).(<u>a</u> .lú)			**		**	*

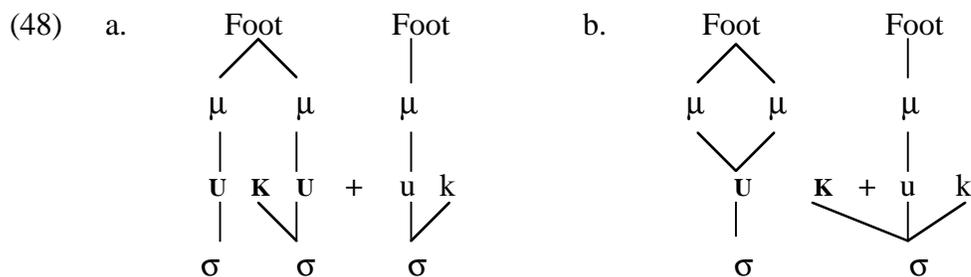
The appeal to ALIGN-MORPHEME-SYLLABLE addresses similar concerns in other stems. For example, consider the stem *aan*, which reduplicates as a-*yaan*, where a glide emerges instead of a copy of the base consonant. For *aan*, it is not possible to copy the consonant in the reduplicated form without violating syllable alignment, as in *aa.n-*an*, as I show in Figure (46) below.



In both representations in (46), the morpheme boundary is well-aligned to foot boundaries, but only (46a), which corresponds to *a-yaan*, satisfies ALIGN-MORPHEME-SYLLABLE. The form in (46b), which corresponds to **anaan*, violates it. The only other way to copy the consonant in the prefix would violate ALLFEETRIGTH, as in *(*aa*)(*ni*)(*aan*). The best form is therefore the light-heavy sequence *a-yaan*, which satisfies syllable-alignment because the *y* is analyzed as part of the stem. I summarize this in Tableau (47).

(47)	aan + DURATIVE	ALIGN- MORPH-FT	ALIGN- MORPH-σ	ALLFEET RIGHT	*HH	FTBIN
a.	(aà)(y-aán)		*!	**	*	
b.	(à)(n -aán)		*!	**		*
c.	☞ (à)(yaán)			**		*
d.	(à a)(ni)(yaán)			*****!		*

The appeal to ALIGN-MORPHEME-SYLLABLE also predicts the proper durative for *uk*. As discussed above in reference to the data in Tables (39) and (40), this analysis assumes the morphological parse of *ukuuk* to be *uku+uk*. In this case, ALIGN-MORPHEME-FOOT cannot rule out the form *uuk-uk*, as Figure (48) shows.



The representation in (48a) corresponds to *uku-uk*, while (48b) shows **u-kuuk*. In both cases, the morpheme boundary is well aligned to a foot. However, ALIGN-MORPHEME-SYLLABLE rules out (48b) because its morpheme boundary does not occur at a syllable boundary; a syllable branches across it. I summarize this in Tableau (49). It should be noted that if *a-yaan* with a glide is the reduplicated form of *aan*, then **uyu-uk* should be possible from *uk*; however, MAX-BR can play a decisive rule to prevent this result; I also show this in (49).

(49)	uk + DURATIVE	ALIGN MORPH-FT	ALIGN MORPH-σ	ALLFT RIGHT	FTBIN	ALL-σ RIGHT	MAX BR
a.	(ùu).(k-úk)		*!	*	*	*	
b.	☞ (ù.ku)(úk)			*	*	*	
c.	(ù.yu)(úk)			*	*	*	*!

An alternative approach would be to attribute the appearance of (*uku*)(*uk*) to WEIGHT-IDENT-BR, which it satisfies since its corresponding vowels are the same length, but which **(uu)(k-uk)* does not, because of its lengthened reduplicant vowel. However, it is necessary to rank WEIGHT-IDENT-BR below DEP-BR, since the opposite ranking could have undesirable predictions for forms like *don-dod*, in which the moraic nasal violates WEIGHT-IDENT, while the unattested epenthetic form **dodi-dod* does not. The use of ALIGN-MORPHEME-SYLLABLE avoids this problem.

With the addition of ALIGN-MORPHEME-SYLLABLE, the vowel-initial forms do pattern like consonant-initial ones: bimoraic reduplicants appear because of the overriding stress and foot constraints, except where adjacent heavy syllables are to be avoided.

4.3.5 Stems with initial syllabic nasals

The last group of forms to consider includes those that have an initial syllabic nasal segment. Pohnpeian allows word-initial nasal geminates and nasal-stop sequences, such as *mpek*, the existence of which is further evidence that nasals in Pohnpeian must be moraic. Given the patterns of reduplication seen in Sections 3.1-3.4, we should expect bimoraic reduplicants for this set of forms, and this prediction is borne out as long as geminate nasals are considered moraic. In *mpek*, for example, the emergence of morpheme-to-foot alignment in reduplication predicts a bimoraic prefix parsed into a separate foot from the stem. It should then be no surprise that the prefix for this form is *mpi-*, a bimoraic foot whose initial mora is associated to the initial nasal consonant. The default vowel is expected because of ALL- σ -RIGHT; it satisfies ANCHOR, which holds over the leftmost moraic segment, in this case *m*. More examples of the reduplicative pattern for forms with syllabic nasals are provided in Table (50). Note that the default vowel is *u* in forms with velarized labials, as in *mp^wu-mp^wul* and *mm^wu-mm^wus*.

(50) Stems with syllabic nasals

mmed	mmimmed	<i>full</i>	nda	ndinda	<i>to say</i>
ŋŋet	ŋŋiŋŋet	<i>to pant</i>	nseen	nsinseen	<i>to snare</i>
ŋŋar	ŋŋiŋŋar	<i>to see</i>	ntiŋ	ntintiŋ	<i>to write</i>
mm ^w us	mm ^w umm ^w us	<i>to vomit</i>	ŋkəl	ŋkuŋkəl	<i>to make sennit</i>
mpek	mpimpek	<i>to look for lice</i>	mp ^w ul	mp ^w ump ^w ul	<i>to flame</i>

When organized by the number of moras in the stem, as in (51), these forms show a pattern like the groups in the previous sections. Every form receives a bimoraic prefix, which is consistent with the consonant-initial and vowel-initial forms. In even-numbered forms there can be no effect of the weight of the stem's first syllable, since syllabic nasals can only be parsed as light syllables. Odd-numbered stems should receive bimoraic prefixes in order to avoid stress clash.

(51)	<i>1 mora</i>	<i>2 moras</i>	<i>3 moras</i>	<i>4 moras</i>
		<u>m.mi</u> -m.med	<u>n.si</u> -n.seen	<u>mpi</u> -mpekelap (hypothetical, predicted)
		<u>m.pi</u> -m.pek		
		<u>n.di</u> -n.da		
		<u>m.p^wu</u> -m.p ^w ul		

In Tableau (52), we see that the system predicts (52c) *mpi*-*mpek* as the best output for *mpek*. As with other LL forms like *dune* and *alu*, in this case the bimoraic prefix is preferred over the monomoraic (52b) **m*-*mpek* by FOOTBINARITY. Moreover, *mpi*-*mpek* incurs only two violations of ALL- σ -RIGHT, since its epenthetic vowel is not syllabic, parallel to *sipi*-*siped* and *ali*-*alu*.

(52)	mpek + DURATIVE	ALIGN MORPH-FT	ALLFT RIGHT	*HH	FT BIN	ALL- σ RIGHT	*OBS/MORA
a.	(<u>mP</u>).(p.m.pék)		**			***	*!
b.	(<u>M</u>)-(m.pék)		**		*!	**	
c.	\mathcal{F} (<u>m.pi</u>)-(m.pék)		**			**	
d.	(<u>m.pè</u>)-(m.pék)		**			***!	

Moving to the odd-numbered form *nseen*, however, there is a potential weight-clash situation, since the heavy syllable *-sin-* in *n*si*-nseen* is followed by another heavy syllable, *-seen*. This has implications for what *HH actually detects: in Section 4.3.2 it is needed to rule out adjacent heavy syllables, like in **duu*-*duup*, but in those cases, they are segmentally identical. In the case of *n*si*-nseen*, the adjacent heavy syllables are not identical. Regardless, *nseen* is a 3-mora stem, and thus, like *duupek*, will not show any effect of *HH. The effect of *CLASH forcing the bimoraic reduplicant is illustrated in Tableau (53).

(53)	nseen + DURATIVE	CLASH	ALLFEET RIGHT	*HH	FT BIN	ALL- σ RIGHT
a.	(<u>N</u>).(N.se)(én)	*!	****		*	**
b.	(<u>N.se</u>).(N).(seén)		*****	?	*	***!
c.	\mathcal{F} (<u>N.si</u>).(N).(seén)		*****	?	*	**

Stems with initial syllabic nasals, then, pattern just as those with internal hiatus and initial vowels do; indeed, as every form does. The reduplicant is bimoraic for one of two reasons, either to avoid stress clash or to achieve binary feet. Both motivations are consequences of the emergence of ALIGN-MORPHEME-FOOT in the context of reduplication, which forces the reduplicative prefix into its own foot. As such it must have its own stress-bearing mora, which motivates bimoraicity in odd-numbered stems to

avoid stress-clash; other pressures motivate bimoraic feet in even-numbered stems, but never at the expense of creating adjacent heavy syllables.

4.4. *The durative: an interim summary*

To this point, I have shown that the Pohnpeian durative reduplicant adheres to a number of generalizations about stress assignment, foot structure, and moraic consonants. The surface form of the prefix is predictable from constraints that formalize these generalizations in Optimality-Theoretic terms. The only constraints that are specific to the reduplicative morpheme are those of Base-Reduplicant correspondence like ANCHOR, MAX-BR, and DEP-BR. As a result, the prosody of the prefix is an example of the Emergence of the Unmarked. In this case, the unmarked structures that emerge in the reduplicant include binary feet, nasal codas, and alternating stresses. The reduplicant tends to be bimoraic, either to avoid stress clash, or to maintain binary feet. Wherever it is bimoraic, it may include an epenthetic vowel to avoid non-homorganic sequences, or nasalized consonants as optimal homorganic codas. In the following section, I will apply the hierarchy developed for the Pohnpeian durative to the language's other reduplicative morpheme, the denotative suffix, whose variation in shape presents further difficulty for a templatic account of the system, since it is *never* bimoraic.

4.5. *The Pohnpeian denotative suffix*

The constraint hierarchy developed in Section 4.3 provides a thorough account of the surface variation in the shape of the durative prefix in Pohnpeian. In this section, I show how the same system predicts the form of the denotative suffix, an affix in which there is far less variation. The denotative suffix has three variants in Pohnpeian. It appears as a CVC, as in *pika-pik*, a CV, as in *makia-ki*, or a VC, as in *eli-el*; in every case, the suffix is monomoraic. I repeat these examples in Table (54).

(54) Introducing the Pohnpeian denotative

piik	<i>sand</i>	pika- pik	<i>sandy</i>
		makia- ki	<i>to sob</i>
el	<i>to massage (t)</i>	eli- el	<i>intrans</i>

The rank of CODACONDITION over WEIGHT-BY-POSITION renders any final coda consonant non-moraic; as a result, each shape variant in (54) is monomoraic. The monomoraic nature of the suffix should not be a surprise: since the suffix is word-final, it is subject to processes like final-vowel lenition, which prevents the rightmost stem vowel from being maximized in the suffix. Furthermore, the rank of ALLFEETRIGHT over FOOTBINARITY and MAX-BR predicts that the suffix will always be monomoraic. Lastly, since the stem's final vowel precedes the suffix and is thus not word-final, it is not subject to FREE-VOWEL and is not deleted. As a result, consonants never occur adjacently at the morpheme boundary, and the Nasal Substitution process is therefore never seen.

I treat each subpattern separately below, but acknowledge first that some forms in each set will seem odd without an explanation of the final consonants of the unreduplicated forms. Some denotatives, such as those in Table (55), do not copy the final consonant of the unreduplicated forms from which they are derived. For example, there is a final *r* in *daper* not copied into *dapa-dap*, while the denotative of *duup* does not copy the final *p* in *duu-du*.

(55) Denotatives for thematic stems

daper	<i>to catch (t)</i>	dapa- dap	<i>intrans</i>
duup	<i>to bathe</i>	duu- du	<i>to bathe (intrans)</i>
idaj	<i>to mash (t)</i>	ida- id	<i>intrans</i>

I consider these mysterious consonants to be ‘thematic consonants’ of the kind discussed in § 2.3.2.2, which means they are not actually part of the bare stem. In other words, they are consonantal suffixes that attach to verbs to create transitive forms, but are not included in the creation of denotatives. Thus, there are stems like *dapa* and *duu* which, when transitive and unreduplicated, have suffixes like *r* and *p*, but when denotative, only have reduplicative suffixes.

Before investigating each subpattern in greater detail, it is necessary first to deal with the phonological process of word-final vowel lenition. This process is not relevant in the discussion of the durative prefix since it only affects absolute word-final position, but is important here because the reduplicative suffix triggers an alternation. That is, we see stem vowels like the *a* of *pika-pik* that disappear from unsuffixed forms, as *piik* shows. Moreover, though the vowel is preserved in the stem of the denotative, it is still not copied into the suffix.

The pattern of final-vowel lenition needs to be attributed to the constraint FREE-VOWEL (Prince & Smolensky 1993), repeated below in (56). This constraint is respected without question in Pohnpeian, and affects word-final vowels, even if they belong to a main root. Though the constraint is phrased in terms of voicing, it effectively deletes post-tonic vowels, on the assumption that devoiced vowels are not licit.

(56) FREE-VOWEL: The vowel following the primary stress is not voiced.

A stem-final vowel can persist in the output if it is followed by a suffix, even if that suffix is reduplicative. However, the reduplicant’s final vowel is subject to FREE-VOWEL. Thus, /pika/ → *pika violates FREE-VOWEL, as does /pika + DENOTATIVE/ → *pika-pika. In contrast, *pika-pik*, in which the stem’s final vowel remains but the suffix’s does not, satisfies FREE-VOWEL.

4.5.1 Applying the Pohnpeian constraint hierarchy

The shape of the Pohnpeian durative prefix is shown in Section 4.3 to follow essentially from the requirement that morpheme boundaries align to foot boundaries. Variations in its shape are the result of other restrictions on syllable weight and consonant

sequences. In this section, I show how the same hierarchy predicts the suffixing patterns shown in Tables (54) and (55), treating each subgroup of stems in turn.

4.5.1.1 Stems that receive a CVC suffix

I provide additional examples of forms that receive a CVC suffix in Table (57). These fall into two groups: those related to unreduplicated stems, in (57a), and those that seem to be fossilized, in (57b).

(57)	Denotative suffix for /...CVCV/ stems			
a.	daper	to catch (t)	dapa- dap	<i>intrans</i>
	lɔŋ	fly	lɔŋɔ-lɔŋ	<i>full of flies</i>
	par	to cut	pere- per	<i>intrans</i>
	piik	sand	pika- pik	<i>sandy</i>
	pil	to choose	pili- pil	<i>intrans</i>
	wɛŋid	to wring	wɛŋi- wɛŋ	<i>intrans</i>
b.			maleke- lek	<i>fish species</i>
			dikeri- ker	<i>healthy looking, of plants</i>
			lepa- lep	<i>to doze</i>
			p ^w idiki- dik	<i>tiny</i>
			sinop ^w u- nop^w	<i>fat, healthy</i>
			pwei- pwei	<i>to be stupid</i>

Although the only synchronically reduplicated forms in (57) are of the form CVCV-CVC, there are three reasons for the claim that all of them are suffixed. First, the middle vowel is fully specified, as in *pika-pik*, unlike the excrescent vowels that arise in some prefixed durative forms; this suggests that the second vowel (and whatever precedes it) is part of the stem. Second, some of the fossilized forms in (57) are nevertheless clearly suffixed forms derived from CVCVCV stems, as in *dikeri-ker*. Third, the semantics of these forms is distinct from the durative, creating adjectives or intransitives.

The underlying forms of the stems in (57) are all either CVCV, like *pili*, CVVCV, as in *loŋo*, or CVCVCV, as in *dikeri*. I consider surface forms like *piik* to have underlying CVCV stems as well. That is, *pika-pik* is derived from underlying *pika* which, unreduplicated, loses its second vowel, but augments to *piik* to maintain the bimoraic minimum for nouns, which have a bimoraic minimum requirement (Davis 1997). When reduplicated, however, such augmentation is obviated by the preservation of the stem-final vowel and addition of the suffix.

Several other aspects of the data in (57) need some additional clarification. First, as foreshadowed in the previous subsection, some of the unreduplicated forms have thematic consonants that do not appear in the reduplicated forms; for example, the *d* of *wɛŋid* is absent from *wɛŋi-wɛŋ*. The stem in this case is *wɛŋi*, whose transitive is created

from *wɛŋi + d*, but whose denotative reduplicates the stem without the thematic *d*. Second, there is a vowel alternation in the pairs *daper ~ dapa-dap* and *par ~ pere-per* that I do not treat.

A third point to discuss for Table (57) is the form *pwei-pwei*. Earlier in Section 4.5, I advance the point that CVC inputs with no final vowels are certainly possible and might lurk among these forms; *pwei-pwei* may derive from such a stem, with a final glide. This would predict a lack of stem-final vowel lenition, as well as satisfaction of *HH, since the final glide would be extrametrical and non-moraic.³ A hypothetical parallel would be seen in any stem that is underlyingly CVC and whose final consonant is nasal and homorganic to the first, such as *tan*. Though unattested, such a stem would be *tan-tan* in the denotative, since the derived consonant sequence is homorganic and licit. It would also reduplicate identically in the durative.

These points aside, I test the Pohnpeian hierarchy against the CVC denotative subset in Tableau (58), which evaluates the denotative of *pika*. Here we see that ALLFEETRIGHT can serve to rule out **pika-pik*, while **pika-pika* is prevented by the high rank of FREE-VOWEL.

(58)	pika + DENOTATIVE	FREE VOWEL	ALLFT RIGHT	FTBIN
a.	(pìka)(pìka)	*!	**	
b.	☞ (pìka)(pík)		*	*
c.	(pikà)(píik)		**!	

I do not consider candidates like **pik-pik* in Tableau (58), since these would fail by high-ranking stem-faithfulness, having lost their stem-final vowel, and which also violate CODACONDITION. However, this raises an interesting point: any stem that is actually underlyingly consonant-final would surface with some means of avoiding adjacent heterorganic consonants; for instance, we could posit *pil* as the lexical form for ‘choose’, and still predict it to reduplicate as *pili-pil*. In other words, CVC stems would be indistinguishable from CVCV stems in the denotative. One exception would be CVC stems like the hypothetical *tan* mentioned above; no vowel would be needed to resolve the adjacent consonants of the reduplicated form. Moreover, stems like *net* would also surface with an excrescent (or underlying stem-final) vowel in the denotative, despite the homorganicity of the potentially adjacent consonants. There is a form *nete-net* ‘sell’ which Spaelti (1997) and Davis (2001) analyze as a prefixed durative, and its apparent immunity to Nasal Substitution (there is no *nen-net*, despite *don-dod*) motivates the treatment of *t-n* sequences differently from *p-m* ones. An alternative is to posit *nete-net* as a suffixed denotative, in which case, the consonant that resists nasal substitution is a

³ Rosenthal (1996) argues for an underlying glide/vowel contrast, as evidenced in the distinction between the duratives *pe-pe* and *pei-pe*. The diphthong in *pe-pe* is bimoraic, composed of two vowels, and so a bimoraic prefix would violate *HH. The stem-final diphthong in *pei-pe*, however, contains a non-moraic glide, in which case, the prefix may be bimoraic without violating *HH.

stem segment. This resonates with two facts: stem consonants would not undergo nasal substitution anyway, and the suffixing hypothesis explains why the second vowel is not *i*, since it can be part of the stem.⁴ The prefixing account, in which *t* exceptionally resists assimilation to *n*, does account for the lack of *nVn-nVt* forms, but the number of *nVti-nVt* forms is hardly greater.

The two other kinds of stems that receive CVC suffixes are both trivocalic, like *dikeri-* and *lɔŋɔ-*. It is important to test the system against such stems, because although they are apparently underived, having no unreduplicated form, I use them in Table (57) as evidence that the denotative is a suffix. Treating *dikeri-* first, the hierarchy again forces a monomoraic, monopodal suffix. As with *pika-pik* in Tableau (58), the rank of ALLFEETRIGHT over FOOTBINARITY rules out all candidates with bimoraic suffixes, since the optimal form uses only two feet. Some candidates with bimoraic suffixes are possible, but incur slightly more violations of ALLFEETRIGHT, and also violate other higher-ranked constraints. For example, **di(keri)(dikér)* violates *LAPSE, while **(dike)(ri-kér)* violates ALIGN-MORPHEME-FOOT. I summarize the evaluation in Tableau (59).

(59)	dikeri + DENOTATIVE	LAPSE	ALIGN- MORPH-FT	ALLFT RIGHT	*HH	FTBIN
a.	di(keri)(dikér)	*!		**		
b.	(dikè)(ri- kér)		*!	**		
c.	(di)(keri)(keér)			*****!		*
d.	☞ di(kèri)(kér)			*		*

The system also predicts CVC suffixes even for stems with long vowels like *lɔŋɔ*, in a manner parallel to *dikeri-kér*, as illustrated in Tableau (60). In this case, the optimal form violates FOOTBINARITY just as *di(kèri)(kér)* does. Because of the pressure to minimize violations of ALLFEETRIGHT, (60d) *lɔ(ŋɔ)(lɔŋ)* is better-formed than (60c) **(lɔɔ)(ŋɔ)(lɔŋ)*, whose reduplicant vowel is respectful of the stem vowel's length and of FOOTBINARITY.

(60)	lɔŋɔ + DENOTATIVE	LAPSE	FREE VOWEL	ALLFT RIGHT	*HH	FTBIN
a.	lɔ(ŋɔ)(lɔɔ)(ŋɔ)		*!	****		*
b.	(lɔɔ)(ŋɔ)(lɔŋɔ)			*****!		*
c.	(lɔɔ)(ŋɔ)(lɔŋ)			*****!		*
d.	☞ lɔ(ŋɔ)(lɔŋ)			*		*
e.	lɔ(ɔŋɔ)(lɔŋ)	*!		**		

⁴ Nevertheless, some duratives do copy a second vowel rather than rely on the default vowel seen in *sipi-siped*.

4.5.1.2 Stems that receive CV suffixes

The denotative of stems ending in underlying CVV is formed with a CV suffix, regardless of whether the vowel sequence is homorganic, as shown below in Table (61). In this set, only *duu-du* is synchronically derived, and like some of the forms like *wɛŋid* in Table (57), it shows evidence of a thematic consonant (seen in *duup*) that is not retained in the reduplicated form. Most of these forms are fossilized, having no unreduplicated form, but they pattern as if they are productively reduplicated. Specifically, it appears that the suffix is subject to final-vowel lenition, since the final long vowels or adjacent pairs of vowels of the stem are not both present in the suffix.

(61) Denotative suffix for /...CVV/ stems

duup	<i>to bathe</i>	duu- du	<i>intrans</i>
		daŋaa- ŋa	<i>lazy</i>
		makia- ki	<i>to sob</i>
		peiruu- ru	<i>clay</i>

The hierarchy predicts CV suffixes for these forms, as shown in Tableau (62), which evaluates the denotative of *makia*. In this case, the uppermost constraints prevent any reduplicated form except nearly full reduplication, as in (62d) **makia-maki*, or minimal reduplication, as in the optimal (62e) *makia-ki*, the latter of which is chosen since it better satisfies ALLFEETRRIGHT. A CV suffix would also surface for a stem like *duu*; in both cases, the reduplicant's final vowel is lenited in order to satisfy FREE-VOWEL.

(62)	makia + DENOTATIVE	FREE VOWEL	ALIGN- MORPH-FT	ALLFT RIGHT	*HH	FTBIN
a.	(mà)(ki.à)(ki.á)	*!		*****		*
b.	(mà)(ki.à)(kií)	*!		*****		*
c.	(ma.kì)(a- ki)		*!	**		
d.	(mà)(ki.à)(ma.kí)			*****!		*
e.	☞ ma(kì.a)(ki)			*		*

4.5.1.3 Stems receiving a VC suffix

The last group of stems are those of the form /...(V)VCV/, which receive a VC suffix, as shown in Table (63). The form *us* is interesting because its lexical representation is likely *usu*, though the reduplicated form deceptively seems to analyze as *us+uus*. Like the vowel-initial forms in Section 4.3.4, however, I claim that the morpheme boundary is between two adjacent identical vowels, as in *usu+us*. Likewise, the form *aal* is posited as *ala* underlyingly; its vowel augments for the minimal noun requirement, but reduplicated, it behaves just like *us*, surfacing as *ala+al*. The remainder of forms in Table (63) are comparatively transparent; the final VCV of these stems is

copied, but without the second vowel; thus, like the forms in Sections 5.1.1 and 5.1.2, these have a suffix that is subject to final-vowel lenition.

(63) Denotative suffix for /...VCV/ stems

us	<i>to pull out</i>	usuus	<i>intrans</i>
		ijiiŋ	<i>to whisper</i>
aal	<i>road, path</i>	alaal	<i>striped</i>
arii	<i>to stir, to probe (t)</i>	erier	<i>intrans</i>
el	<i>to massage (t)</i>	eliel	<i>intrans</i>
idaŋ	<i>to mash (t)</i>	idaid	<i>intrans</i>
		edied	<i>cloudy</i>
		eliel	<i>to rub</i>
		iroir	<i>to look in the distance</i>

This set of forms also follows from the hierarchy, which predicts a VC suffix, as the following Tableau for *eli-el* shows. We can presume the lexical form to be *eli*, which surfaces as *el* if unreduplicated, but the stem-final vowel perseveres if the reduplicative suffix is present. In this case, no form like **ele-el* arises, as it would if this were in the durative, since the potentially assimilating vowel (the first of two adjacent ones) is a stem vowel, and thus bound to high-ranking stem faithfulness. The only true competitor is thus **(eli)(el)*, which, despite being better by FOOTBINARITY, nonetheless is tossed by FREE-VOWEL.

(64)	eli + DENOTATIVE	FREE VOWEL	ALLFT RIGHT	FtBIN
a.	(eli)(<u>el</u>)	*!	**	
b.	 (èli)(<u>él</u>)		*	*

4.5.2 The denotative: a summary

Each of the various forms of the denotative suffix in Pohnpeian, then, is predicted from the constraint hierarchy motivated for the durative prefix in Section 4.3. What is interesting about the denotative suffix is that it shows no effect of *HH and FOOTBINARITY, even though these two constraints have a prime role in the durative prefix pattern. For the denotative, the shift of FREE-VOWEL's effect from stem to suffix means that adjacent heavy syllables are avoided independently of *HH, since FREE-VOWEL would never let any final syllable be heavy. Furthermore, the rank of ALLFEETRIGHT ensures that the suffix will always be monomoraic; it thus drives a sort of prosodic compression which does not affect unsuffixed stems, akin to the model proposed by Hendricks (1999) for limiting reduplicant size. Unlike Hendricks, however, this account makes no use of morpheme-specific constraints like ALIGN-ROOT; instead, the aligned elements are strictly prosodic units like syllables and feet.

What is more interesting is that the denotative's shape follows from the exact same constraint hierarchy motivated for the durative prefix. The fact that there is a bimoraic tendency in the prefix but a monomoraic limit in the suffix is simply an epiphenomenon, a bumbling consequence of the extra-reduplicative rightward pressure of foot structure. This is a happy result because the alternative, a morpheme-specific templatic account, could only stipulate $DURATIVE=\mu\mu$ and $DENOTATIVE=\mu$. Further, as I show in the next section, a templatic account *cannot* handle even the durative system by itself, let alone offer an explanation for the contrast in quantity between the prefix and suffix.

4.6. *Against an OT account with prosodic target (RED = PCAT)*

In this section I will argue against the notion that the Pohnpeian durative can be modeled in Optimality Theory with the template constraint defined in (65), which requires the reduplicant to associate to a heavy syllable. Such a constraint is of the form $MCAT = PCAT$, as proposed in McCarthy & Prince (1993). We will see that a templatic approach with no reference to stress or foot structure cannot capture the pattern, essentially because the generalization that the reduplicant is a heavy syllable is not always true at the surface.

(65) $RED=\sigma_{\mu\mu}$ The reduplicant is a heavy syllable.

Given the existence of forms like *du-duup*, which violates $RED=\sigma_{\mu\mu}$, it must be the case that some other constraint outranks the template constraint. Presumably the higher constraint is *HH, repeated below in (66).

(66) *HH Adjacent syllables must not be heavy.

The effect of these constraints is illustrated first in Tableau (67), which evaluates the reduplicated form of *pa*. Since both candidates satisfy *HH constraints, the better one is (67a) *paa-pa* since it also satisfies $RED=\sigma_{\mu\mu}$. In Tableau (58), we see that the ranking of *HH over $RED=\sigma_{\mu\mu}$ ensures that *du-duup* is chosen over **duu-duup*.

(67)	pa + DURATIVE	*HH	$RED=\sigma_{\mu\mu}$
a.	<i>paa.pa</i>		
b.	<i>pa.pa</i>		*!

(68)	duup + DURATIVE	*HH	$RED=\sigma_{\mu\mu}$
a.	<i>*duu.duup</i>	*!	
b.	<i>du.duup</i>		*

The ranking is shown in Tableau (69) to work for heavy-heavy polysyllables as well, with a stipulation: $RED=\sigma_{\mu\mu}$ must be able to distinguish a reduplicant that is smaller

than a heavy syllable, like *to-*, from one that is larger, like **tooro*. Blevins (1996) claims for Mokilese that a template constraint can make such a distinction, but curiously, the constraint would have to prefer smaller reduplicants in Pohnpeian, and larger ones for Mokilese.

(69)	tooroor + DURATIVE	*HH	RED= $\sigma_{\mu\mu}$
a.	too .too.roor	**!	
b.	☞ to .too.roor	*	*
c.	too.ro .too.roor	*	**!

The system begins to fail when turning to other polysyllables. In (70), since *HH must outrank RED= $\sigma_{\mu\mu}$, the hierarchy predicts a heavy syllable for *siped*, which is the wrong result. Tableau (71) shows a similar problem in the evaluation of HL stems like *duupek*: the system predicts **du-duupek* over *duu-duupek*.

(70)	siped + DURATIVE	*HH	RED= $\sigma_{\mu\mu}$
a.	Ⓢ sii .si.ped		
b.	si .si.ped		*!
c.	☞ si.pi .si.ped		*! ☹

(71)	duupek + DURATIVE	*HH	RED= $\sigma_{\mu\mu}$
a.	☞ duu .duu.pek	*! ☹	
b.	Ⓢ du .duu.pek		*

The mechanisms we might appeal to for resolving these paradoxes create additional problems. For example, we might propose that MAX-BR outranks RED= $\sigma_{\mu\mu}$ to have *sipi-siped* emerge in Tableau (70). However, such a change in ranking predicts fully faithful copying over templatic satisfaction, as in **sipedi-siped*. Elsewhere, we might situate WEIGHT-IDENT-BR over *HH to have *duu-duupek* emerge over **du-duupek* in Tableau (71), but this will have dire results for true Quantitative Complementarity forms like *du-duup*.

In general, using $\sigma_{\mu\mu}$ as a prosodic target for reduplication in Pohnpeian does not allow for an adequate account of the data within Optimality Theory. The basic problem is that the reduplicant is not always a heavy syllable at the surface. The contradictory results are a relic of two assumptions: that a constraint requiring association to a specific prosodic target is active in Pohnpeian, and that only syllable weight and coda constraints come into play.

Several ways of resolving this problem within a template model exist, but at the expense of serious compromise to the theory. Richards (1995) argues for multiple evaluations, essentially assigning each kind of stem a separate constraint hierarchy, yet as

we have seen, the prefix's shape is predictable from the shape of the stem. A similar approach would be to use level-ordered evaluations, as argued for by Kiparsky (1999). The output of Level I would uniformly be a heavy syllable, while Level II would be responsible for the shortening and epenthesis patterns. Davis (1997, 2001) argues for a Sympathy-Theoretic approach, which masks the serial evaluation of intermediate representations, but only to account for the contrast between epenthesized and nasalized reduplicants. These approaches lack several of the advantages of the present analysis. In particular, they fail to attribute the surface pattern of Pohnpeian to a single constraint hierarchy. Furthermore, they offer no independent motivation for the tendency for bimoraic prefixes, or for the monomoraic nature of the suffix.

One last alternative to the present account, and a non-templatic one, is suggested by McCarthy & Prince (1986). To explain the pattern of Quantitative Complementarity, they propose that Pohnpeian duratives allow an emergent preference for feet with exactly one heavy syllable. Thus, we see (*paa-pa*) and (*du-duup*) instead of *(*paa*)(*paa*) and *(*duu*)(*duup*), and (*to-too*)(*roor*) instead of *(*too*)(*too*)(*roor*). However, this requires a stipulation that *tepi-tep*, at some pre-epenthetic level, is (*tep-tep*), parallel to (*paa-pa*), with a single heavy syllable. In other words, this account has the same opacity of the templatic approach. It also is inconsistent with Rehg's description of Pohnpeian stress (which was unavailable in 1986). Moreover, this story again is one that cannot be unified with an account of the suffix.

4.7. *Final conclusions*

In this chapter, I have presented a single constraint hierarchy that captures the complete Pohnpeian reduplicative system. The moraic quantity of both the prefix and suffix follow from constraints over foot structure and stress assignment, and their interaction with the requirement that every morpheme aligns to foot boundaries. I have shown that the prefix tends to be bimoraic, both to avoid stress clash and to maintain binary feet. The exact shape of the bimoraic variant is sometimes a consequence of strategies like epenthesis and nasal substitution, both of which serve to avoid specific types of coda consonants.

The prefix is monomoraic only to avoid sequences of heavy syllables, but the apparent phenomenon of "Long Distance Quantitative Complementarity," in which the prefix is sensitive to the stem's second syllable, simply results from the restricted emergence of *HH, whose rank is only evident in stems with even numbers of moras.

The denotative suffix is always monomoraic, which is consistent with rightward pressure of footing in Pohnpeian. Since monomoraic feet can occur, the best denotatives are ones with final monomoraic feet, which allow non-final feet to be better aligned to the right.

The account presented for Pohnpeian reduplication has been atemplatic, which offers a number of theoretical advantages. First, it satisfies the arguments against templates laid out in Spaelti (1997), McCarthy & Prince (1999), and Hendricks (1999). Second, it allows for an internal consistency within Pohnpeian, by predicting the shape of both the prefix and suffix. In contrast, a quantitative-templatic account requires separate

constraints for the two affixes, and would offer no principled account of the difference in their quantitative tendencies. Third, an atemplatic model will allow for a more unified pan-Micronesian discussion of reduplicative shapes. Should we use explicit templates, then each language has its own unique templatic constraint. However, by using a model of emergent prosody, we can characterize language-specific differences in reduplicative shape as a function of the reranking of the same set of constraints.

In the next chapter, I will show that only minor changes to the Pohnpeian hierarchy are necessary to model the cognate prefixes of its sister languages, Mokilese and Pingilapese. In subsequent chapters, I will show that all Micronesian languages share a subset of constraints whose rank is invariant, including the rank of CODACONDITION » WEIGHT-BY-POSITION, ALIGN-MORPHEME-FOOT » ALLFEETRIGHT » FOOTBINARITY, and MAX-BR » DEP-BR. Moreover, I will show that there is a group of constraints whose rank has drifted against the invariant set, and that this drift of rank provides a model of divergence in the phonology of Micronesian reduplication. The analysis will be followed in Chapter 6 by a discussion of how the three languages together support the claims of Confluence.

5. Reduplication in Mokilese and Pingilapese

5.1. Introduction

In Chapter 4, I offer an account of the Pohnpeian durative prefix, attributing its bimoraicity to constraints on foot structure and stress placement. I also show that the form of a second reduplicant, the denotative suffix, is predictable from the same constraint hierarchy. In this chapter, I investigate the cognate affixes in two other Pohnpeic languages, Mokilese (Harrison 1976) and Pingilapese (Good & Welley 1989). These languages are spoken on outlying atolls of Pohnpei state, and together with Pohnpeian, constitute a Pohnpeic sub-group of the Micronesian family. Considered together, the three offer a first opportunity to test the predictions of the Confluence hypothesis, since they share a common ancestor language, and each has experienced phonological innovation.

An important background point is that communities of both Mokilese and Pingilapese speakers are found on Pohnpei. In fact, most Mokilese speakers live on Pohnpei, and moreover, Harrison asserts that all residents of Mokil have spent some significant amount of time on Pohnpei. The situation for Pingilapese is similar. Given the resulting high degree of contact between the three, as well as a degree of mutual intelligibility, it is tempting to characterize them as dialectal variants—especially for Pingilapese, which does not have comprehensive grammars and dictionaries like those of Mokilese and Pohnpeian.

The use of labels like *dialect* and *language* is not a concern here, but the manner in which these three varieties differ from each other is. I offer a deeper discussion of systematic phonological contrasts in the Pohnpeic sub-group in Chapter 6, but this chapter is devoted first to developing a rich constraint system individually for Mokilese and Pingilapese.

I organize the discussion as follows. I first develop a constraint hierarchy for the Mokilese progressive prefix, the cognate of the Pohnpeian durative. Given some strong empirical similarities between the Mokilese and Pohnpeian prefixes, the account here will be highly reminiscent of that developed in Chapter 4. As a result, the analysis I propose differs from previous accounts (McCarthy & Prince 1986, Blevins 1996, Kennedy 2000, Crowhurst 2002), in that it does not attribute the shape of the prefix to a reduplicant-specific prosodic template. Instead, I argue that the prefix's prosody follows from a requirement that morphemes be well-aligned to feet.

I also introduce a second reduplicative pattern in Mokilese, a suffix which is a cognate of the Pohnpeian suffix—Harrison (1973) calls them both the denotative. I show that its shape follows from the same system as that developed for the prefix. I then extend the analysis to the cognate prefix and suffix of Pingilapese. The end result is a set of three constraint grammars that overlap in some ways and not others—which offers plenty to chew upon in Chapter 6.

5.2. *The progressive prefix in Mokilese*

In this section, I introduce and analyze the progressive prefix in Mokilese, a language closely related to Pohnpeian. Mokilese uses a reduplicative prefix to mark the progressive aspect; its shape and function make it an obvious cognate of the Pohnpeian durative. I provide examples of the Mokilese progressive in Table (2); the data are from Harrison (1976). I adhere to Harrison's transcription, except I replace his digraphs with the following symbols: *oa* with ɔ , *ng* with η , and *Vh* with *VV*.

The forms in Table (2) are organized by the weight of stem syllables, to be parallel with Tables (7-9) in Chapter 4; note that the two languages share a tendency for bimoraicity in the prefix. I include the triplicated form *kɔɔ-kɔɔkɔɔl* as an example of a stem to parallel Pohnpeian *maasaas*, since I have not found citations of progressives of similar stems in Mokilese (although they exist, such as *maajaaj* 'be clear').

(2) The Mokilese progressive

	<i>Consonant-initial forms</i>	<i>gloss</i>	<i>Parallel form in Pohnpeian</i>
<i>monosyllabic stems</i>	pa → paa -pa	<i>weaving</i>	paa -pa
	kak → kak -kak	<i>bounce</i>	kaŋ -kak
	dop → dopi -dop	<i>buying</i>	tepi -tep
	jaak → jaa -jaak	<i>bending</i>	du -duup
	kasɔ → kas(i) -kasɔ	<i>throwing</i>	din -dilip
<i>polysyllabic stems</i>	pɔdok → pɔdi -pɔdok	<i>planting</i>	
	nekid → neki -nekid	<i>saving</i>	sipi -siped
	wia → wii -wia	<i>doing</i>	rii -riaala
	pouje → poo -pouje	<i>connecting</i>	lii -liaan
	sɔɔrok → sɔɔ -sɔɔrok	<i>grinding coconut</i>	duu -duupek
	kookɔ → koo -kookɔ	<i>being torn</i>	pee -peese
kɔul → kɔɔ -kɔɔkɔɔl	<i>singing</i>	to -tooroor	

Most of the forms in Table (2) receive prefixes in a parallel manner to similar Pohnpeian forms. For example, *paa-pa* is identical to its Pohnpeian cognate, while *dopi-dop* has an excrescent vowel parallel to Pohnpeian *tepi-tep*. In addition, the lack of place restriction on word-final consonants suggests that Mokilese final consonants, like those of Pohnpeian, are extrametrical and non-moraic.

The Mokilese pattern differs from Pohnpeian in two ways. First, Mokilese does not have a pattern of Quantitative Complementarity, as adjacent heavy syllables in forms like *jaa-jaak* show. Second, Mokilese has a greater tolerance for moraic consonants, and does not employ Nasal Substitution to avoid moraic obstruents. For example, forms like *kak-kak* are possible in Mokilese where Pohnpeian would demand a nasalized *kaŋ-kak*. In fact, Mokilese allows any moraic consonant that is homorganic with the following onset, and an additional set of sequences are optionally permissible. Hence, *kas-kasɔ* may receive an excrescent vowel, variably appearing as *kasi-kasɔ*. As for the treatment

of potential non-homorganic sequences, Mokilese is quite like Pohnpeian, in that both languages use epenthesis to resolve them, as in *neki-nekid* and *pɔdi-pɔdok*.

These latter two forms are important because they and other Mokilese forms are usually cited without excrescent vowels, as in McCarthy & Prince (1986), Blevins (1996), Kennedy (2000), and Crowhurst (to appear). Data in all these works is drawn from Harrison (1976), who illustrates reduplication in a standardized Mokilese orthography that does not represent excrescent vowels. Elsewhere in his grammar, however, Harrison describes a vowel-insertion process that breaks up non-homorganic sequences like *k-n* (p. 42), which applies in forms like *nek-nekid* (p.c.). While this makes Mokilese and Pohnpeian look more similar than they might otherwise seem, it is unfortunate, since McCarthy & Prince (1986), Blevins (1996), Kennedy (2000), and Crowhurst (to appear) use the languages as an argument for $\sigma_{\mu\mu}$ as a unit of prosodic morphology, despite the fact that the prefix often is not a heavy syllable.

Analytically, we can attribute the avoidance of such sequences to CODACONDITION, as defined in (3). This is simply a restriction on the association between moras and consonants.

- (3) CODACONDITION Moraic consonants with unique [place] specification are forbidden.

Mokilese has full respect for CODACONDITION: the medial codas of forms like *kak-kak* satisfy it, while the non-homorganic sequences of **pɔd-pɔdok* do not. I return to this in greater detail in the next section, but I should repeat here that word-final consonants satisfy CODACONDITION since they are not moraic.

The construal of word-final consonants is not merely a stipulation on structure; it can follow from formal constraints. In addition to CODACONDITION, the distribution of moraic consonants is also a function of the constraint WEIGHT-BY-POSITION, defined in (4), which requires coda consonants to be moraic, as I show in Tableau (5).

- (4) WEIGHT-BY-POSITION Coda consonants are moraic.

(5)	pɔdok	CODA CONDITION	WEIGHT-BY- POSITION
a.	$\mu\mu \quad \mu \quad \mu\mu$ (pɔd)(pɔ)(dok)	d!k	
b.	$\mu\mu \quad \mu \quad \mu$ (pɔd)(pɔ)(dok)	d!	
c.	$\mu \quad \mu \quad \mu$ (pɔd)(pɔ)(dok)		kd!
d.	$\mu \mu \quad \mu \quad \mu$ ☞ (pɔdi)(pɔ)(dok)		k

CODACONDITION rules out any form of **pɔd-pɔdok* that has a moraic consonant, such as the form (5a), with both its codas moraic, and (5b), with only one moraic coda. A third version is possible in which neither coda is moraic; this fully satisfies CODACONDITION, but incurs two violations of WEIGHT-BY-POSITION, whereas the optimum *pɔdi-pɔdok* violates it only once. Because of this result, throughout this chapter I consider all medial codas to be moraic and all final ones not to be.

5.2.1 Emergent feet in Mokilese prefixing

In this section, I introduce a non-templatic manner of deriving bimoraic prefixes for Mokilese, inspired by the model developed for Pohnpeian in Chapter 4. Rehg (1993) claims the prosodic structure of Mokilese is similar to Pohnpeian, with primary stress following on the final moraic segment, and preceding stresses occurring on alternating moraic segments. Because every durative prefix in Pohnpeian receives exactly one stress, the tendency for the prefix to be bimoraic is attributed in part to the requirement that morphemes be aligned to foot boundaries. Bimoraic prefixes are avoided in Pohnpeian only to avoid stress clash.

However, given the absence of Quantitative Complementarity in Mokilese, I do not appeal stress-clash avoidance to guarantee the quantity of the Mokilese prefix. Still, a similar use of morpheme-to-foot alignment is possible for Mokilese, since the progressive prefix is invariantly bimoraic. As a result, the analysis can begin with the proposal that ALIGN-MORPHEME-FOOT, defined in (6), is ranked very highly in Mokilese.

- (6) ALIGN-MORPHEME-FOOT Morpheme boundaries are aligned to foot boundaries. (Where morpheme boundaries are measured at the segmental level)

As I have already noted, Mokilese does not have a pattern of Quantitative Complementarity, the Pohnpeian phenomenon in which the prefix has the opposite quantity of the stem to which it attaches. Thus, while in Pohnpeian we see bimoraic prefixes for monomoraic stems, as in *paa-pa*, and monomoraic prefixes for bimoraic stems, as in *du-duup*, Mokilese has bimoraic prefixes in both cases: *paa-pa*, and *jaa-jaak*. Quantitative Complementarity is predicted in Pohnpeian by the rank of *HH over FOOTBINARITY, both of which are defined in (7).

- (7) *HH Heavy syllables must not be adjacent.
FOOTBINARITY Feet are bimoraic.

With *HH ranked higher, Pohnpeian creates a monomoraic foot for the prefix of *duup*, at the expense of FOOTBINARITY, in favour of satisfying *HH. A bimoraic prefix could not satisfy *HH, as Tableau (8) illustrates.

(8)	duup + DURATIVE POHNPEIAN	ALIGN MORPH-Ft	*HH	FOOT BIN
a.	(duu).duup)		*!	
b.	 (du).duup)			*

Mokilese can receive a bimoraic prefix for heavy monosyllables like *jaak* simply by having a higher rank of FOOTBINARITY. Thus, a bimoraic prefix is preferred because it satisfies FOOTBINARITY, despite its violation of *HH, as Tableau (9) shows.

(9)	jaak + PROGRESSIVE MOKILESE	ALIGN MORPH-Ft	FOOT BIN	*HH
a.	 (jaa)(jaak)			*
b.	(ja)(jaak)		*!	

The same rank of FOOTBINARITY over *HH is enough to achieve bimoraic prefixes for Mokilese in monomoraic stems like *pa* and trimoraic stems like *sɔɔrok*. Because of the highest rank of ALIGN-MORPHEME-FOOT, a form like (*pa-pa*), with a morpheme boundary inside the foot, cannot be optimal. The prefix must then comprise its own foot, which in turn must be binary because of FOOTBINARITY.

Note, however, that monomoraic final feet are tolerated in stems, as *paa-pa* shows. FOOTBINARITY is thus outranked by the constraint ALLFEETRIGHT, as defined in (10), to force such a result. The effects of the ranking of ALIGN-MORPHEME-FOOT and ALLFEETRIGHT are summarized in Tableau (11).

- (10) ALLFEETRIGHT Feet are final; Assess a violation for each mora occurring between the right edge of every foot and the right edge of the word.

(11)	pa + PROGRESSIVE MOKILESE	ALIGN MORPH-Ft	ALLFEET RIGHT	FOOT BIN	*HH
a.	(pa .pá)	*!			
b.	(pàa)(pá)		**!		*
c.	(pà)(pá)		*	**!	
d.	 (pàa)(pá)		*	*	

The same result obtains for *sɔɔrok*. Since FOOTBINARITY outranks *HH, the preferred prefix is a binary one, as in *sɔɔ-sɔɔrok*, even though it violates *HH. Satisfying *HH would incur a violation of FOOTBINARITY in the prefix, as in *(*sɔ*)(*sɔɔ*)(*rok*), or ALIGN-MORPHEME-FOOT, as in *(*sɔ-sɔ*)(*rok*). Furthermore, ALLFEETRIGHT rules out a competitor like **sɔɔroki-sɔɔrok*, which satisfies FOOTBINARITY to the same extent that the optimum does, and which better satisfies *HH. Note that ALLFEETRIGHT is ranked

below ALIGN-MORPHEME-FOOT, which prevents $*(sɔ-sɔ)(ɔrok)$ from emerging. These effects are summarized in Tableau (12).

(12)	sɔɔrok +PROGRESSIVE MOKILESE	ALIGN MORPH-FT	ALLFEET RIGHT	FOOT BIN	*HH
a.	$\text{☞ } (sɔɔ)(sɔɔ)(rok)$		****	*	*
b.	$(sɔ)(sɔɔ)(rok)$		****	**!	
c.	$(sɔ-sɔ)(ɔrok)$	*!	**		
d.	$(sɔɔ)(roki)(sɔɔ)(rok)$		***!	*	

The rank of ALLFEETRIGHT over MAX-BR actually guarantees that the prefix will never be more than a single foot. However, since I have not actually seen any four-mora stem cited in the progressive, I do not provide a tableau for the progressive of *maajaaj*; however, the rank of ALLFEETRIGHT over MAX-BR predicts that *maajaaj* would receive a single-foot reduplicant, as in $(maa)-(maa)(jaaj)$, instead of the more faithful (but two-foot) full-copy of $(maa)(jaa)(maa)(jaaj)$. There is additional motivation for the Mokilese rank of ALLFEETRIGHT in Section 5.2.5 below.

Before enriching the hierarchy to handle the avoidance of consonant sequences, I should acknowledge that a truly stress-driven alternative account like that developed for Pohnpeian is possible, but just not necessary. Because of the Mokilese rank of FOOTBINARITY over *HH, we do not need to appeal to stress-clash avoidance to derive bimoraic prefixes in heavy-initial trimoraicisms like *sɔɔ-sɔɔrok*—an approach that was needed in Pohnpeian to force the bimoraic prefix of *duu-duupek*.

The stress account works as follows. Since the reduplicant receives its own foot, it also has a stressed mora; hence, we can attribute the bimoraic prefix in forms like *paa-pa* to a requirement that stresses alternate—that they not be adjacent. This can be accomplished with *CLASH and *LAPSE. Rehg (1993) suggests that the stress facts for Mokilese are similar to Pohnpeian: stress associates to moras, with primary stress invariably on the rightmost mora of the word, and secondary stress on alternate moras.

Together with ALIGN-MORPHEME-FOOT, the constraints *CLASH and *LAPSE predict bimoraic prefixes for monomoraic stems like *pa*. The monomoraic competitor would result in either a stress clash, as in $*(pà).(pá)$, or a violation of ALIGN-MORPHEME-FOOT, as in $*(pa.pá)$. The same is true of monomoraic prefixes for *duupek* in Pohnpeian: avoidance of stress clash, as in the optimum $(dùu)(dúu)(pek)$, is more important than avoidance of adjacent heavy syllables. However, given the Mokilese rank of FOOTBINARITY over *HH (which effectively buries it), there is no need for an overt appeal to stress placement to obtain a bimoraic prefix in *sɔɔ-sɔɔrok*. The only reason to avoid this approach for Mokilese is to save brain energy—the ink is already spent.

5.2.2 Resolving consonant sequences

The use of FOOTBINARITY also predicts bimoraic prefixes for *kak* and *dop*, but since these stems have final consonants, several options will arise. Not only is vowel

lengthening possible, parallel to *paa-pa*, but so is completely faithful reduplication, as in *kak-kak*, and reduplicative epenthesis, as in *dopi-dop*. The system therefore needs some expansion in order to allow gemination only in *kak-kak* and epenthesis only in *dopi-dop*. It also needs to guarantee that Nasal Substitution does not occur in Mokilese; that is, *kak* should not reduplicate as **kaŋ-kak*.

Excrescent vowels appear in Mokilese only if two potentially adjacent consonants are non-homorganic. I therefore include CODACONDITION in the hierarchy, which will motivate the avoidance of non-homorganic sequences. In addition, I include a constraint IDENT-PLACE-BR, defined in (13), which requires identity of [place] for segments in correspondence. This is important since a reduplicative consonant could otherwise have an altered place of articulation, as in **(dòd).(dóp)*, that would satisfy CODACONDITION.

(13) IDENT-PLACE: Segments in correspondence have identical [place] specification.

Since Mokilese reduplicates *dop* as *dopi-dop*, it must be the case that the satisfaction of IDENT-PLACE and CODACONDITION is met at the expense of epenthesis, since the actual form contains an epenthetic segment lacking in the fully faithful **dop-dop*. They must then outrank DEP-BR, defined in (14), which forbids reduplicative epenthesis.

(14) DEP-BR Every segment in the Reduplicant has a correspondent in the Base.

In addition, another way of avoiding the non-homorganic sequence is to avoid copying the second consonant, as in **doo-dop*, an option that Mokilese does not use. As a result, Base-Maximization must be a priority over the avoidance of epenthesis, so MAX-BR, defined in (15), also needs to outrank DEP-BR.

(15) MAX-BR Every segment in the Base has a correspondent in the Reduplicant.

The effect of ranking IDENT-PLACE, CODACONDITION, and MAX-BR over DEP-BR is summarized in Tableau (16). The assimilated form *dod-dop* is ruled out by IDENT-PLACE, the faithful *dop-dop* by CODACONDITION, and the undercopied *doo-dop* by MAX-BR. As a result, the epenthetic form *dopi-dop* emerges as the winner. Although not all of the rankings in Tableau (16) are critical, I consider the top two undominated since they do not appear to be violated elsewhere.

(16)	dop + PROGRESSIVE	IDENT PLACE	CODA COND	MAX BR	DEP BR
a.	☞ (dò.pi).(dóp)				*
b.	(dòo).(dóp)			p!	
c.	(dòp).(dóp)		*!		
d.	(dòd).(dóp)	*!			

The situation for *kak-kak* is more competitive, however, since several candidates satisfy IDENT-PLACE, CODACONDITION, and MAX-BR. For example, a long-vowel form like **kaa-kak* could satisfy MAX-BR, as long as the reduplicant's consonant stands in a multiple correspondence relation with both consonants of the stem—in fact, this is what I propose emerges in Pingilapese, in Section 5.3. Such a multiple-correspondent form also satisfies IDENT-PLACE, because its prefix's only consonant is specified for the same place feature as both its stem correspondents. It also easily satisfies CODACONDITION as it has no moraic consonants at all.

Furthermore, the fact that the reduplicant's final consonant is homorganic with what follows sets up a situation in which a Pohnpeian-like process of Nasal Substitution could occur, allowing a form like **kàŋ-kák*, another form that satisfies each constraint in Tableau (16). To avoid such results, I appeal to several more constraints of Base-Reduplicant Identity, formally defined in (17): WEIGHT-IDENT-BR, which forbids the vowel-lengthening in **kaa-kak*, and IDENT-NASAL, which forbids the nasal substitution in **kàŋ-kák*.

- (17) WEIGHT-IDENT Segments in correspondence are identical in their quantity.
- IDENT-NASAL Segments in correspondence have identical [nasal] specification.

These constraints have a critical ranking over *OBS/MORA, defined in (18), which is a formalization of the requirement that moraic consonants be sonorant.

- (18) *OBS/MORA Moraic consonants must be sonorant

The result is that *kak-kak*, which violates *OBS/MORA, is preferred over **kaa-kak* and **kàŋ-kák*, each of which violates one of the constraints in (17). DEP-BR must also outrank *OBS/MORA, to keep **kaki-kak* from emerging, in which epenthesis helps avoid the moraic obstruent. I summarize the situation in Tableau (19).

(19)	kak + PROGRESSIVE	IDENT PLACE	CODA COND	MAX BR	DEP BR	WEIGHT IDENT	IDENT NASAL	*OBS/ MORA
a.	(kà.ki).(kák)				*!			
b.	(kàa).(kák)					*!		
c.	(kàŋ).(kák)						*!	
d.	☞ (kàk).(kák)							*

It should be noted that the opposite ranking for IDENT-NASAL and *OBS/MORA would produce a Pohnpeian-like form: the nasally-substituted **kàŋ-kák* would be optimal. In other words, it is the very low rank of *OBS/MORA in Mokilese that allows obstruent geminates to emerge.

5.2.3 Reduplicating polysyllables

One last issue remains before we move to the vowel-initial subpattern. For though the hierarchy cleanly predicts epenthesis only in cases of potential non-homorganic sequences, it does so only for monosyllables. Polysyllables like *pɔdɔk* receive a bimoraic prefix, as in *pɔdi-pɔdɔk*, but with an excrescent vowel rather than a copy of the stem's second vowel. I attribute this to a general requirement of size restriction, formalized as ALL-σ-RIGHT in (20).

- (20) ALL-σ-RIGHT Align-R(Syllable, Word)
All syllables are final.

Without this constraint, MAX-BR would choose **(pɔdo)(pɔdɔk)* over *(pɔdi)(pɔdɔk)*. Abstractly, we can represent the optimal form as having only three syllables; its epenthetic vowel is not the nucleus of a syllable, and as a result, the form better satisfies ALL-σ-RIGHT.

Imaginably, a competing representation of **(pɔdo)(pɔdɔk)* could also have only three syllables, but this form can be ruled since it contains a morphological vowel (the second vowel of the prefix) which is not syllabified. I formalize this as the constraint PARSE-VOWEL, defined in (21).

- (21) PARSE-VOWEL All correspondent vowels are syllable nuclei.

The role of ALL-σ-RIGHT and PARSE-VOWEL is shown in Tableau (22). Several candidates have bimoraic prefixes, satisfying FOOTBINARITY. The most faithful form, **(pɔdo)(pɔdɔk)*, has two possible representations; a 3-syllable form is ruled out by PARSE-VOWEL, while a 2-syllable form violates ALL-σ-RIGHT one too many times. Of the two remaining competitors, *(pɔdi)(pɔdɔk)*, which includes a copy of the second consonant, is preferred by MAX-BR over the less-maximized **(pɔɔ)(pɔdɔk)*. Clearly, a closed heavy syllable, as in **(pɔd)(pɔdɔk)*, is to be avoided, as it violates CODACONDITION.

Note that there may appear to be some redundancy in Tableau (22); I have attributed the bimoraic quantity of the prefix to FOOTBINARITY. However, if we ignored FOOTBINARITY, the optimal form would still be chosen over **(pɔɔ)(pɔdɔk)*, since MAX-BR can distinguish them. However, when we consider forms like *(wiɪ)(wia)*, whose stem has two vowels in hiatus, it becomes clear that FOOTBINARITY is a necessary member of the hierarchy.

(22)	pɔdɔk + PROGRESSIVE	CODA COND	FOOT BIN	PARSE VOWEL	ALL-σ RIGHT	MAX BR	DEP BR
a.	(pɔd)(pɔdɔk)	*!			**	ok	
b.	(pɔ)(pɔdɔk)		*!		**	dok	
c.	(p ɔ d o)(p ɔ d o k) $\begin{array}{ccc} \backslash & \backslash & \backslash \\ \sigma & \sigma & \sigma \end{array}$			o!	**	k	
d.	(p ɔ d o)(p ɔ d o k) $\begin{array}{cccc} \backslash & \backslash & \backslash & \backslash \\ \sigma & \sigma & \sigma & \sigma \end{array}$				***!	k	
e.	(p ɔ ɔ)(p ɔ d o k) $\begin{array}{ccc} \backslash & \backslash & \backslash \\ \sigma & \sigma & \sigma \end{array}$				**!	dok!	
f.	\leftarrow (p ɔ d i)(p ɔ d o k) $\begin{array}{ccc} \backslash & \backslash & \backslash \\ \sigma & \sigma & \sigma \end{array}$				**	ok	*

Given that ALL-σ-RIGHT needs to figure in the system and outrank MAX-BR, stems with internal hiatus will always reduplicate with only one vowel in the prefix. Both *wii-wia* and **wi-wia* (which violate MAX-BR equally) satisfy ALL-σ-RIGHT better than the more faithful **wia-wia*. However, no other constraint can pick the bimoraic prefix of *wii-wia* over **wi-wia*, and in fact, WEIGHT-IDENT prefers the monomoraic reduplicant in **wi-wia*. As a result, some constraint besides MAX-BR motivates the choice of the bimoraic prefix, and FOOTBINARITY can serve exactly this purpose. The role of FOOTBINARITY for choosing *wii-wia* over **wi-wia* is summarized in Tableau (23), where it is clear that without FOOTBINARITY, an incorrect candidate would be chosen.

(23)	wia + PROGRESSIVE	CODA COND	FOOT BIN	ALL-σ RIGHT	MAX BR	DEP BR	WEIGHT IDENT
a.	(wi)(wia)		*!	**	a		
b.	\leftarrow (wii)(wia)			**	a		*
c.	(wia)(wia)			***			

The rank of FOOTBINARITY and ALL-σ-RIGHT show that the hierarchy handles stems with hiatus vowels, without additional recourse to a constraint like ONSET. The constraints introduced here therefore handle the complete set of consonant-initial reduplicatives in Mokilese. Superficially, the form of the Mokilese progressive may seem quite different from that of the Pohnpeian durative: excrescent vowels appear in a more restricted set of environments in Mokilese, and there is no nasal substitution. Moreover, unlike in Pohnpeian, the Mokilese prefix is always bimoraic. However, the

two systems follow from nearly identical grammars. The possibility of homorganic obstruent sequences and the lack of nasal substitution in Mokilese can both be attributed to a rank of *OBS/MORA below IDENTNASAL. Likewise, the tolerance of sequences of heavy syllables in Mokilese follows from the rank of *HH below FOOTBIN. The two languages can otherwise have much of the same constraint hierarchy. In the following subsection, I test the predictions of these changes for vowel-initial progressives in Mokilese.

5.2.4 Mokilese vowel-initial forms

Vowel-initial stems in Mokilese present an interesting problem for the notions of prosodic alignment and template satisfaction. Examples of such forms are provided in Table (24). In nearly every case, the reduplicated form begins with a vowel followed by a geminate consonant. One exception is *andandip*, in which case what follows the initial vowel is a homorganic sequence of obstruent and nasal.

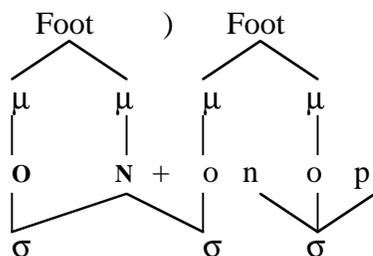
(24) Progressive forms of vowel-initial verbs

<i>verb</i>	<i>gloss</i>	<i>progressive</i>	<i>gloss</i>
ir	<i>to string</i>	<u>irr</u> -ir	<i>to be stringing</i>
onop	<i>to prepare</i>	<u>onn</u> -onop	<i>to be preparing</i>
andip	<i>to spit</i>	<u>and</u> -andip	<i>to be spitting</i>
		<u>all</u> -alu	<i>walking</i>
		<u>urr</u> -uruur	<i>laughing</i>

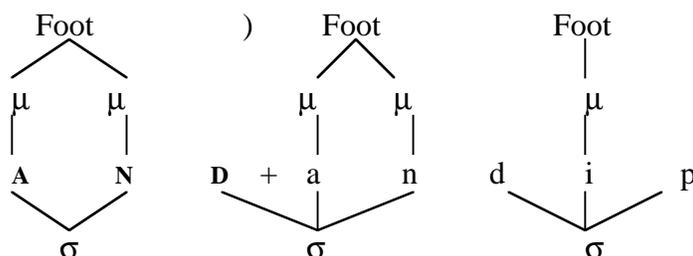
Given that the progressive forms' geminates branch across syllable boundaries, this group of stems has proven frustrating for non-derivational OT accounts. Blevins (1996) suggests the template constraint RED= σ_{mm} is gradiently violable, such that *ir.r-ir is a worse violation than ir.r-ir. In other words, a reduplicant that is smaller than a heavy syllable is a fatal violation, while one that creates a heavy syllable plus extra segmental material is acceptable. Kennedy (2000) argues for a left-sided template, which ir.r-ir fully satisfies. In contrast, Crowhurst (2002) argues for a right-sided template, but crucially, the prefix's prosodic alignment is evaluated at the moraic level. Forms like ir.r-ir and an.d-an.dip have well-aligned prefixes, because the onset of the second syllable is non-moraic, by virtue of being an onset.

The view that the Mokilese vowel-initial progressive subpattern is a problematic case of misalignment is a consequence of an assumption that the language strictly obeys the Prosodic Hierarchy. That is, we assume that its segments parse into moras, its moras into syllables, and its syllables into feet. However, if we dispense with a strict interpretation of the Prosodic Hierarchy, it is possible to posit representations in which segments associate to moras at one tier, but to a syllabic tier independently, as introduced in § 3.5.2. I provide examples of such a representation for onn-onop and and-andip is provided in Figure (25).

(25) a. Mokilese *onn-onop*



b. Mokilese *andandip*



Both structures in (25) have an internal morpheme boundary, indicated by the + sign, that occurs between two moraic segments which belong to different feet. As such, the morpheme boundary in both forms is well-aligned to a foot boundary.

This representation of structure, and its interaction with Alignment, shares the basic intuition of Crowhurst's approach: that for the association of the reduplicant to some prosodic category, only the alignment of moraic segments matters. However, the separation of moras and syllables into independent tiers in (25) allows ALIGN-MORPHEME-FOOT (which carries out the work of Crowhurst's ALIGN-RED- $\sigma_{\mu\mu}$ -R) to evaluate the association between *segmental* morpheme boundaries and foot boundaries. As a result, regardless of how the prefix is syllabified, its right segmental boundary (following the geminate *n* in *onn-onop* and *d* in *and-andip*) is still well-aligned to its foot, and the constraint is satisfied. There is therefore no need for an alignment constraint that holds over morpheme boundaries at the moraic level.

Several other differences exist between this account of Mokilese and Crowhurst's that deserve some comment. Rather than specifically align the reduplicant, the present approach attributes the prefix's shape to a general requirement of morpheme-to-foot association. As such it avoids the kind of template that predicts prosodic back-copy; this argument against templatic satisfaction in OT is known as the Kager-Hamilton Conundrum (McCarthy & Prince 1999), which remains a problem even for one-sided templatic approaches. The present account also obviates the need for "heavy-syllable" as a unit of prosodic morphology to which morphological categories may be required to associate.

Having shown how the geminate of *onn-onop* and the nasal-obstruent sequence of *and-andip* both satisfy ALIGN-MORPHEME-FOOT, it is now possible to show how the hierarchy developed in this section handles these forms. In the case of *andip*, a monomoraic prefix is prevented by FOOTBINARITY, which rules out $*(\grave{\mathbf{a}})(\mathbf{n}\text{-}\grave{\mathbf{a}})(n.d\acute{\mathbf{i}}p)$, or ALIGN-MORPHEME-FOOT, which rules out $*(\mathbf{a.n}\text{-}\grave{\mathbf{a}})(n.d\acute{\mathbf{i}}p)$, in which the first foot dominates moraic segments belonging to two different morphemes—in other words, it branches over a morpheme boundary.

Of the bimoraic possibilities, a form like $*(\grave{\mathbf{a}}\mathbf{n})(\grave{\mathbf{a}}n)(d\acute{\mathbf{i}}p)$ is forbidden by CODA CONDITION, since its prefix has a moraic *n* with its own [place] feature. This only leaves $(\grave{\mathbf{a}}\mathbf{n})\mathbf{d}(\grave{\mathbf{a}}n)(d\acute{\mathbf{i}}p)$, which corresponds to the representation in Figure (25), and an epenthetic form, $*(\grave{\mathbf{a}}\mathbf{n}\mathbf{i})(\grave{\mathbf{a}}n)(d\acute{\mathbf{i}}p)$ as satisfactory candidates. Both forms satisfy ALIGN-MORPHEME-FOOT and are tied by FOOTBINARITY and ALL- σ -RIGHT, which the epenthetic form violates minimally in a manner parallel to *pɔdi-pɔdok* in Tableau (22). The choice between them is ultimately made by MAX-BR. This result is summarized in Tableau (26).

(26)	andip + PROGRESSIVE	ALIGN MORPH-FT	CODA COND	FOOT BIN	ALL- σ RIGHT	MAX BR	DEP BR
a.	$(\grave{\mathbf{a}})(\mathbf{n}\text{-}\grave{\mathbf{a}})(n.d\acute{\mathbf{i}}p)$			**!	**	dip	
b.	$(\mathbf{a.n}\text{-}\grave{\mathbf{a}})(n.d\acute{\mathbf{i}}p)$	*!			**	dip	
c.	$(\grave{\mathbf{a}}\mathbf{n})(\grave{\mathbf{a}}n)(d\acute{\mathbf{i}}p)$		*!	*	**	dip	
d.	$\Rightarrow (\grave{\mathbf{a}}\mathbf{n})\mathbf{d}(\grave{\mathbf{a}}n)(d\acute{\mathbf{i}}p)$			*	**	ip	
e.	$(\grave{\mathbf{a}}\mathbf{n}\mathbf{i})(\grave{\mathbf{a}}n)(d\acute{\mathbf{i}}p)$			*	**	dip!	*
f.	$(\grave{\mathbf{a}}\mathbf{n})\mathbf{n}(\grave{\mathbf{a}}n)(d\acute{\mathbf{i}}p)$			*	**	dip!	

A parallel argument is possible for *onop*, for which the bimoraicity of the prefix is again motivated by FOOTBINARITY. As with *andip*, the plausible candidates are an epenthetic form $*(\mathbf{o}\mathbf{n}\mathbf{i})(on\acute{o}p)$ and the optimal $(\mathbf{o}\mathbf{N})(\mathbf{n}\text{-}on\acute{o}p)$, with a geminate across a syllable boundary. Here the choice is made by DEP-Br, as summarized in Tableau (27).

(27)	onop+ PROGRESSIVE	ALIGN MORPH-FT	CODA COND	FOOT BIN	ALL- σ RIGHT	MAX BR	DEP BR
a.	$(\mathbf{o})(\mathbf{n}\text{-}on\acute{o}p)$			*!	**	op	
b.	$(\mathbf{o}\mathbf{N})(on\acute{o}p)$		*!		**	op	
c.	$\Rightarrow (\mathbf{o}\mathbf{N})(\mathbf{n}\text{-}on\acute{o}p)$				**	op	
d.	$(\mathbf{o}\mathbf{n}\mathbf{i})(on\acute{o}p)$				**	op	*!

Another candidate to consider is **omp-onop*, in which the prefix is more faithful to the stem than that of the optimal *onn-onop*. However, the constraint IDENT-PLACE prefers the optimum, since **omp-onop* contains a segment, *m*, whose place features are unlike those of its base correspondent *n*. This effect is similar to the avoidance of *dod-dop* in Tableau (16).

An interesting implication of *onn-onop* is that WEIGHT-IDENT-BR, which its geminate violates, must rank below DEP-BR, to ensure that the epenthetic form **oni-onop* is not optimal. This ranking is suggested for Pohnpeian in § 4.3.4, and as further perusal of Pingilapese in Section 5.3 will show, seems to be robust across the Pohnpeic group.

Furthermore, the use of gemination in *on.n-o.nop* instead of the ungeminated bimoraic form **on.o.nop* (27b) is attributed here to the activity of CODACONDITION, and not to ONSET, as is the case for Blevins (1996), Kennedy (2000), and Crowhurst (2002). This makes the present analysis more attractive for two reasons: first, it is consistent with the fact that CODACONDITION is respected across the language, while ONSET is not; second, there is a parallel in hiatus stems. For example, the lengthened vowel of *wii-wia* is also attributed not to ONSET, but to another independently motivated Markedness effect, ALL-σ-RIGHT.

A final contribution of Tableau (27) is that it allows us to characterize the third grammatical difference between Pohnpeian and Mokilese. If Pohnpeian had a stem *onop*, we would expect the durative to surface looking like the epenthetic form (27d), *oni-onop*. An exact parallel is Pohnpeian *ami-amas* ‘being raw,’ which occurs instead of **amm-amas*, despite Pohnpeian’s permissiveness of nasal geminates.

To predict epenthesis in such cases in Chapter 4, I attribute Pohnpeian’s avoidance of cross-syllable gemination to a second morpheme-alignment constraint, defined in (28) as ALIGN-MORPHEME-SYLLABLE. This constraint requires morpheme boundaries to align to syllable edges and is satisfied by *ami-amas*, but not by *amm-amas*.

- (28) ALIGN-MORPHEME-SYLLABLE Morpheme edges are aligned to syllable boundaries.

The Mokilese forms *on.n-o.nop* and *an.d-an.dip* violate ALIGN-MORPHEME-SYLLABLE, suggesting that the language ranks it below DEP-BR. This critical ranking is illustrated in Tableau (29), where it is shown that the epenthetic candidate **oni-onop* is ruled out only because DEP-BR crucially outranks ALIGN-MORPHEME-SYLLABLE.

(29)	onop + PROGRESSIVE MOKILESE	MAX BR	DEP BR	ALIGN- MORPH-SYLL
a.	☞ (oN)(n-onóp)	op		*
b.	(oni)(onóp)	op	*!	

Something to notice in Tableau (29) is that a higher rank of ALIGN-MORPHEME-SYLLABLE predicts the epenthetic candidate, parallel to Pohnpeian *ami-amas*. It can therefore be said that ALIGN-MORPHEME-SYLLABLE outranks DEP-BR in Pohnpeian, but vice versa in Mokilese.

A plausible alternative to the use of ALIGN-MORPHEME-SYLLABLE for differentiating Mokilese *onn-onop* from Pohnpeian *ami-amas* is to appeal to a difference in their tolerance of gemination and epenthesis. I return to this issue in greater detail in Chapter 6, where I show that only the ALIGN-MORPHEME-SYLLABLE approach is

appropriate. As an interim summary, the following rankings can be said to be common to Pohnpeian and Mokilese:

- (30) a. *CLASH,
*LAPSE, » ALLFEETRIGHT
ALIGN-MORPHEME-FOOT
- b. ALLFEETRIGHT » FOOTBINARITY
- c. FOOTBIN,
ALL- σ -RIGHT, » DEP-BR » WEIGHT-IDENT » IDENT-NASAL
MAX-BR,
CODACOND

In addition, the languages have three contrastive rankings: Mokilese ranks *HH under FOOTBINARITY, below which it can have no visible effect; *OBS/MORA below IDENT-NASAL, below which it can have no visible effect, and ALIGN-MORPHEME-SYLLABLE below DEP-BR. In the following subsection, I show how the Mokilese system predicts the shape of its denotative suffix.

5.2.5 *The Mokilese denotative*

The remainder of this section is devoted to the illustration of how the Mokilese hierarchy also predicts the shape of its denotative suffix. As in Pohnpeian, there are three basic shapes of the Mokilese denotative suffix: a CVC form, as in *p^wirej-rej* ‘dirty’, a CV form, as in *nee-ne* ‘to divide’, and a VC form, as in *ala-al* ‘striped’. I will treat each suffix type individually, showing how its shape is predictable from the shape of the stem.

5.2.5.1 *CVC denotatives*

The set of CVC suffixes can be split into two subgroups: those that follow a fully specified stem-final vowel, as in *pik* → *pika-pik* ‘sandy’, and those that do not, as in *p^wirej-rej*. The latter cases are cited in Harrison’s orthography, but should be subject to his vowel-excrescence rule, which predicts them to surface with epenthesis, as in *p^wireji-rej*. The difference between the two subgroups is thus that one is composed of vowel-final stems like /pika/, while the other is composed of consonant-final stems like /p^wirej/. I provide additional examples of CVC denotatives in Tables (32-34), where it is evident that some additional discussion of the suffix’s shape is warranted.

The forms in Table (32) are verbs with stem-final vowels that persist in the denotative; for example, /pina + DENOTATIVE/ → *pina-pin*. The middle vowels must be stem vowels as their specification seems unpredictable; however, they are not copied into the suffix, which I attribute to FREE-VOWEL, repeated below as (31). Although it formally requires devoicing, FREE-VOWEL will have the effect of deleting word-final short vowels and shortening word-final long vowels in Mokilese.

- (31) FREE-VOWEL The vowel following the primary stress is not voiced.

It may seem odd, however, that an unreduplicated form can preserve its stem-final vowel, in apparent defiance of stem-final vowel lenition, as in *pina*, *sikɔ*, and *rujɔ*. However, I assume that unreduplicated transitive forms like *pina* are actually morphologically complex. The transitive classifier that these verbs take is some vowel, similar to the *-y/-w* classifier of Woleaian. Thus, *pina* starts out as /pina + V/, and the final suffix vowel disappears in satisfaction of stem-final vowel deletion. This vocalic suffix is absent from denotative forms; as a result, the reduplicated forms all undergo final-vowel deletion with regularity. Note also that there is a process of ablaut that affects the stem-final vowel in many of the suffixed forms; for example, we see *jile-jil* instead of **jilɔ-jil*; I leave this alternation aside.

- (32) Mokilese denotative for verbs with stem-final vowel preserved in both forms

<i>probable UR</i>	<i>transitive (final vowel preserved by V suffix)</i>	<i>denotative</i>
<i>pina</i>	<i>pina</i> <i>to cover something</i>	<i>pina-pin</i> <i>to cover</i>
<i>jile</i>	<i>jilɔ</i> <i>to guard something</i>	<i>jile-jil</i> <i>to guard</i>
<i>sike</i>	<i>sikɔ</i> <i>to talk about something</i>	<i>sike-sik</i> <i>to converse</i>
<i>kira</i>	<i>kirɔ</i> <i>to peel</i>	<i>kira-kir</i> <i>denotative</i>
<i>jila</i>	<i>jilɔ</i> <i>to guard something</i>	<i>jila-jil</i> <i>intransitive</i>
<i>rujo</i>	<i>rujɔ</i> <i>to rub</i>	<i>rujo-ruj</i> <i>intransitive</i>

The forms in (33) resemble those in (32), with the exception that the final vowels of the transitive forms are totally absent from the denotatives. For example, the final vowel of *kosɔ* is absent from the denotative *kos-kos*; I take this as evidence that the stem is underlyingly /kos/, and surfaces as *kosɔ* in the transitive (through some classificational suffixation) but *kos-kos* in the denotative. Moreover, the denotative suffixes in (33) are predicted to be separated from the stem by excrescent vowels.

- (33) Mokilese denotative for verbs with consonant-final lexical entries

<i>probable UR</i>	<i>transitive (includes V remnant of VV suffix)</i>	<i>denotative</i>
<i>kas</i>	<i>kasɔ</i> <i>to throw something</i>	<i>kas-i-kas</i> <i>to throw</i>
<i>dɔp^w</i>	<i>dɔp^wɔ</i> <i>to pull something</i>	<i>dɔp^w-i-dɔp^w</i> <i>to pull</i>
<i>kos</i>	<i>koso</i> <i>to cut</i>	<i>kos-i-kos</i> <i>denotative</i>
<i>pirɔk</i>	<i>pirɔki</i> <i>to braid</i>	<i>pirɔk-rɔk</i> <i>braided</i>

The forms in (34) also need some explanation; each has a thematic consonant in the transitive, like the *d* in *pilɔd* or the *n* in *daun*, that is absent from the denotative. Again, I consider these to be morphologically complex, with the final consonants acting as transitive classifiers. Thus *pilɔd* is derived from /pilɔ+d/, but in the denotative, the *d*

is absent, so /pilɔ-pilɔ/ surfaces as *pile-pil* in respect of stem-final vowel deletion. The other denotative forms, *dɔu-dɔu* and *jɔi-jɔi*, seem to resist vowel deletion, since the final underlying segment of the reduplicative suffix is not deleted. However, these are not problematic if we consider them to be glide-final. Since these glides are word-final, they are extrametrical like other final consonants, non-moraic, and not subject to final-vowel lenition.

- (34) Mokilese denotative for verbs with transitive thematic consonants

<i>probable UR</i>	<i>unreduplicated</i> (includes C suffix)		<i>denotative</i>	
dau	daun	<i>to fill</i>	dɔu- dɔu	<i>denotative</i>
jai	jaim	<i>to sharpen</i>	jɔi- jɔi	<i>denotative</i>
pilɔ	pilɔd	<i>to pick something</i>	pile- pil	<i>to pick</i>

The last subgroup consists of nouns, which are unsuffixed, and thus have no evidence of final vowels except in the denotative. Thus *pika-pik* is assumed to have an underlying form /pika/. The others are considered to be underlyingly consonant final, and I include excrescent vowels in their denotative forms.

- (35) Mokilese denotative nouns

<i>probable UR</i>	<i>unreduplicated</i>		<i>denotative</i>	
pika	pik	<i>sand</i>	pika- pik	<i>to be sandy</i>
lɔŋ	lɔŋ	<i>a fly</i>	lɔŋ-i- lɔŋ	<i>full of flies</i>
p ^w irej	p ^w irej	<i>dirt</i>	p ^w irej-i- rei	<i>dirty</i>
sakai	sakai	<i>rock</i>	sakai-i- kai	<i>rocky</i>

Although each group of stems in the above tables needs some explanation, they all share the property of having CVC suffixes. What distinguishes the four groups is the underlying form of the stem; however, once we account for the variety of unreduplicated surface forms, it becomes clear that every stem ends underlyingly in either CVC, as in /p^wirej/, or CVCV, as in /pina/. It is now possible to test the hierarchy from Sections 5.2.1-5.2.4 against this group.

For the denotative of a stem like *pina*, the high rank of ALIGN-MORPHEME-FOOT predicts that the reduplicant will begin at a foot boundary, while FREE-VOWEL ensures that the suffix will not include a copy of the stem-final vowel. Note that the stem-final vowel can persevere in the base in *pina-pin* because it is no longer word-final, and is thus preserved to satisfy MAX-IO.

The only viable competing forms are (*pina*)(**pín**) and *(*pinà*)(**piín**), with a lengthened suffix vowel. Despite the fact that the latter is better by FOOTBINARITY, the actual form surfaces through better satisfaction of the higher ranked ALLFEETRIGHT.

(36)	pina + DENOTATIVE	ALIGN MORPH-FT	CODA COND	FREE VOWEL	MAX IO	ALLFT RIGHT	FOOT BIN
a.	(pìna)(pína)			*!		**	
b.	 (pìna)(pín)					*	*
c.	(pinà)(pín)					**!	
d.	(pìm)(pím)				*!	*	
e.	(pìn)(pín)		*!		*	*	*

A similar result obtains for stems with underlying final consonants like $p^w irej$. A number of forms satisfy both ALIGN-MORPHEME-FOOT and CODA CONDITION, the fully-copied $*(p^w i)(rèj i)(p^w iréj)$ and the optimal $p^w i(rèj i)(rèj)$; the choice between them is made by ALLFEETRIGHT. Other competitors include $*(rèj i)(rèj)$, which ties the optimum for ALLFEETRIGHT but violates MAX-IO, and $*p^w i(rèj i)(ré)$, which is ruled out by MAX-BR.

(37)	$p^w irej$ + DENOTATIVE	ALIGN MORPH-FT	CODA COND	FREE VOWEL	MAX IO	ALLFT RIGHT	MAX BR
a.	($p^w irè$)($ji-réj$)	*!				**	$p^w i$
b.	($p^w i$)(reJ)($p^w iréj$)		*!			*****	
c.	($p^w i$)($reji$)($p^w iréj$)					*****!	
d.	 $p^w i(rèj i)(rèj)$					*	$p^w i$
e.	$p^w i(rèj i)(ré)$						$p^w ij!$
f.	($rèj i$)($rèj$)				$p^w li$		

The hierarchy developed for the progressive prefix thus predicts the form of the denotative suffix in Tables (32-34): wherever the stem has a final CVC or CVCV sequence underlyingly, the suffix is correctly predicted to be a CVC. The suffix is invariantly a monomoraic foot, minimized by the effect of ALLFEETRIGHT.

5.2.5.2 CV denotatives

A second possibility for the denotative is a CV suffix, as in *nee-ne*. The transitive form of this verb is *neek*, with a thematic consonant not reflected in the derived form. It should be no surprise that a stem like *nee* would copy only a CV suffix, since a fully-copied form like $*(nee)(nee)$ would violate both FREEVOWEL (since its final long vowel is not shortened) and ALLFEETRIGHT. The only other possibility, $*(ne-ne)$, would not arise since its stem vowel is shortened, and it would also violate ALIGN-MORPHEME-FOOT. These effects are summarized in Tableau (38).

(38)	nee + DENOTATIVE	ALIGN MORPH-FT	CODA COND	ALLFT RIGHT	FOOT BIN
a.	☞ (nèe)(né)			*	*
b.	(neè)(neé)			**!	
c.	(ne- né)	*!			

An interesting effect of the grammar is that for CVV stems, the progressive and denotative would look identical. In the progressive form, the stem-final vowel would shorten in order to satisfy FREEVOWEL, while the prefix would retain a long vowel in order to maintain alternating stress. The denotative, as the above tableau shows, keeps the stem vowel long, since the suffix protects it from final-vowel lenition, and the suffix vowel shortens.

The last set of denotative forms are those derived from VC verbs like *al* ‘stripe’ and *uk* ‘blow’. While the suffix of each these denotatives apparently has a lengthened vowel, as in *alaal* and *ukuuk*; there is another possible parse for these forms. For example, *ala-al* could contain a second vowel in the stem that is identical to the following vowel, parallel to the prefixed Pohnpeian form *uku-uk* discussed in § 4.3.4. This representation is preferred by ALLFEETRIGHT, and also wins over the competitor *a.l-al* which, depending on its footing, would violate ALIGN-MORPHEME-FOOT or *CLASH. Other competitors include forms like **all-al* and **aal-al*, each of which is ruled out by stem-faithfulness because they have a lengthened stem segment. I summarize this in Tableau (39).

(39)	ala + DENOTATIVE	ALIGN MORPH-FT	CODA COND	WEIGHT IDENT-IO	ALLFT RIGHT	FOOT BIN
a.	☞ (àla)(ál)				*	*
b.	(à)l(aál)				**!	*
c.	(a.l- ál)	*!				
d.	(àa)l(ál)			aa!		
e.	(à)l(ál)			ll!		

The Mokilese denotative thus behaves much like its cognate in Pohnpeian. Despite its various surface forms, its shape is predicted neatly by the hierarchy developed for the progressive. The rank of ALLFEETRIGHT » FOOTBINARITY ensures that the suffix is always monomoraic, and the alternants CVC, CV, and VC reflect the segmental melody of the stem.

5.2.6 Mokilese: a discussion

In VC denotative forms, an interesting contrast emerges for Mokilese that is absent in Pohnpeian. In both languages, many CVC and CV denotatives look identical to progressive (or durative) forms. For example, both languages would reduplicate a CVC

stem like $d\wp^w$ as $d\wp^wi-d\wp^w$, in both the progressive and denotative. They would also reduplicate a CVV form like *duu* as *duu-du*, again for both derived forms. However, the similarity in appearance for VC forms is only found in Pohnpeian, in which the hierarchy predicts a stem like *uk* to occur as *uku-uk* in both the denotative and progressive. Mokilese, in contrast, would have *uk.k-uk* as a progressive and *uku-uk* as a denotative.

It is an interesting asymmetry that Mokilese vowel-initial stems receive prefixes with gemination, as in *onn-onop*, but suffixed forms cannot have gemination. Gemination is allowable in the prefixing case because of the relatively low rank of WEIGHT-IDENT-BR, while the relatively high rank of WEIGHT-IDENT-IO prevents gemination in the suffixing case. The difference is a function of the locus of gemination: in the prefix in *onn-onop*, but in the stem in **all-al*.

Thus, Mokilese vowel-initial forms aside, it is possible for a verb to be ambiguously reduplicated, where its surface form does not make it obvious whether it has a prefix or a suffix. We can speculate that such situations are in fact avoidable by the presence of thematic consonants, which can occur with progressives, but not denotatives. For the Pohnpeian speaker, then, *duu-du* ‘dive’ is clearly a denotative, since it lacks the thematic consonant *p* seen in *duup* and *du-duup*. Likewise, the Mokilese speaker knows *nee-ne* is a denotative, since it lacks the thematic consonant seen in *neek* (and, presumably, *nee-neek*).

To some extent, then, acknowledging the ability of speakers to distinguish denotatives and progressives leads to the claim that the two affixes are distinct partially by extra-phonological factors. That is, syntactic information about the function of the reduplicated form and lexical information about the stem’s thematic consonant can both help disambiguate an otherwise ambiguous derived form. I find this result satisfactory, since the motivation for even having two reduplicative morphemes is itself extra-phonological.

Furthermore, there appears to be some similarity in the function of the two affixes. The prefix in both languages inflects a verb for habitual aspect, thus creating a stem that describes continuing activity. The function of the denotative is more difficult to single out, but its intransitive tendency suggests a sort of non-specific predication. As an example, making a denotative for a verb like *throw* results in an intransitive, applicable to anything or anyone that throws, but not referring to a particular event of throwing. It should not be a stretch to see an adjectival function in the denotative, then, and with it, a hint of iteration or continuousness.

Indeed, Goodenough & Sugita (1980) observe some difficulty on the part of the linguist for differentiating between the two cognate affixes of Chuukese. They conclude that one affix, the suffix, indicates repetition of an action at a particular time, while the prefix indicates repetition of an action over many instances.

Given the similarity in both form and function of the affixes in Mokilese, it should be no surprise that the line between them is sometimes unclear, and that what phonologically behaves as one kind of affix is interpreted as the other, by both speakers and researchers. For example, Harrison cites the Mokilese forms *oppop* ‘pull’ and *ijjej* ‘husk’ as denotative verbs, yet they clearly look progressive, as the gemination should

indicate. Nevertheless, a curious but plausible possibility is that these forms are underlyingly geminate-final, and that such structures are illicit at the surface. Thus, the stem /opp/ would surface *op* unreduplicated, as *op.p-op* in the progressive, and *op.p-op* in the denotative. Still, parallel examples of this mismatch arise in other Micronesian languages, including Pohnpeian, Chuukese, Woleaian, and Kosraean, and are not as easily explained away.

It is with this muddiness in mind that I acknowledge the existence of four Mokilese denotatives that seem to resist the general pattern described in Section 5.2.5; these forms are provided in Table (40). Two of these forms, *m^wa-m^waal* and *kɔ-kɔik*, actually look like Pohnpeian duratives, since they appear to respect Pohnpeian's pattern of Quantitative Complementarity.

Another form, *pɔipɔi*, is odd because it appears to be derived from a stem like /pai/, with a final glide that resists FREEVOWEL, similar to *jɔi-jɔi* in Table (32). Nevertheless, the glide is absent from the underived form *pa*. Oddly, then, the stem's final segment acts like a vowel when not reduplicated, where it is deleted in respect of stem-final lenition.

Lastly, the denotative form *dɔdɔ* 'sew' completely defies what is predicted by the rank of ALIGN-MORPHEME-FOOT. Interestingly, it resembles the attested prefixing pattern of Kosraean, in which monomoraic verbs receive monomoraic prefixes.

(40) Exceptional Mokilese denotatives

<i>unreduplicated</i>	<i>gloss</i>	<i>denotative</i>	<i>gloss</i>
pa	<i>to weave</i>	pɔipɔi	<i>denotative</i>
dɔ	<i>to sew something</i>	dɔdɔ	<i>to sew (intr)</i>
m ^w aal	<i>bad</i>	m ^w am ^w aal	<i>to treat badly (intr)</i>
kaik	<i>to scratch something</i>	kɔkɔik	<i>to scratch (intr)</i>

5.2.7 Mokilese: a summary

In this section, I have presented a model that predicts the form of the Mokilese progressive prefix and denotative suffix. The shape of the affix follows from a general requirement, emergent in the context of reduplication, that morpheme boundaries match foot boundaries. The prefix is always bimoraic, in some cases to avoid stress clash, and in others to achieve binarity. Binary feet are created with moraic consonants where possible, either with gemination or homorganicity, and otherwise with vowel excrescence. The apparent heavy-syllable requirement thus follows from the tandem of ALIGN-MORPHEME-FOOT and ALL-σ-RIGHT, the latter of which has the effect of choosing feet composed of single syllables. This generalization allows for a unified account of both affixes; the suffix is also a single foot, but given the rank of ALLFEETRIGHT, can only be monomoraic.

As a result, a variety of Mokilese reduplicative subpatterns are shown to follow from a single constraint hierarchy that uses no morpheme-specific size requirement. In that respect, this account makes Mokilese look quite like its sister language Pohnpeian. Furthermore, the languages share a great deal of the same crucial rankings. They differ

in three respects: Mokilese tolerates adjacent heavy syllables, moraic obstruents, and syllabic misalignment. In the following section, I introduce the continuous prefix in Pingilapese, a third member of the Pohnpeic group, and show how it too shares much of the same system.

5.3 *The Pingilapese continuous prefix*

Pingilapese (Good & Welley 1989) is a Micronesian language of the Pohnpeic group, closely related to Pohnpeian and Mokilese. It uses a reduplicative prefix to mark the continuous aspect on verbs, and a suffix to derive adjectives. I treat the Pingilapese continuous marker as a cognate of the Pohnpeian durative and Mokilese progressive, given the semantic and phonological among them.

Rather than motivate an analysis of the Pingilapese continuous prefix from scratch, I will use the hierarchy common to Pohnpeian and Mokilese as a starting point, since the Pingilapese affix shares aspects of both. I present first the continuous for consonant-initial forms in Section 5.3.1, and then vowel-initial forms in Section 5.3.2. In Section 5.3.3, I discuss the Pingilapese denotative suffix.

5.3.1 *Consonant-initial forms*

Like the Mokilese progressive, the Pingilapese continuous is invariantly bimoraic. It surfaces as a heavy syllable under several conditions: if the stem has a long vowel, as in *kee-keem^wis* ‘showing love through a gift’ and *m^wɔɔ-m^wɔɔd* ‘waiting’, a diphthong, as in *kou-koul* ‘singing’ and *saa-saul* ‘sinking’, or is a CV, as in *dæ:-dæ* ‘sewing’.

Examples of CVV prefixes are given in Table (41); note a single exceptional CV suffix in *dæ-daur*, which could be an isolated instance of Pohnpeian-like Quantitative Complementarity. Here and elsewhere for Pingilapese, I adhere to Good & Welley’s transcription, except that *Vh* is replaced with *vv*, *ng* with *ŋ*, *oa* with *ɔ*, and *ae* with *æ*.

(41)	The Pingilapese Continuous for CVV and CV stems			
a.	<i>m^wɔɔd</i>	<i>wait</i>	<i>m^wɔɔ-m^wɔɔd</i>	<i>continuous</i>
b.	<i>keem^wis</i>	<i>show love through a gift</i>	<i>kee-keem^wis</i>	<i>continuous</i>
	<i>meir</i>	<i>sleep</i>	<i>mei-meir</i>	<i>continuous</i>
	<i>koul</i>	<i>sing</i>	<i>kou-koul</i>	<i>continuous</i>
	<i>wou</i>	<i>bark</i>	<i>wou-wou</i>	<i>continuous</i>
	<i>kɔu</i>	<i>build a house</i>	<i>kɔu-kɔu, kɔɔ-kɔu</i>	<i>continuous</i>
	<i>saul</i>	<i>sink</i>	<i>saa-saul</i>	<i>continuous</i>
	<i>daur</i>	<i>trace the past</i>	<i>dæ-daur</i>	<i>continuous</i>
c.	<i>dæ</i>	<i>sew</i>	<i>dææ-dæ</i>	<i>continuous</i>

The diphthong sequences are interesting because in some cases the reduplicant copies and lengthens the nucleus, as in *saa-saul*, but in others it copies the full diphthong, as in *kou-koul*, *wou-wou*, and *mei-me*. Since there are no cases of *ou* copying as *oo*, or of *au* copying as *au*, we cannot be certain whether the difference between *kou-koul* and *saa-saul* is a result of different lexical representations or of an avoidance of *au* in the

reduplicant. It could be that *koul* has an underlying vowel-glide sequence, while *saul* has a vowel-vowel sequence, and that only vowel-glide sequences can be fully copied. Alternatively, it could be that all diphthongs copy except *au* (and for some speakers, *ɔu*).

The prefix also surfaces as a heavy syllable if the stem begins with a CVC sequence in which the two consonants are homorganic, as in *paa-pap* ‘swimming’, *dee-dedei* ‘sewing’, and *dii-diraip* ‘driving’. However, if the stem begins with a CVC sequence in which the consonants are not homorganic, the reduplicant surfaces as a disyllabic CVCV, as in *kusu-kusupæk*. Additional examples are provided in Table (42).

(42)	The Pingilapese Continuous for CVC... stems			
a.	<i>dedei</i>	<i>sew (intr)</i>	<u>dee</u> - <i>dedei</i>	<i>continuous</i>
	<i>diraip</i>	<i>drive</i>	<u>dii</u> - <i>diraip</i>	<i>continuous</i>
	<i>pap</i>	<i>swim</i>	<u>paa</u> - <i>pap</i>	<i>continuous</i>
b.	<i>kerir</i>	<i>love in secret</i>	<u>keri</u> - <i>kerir</i>	<i>continuous</i>
	<i>kusupæk</i>	<i>coming of surf over reef in low tide</i>	<u>kusu</u> - <i>kusupæk</i>	<i>continuous</i>
	<i>læmæ</i>	<i>think</i>	<u>læmæ</u> - <i>læmæ</i>	<i>thinking</i>
	<i>pile</i>	<i>say</i>	<u>pili</u> - <i>pile</i>	<i>continuous</i>
	<i>ræpaaki</i>	<i>find</i>	<u>ræpæ</u> - <i>ræpaaki</i>	<i>continuous</i>
	<i>sæŋ</i>	<i>cry</i>	<u>sæŋæ</u> - <i>sæŋ</i>	<i>continuous</i>
	<i>wen</i>	<i>dance</i>	<u>wene</u> - <i>wen</i>	<i>continuous</i>
	<i>læmæ</i>	<i>think (intr)</i>	<u>læmæ</u> - <i>læmæ</i>	<i>think (tr)</i>

Several descriptive comparisons can be made between Pingilapese and its sisters. First, forms like *m^wɔɔ-m^wɔɔd* show that Pingilapese, like Mokilese, tolerates sequences of heavy syllables. Second, the emergence in Pingilapese of forms like *paa-pap*, however, is reminiscent of Pohnpeian restrictions on moraic consonants, but Pingilapese uniquely lengthens the vowel in exactly those circumstances in which Pohnpeian would employ nasal substitution. Third, where reduplication creates potentially non-homorganic consonant sequences, Pingilapese tends to separate them with a copy vowel, as in *sæŋæ-sæŋ* and *wene-wen*, where Mokilese and Pohnpeian use a default high vowel.

The bimoraic nature of the prefix in Pohnpeian and Mokilese is essentially a product of the ranking given in (43). This is sufficient to predict the Pingilapese CVV forms in Table (41), but some elaboration will be necessary for the forms in Table (42).

(43) ALIGN-MORPHEME-FOOT » ALLFEETRIGHT » FOOTBIN

The effect of the hierarchy is to ensure that all stems receive bimoraic prefixes to acquire binary feet. No stems can receive a monomoraic prefix without violating either ALIGN-MORPHEME-FOOT, as in *(*ke-kè*)(*em^wís*), or FOOTBINARITY, as in *(*kè*)-

(kèe)(m^wís). Likewise, full copy is prevented by the rank of ALLFEETRIGHT over MAX-BR. This effect is summarized in Tableau (44).

(44)	keem ^w ís + CONTINUOUS	ALIGN MORPH-FT	ALLFT RIGHT	FOOTBIN	MAX-BR
a.	(ke -kè)(em ^w ís)	*!	**		mis
b.	(kè)(kèe)(m ^w ís)		****	**!	mis
c.	(kèe)(kèe)(m ^w ís)		****	*	mis
d.	(kèe)(m^wísi)(kèe)(m ^w ís)		****...!		

When considering CVC stems, however, it becomes clear that a richer description of the hierarchy is required, since several bimoraic options are possible—especially in stems which pose a risk of homorganic sequences. For example, for *pap*, which reduplicates as *paa-pap*, we could expect competitors like the fully faithful **pap-pap*, an epenthetic **papi-pap* or **papa-pap*, or a nasally substituted **pam-pap*. Each of these forms satisfies the basic hierarchy of (43) better than the monomoraic form **pa-pap*.

In Chapter 4 and in Section 5.2 above I establish a basic Pohnpeic faithfulness ranking of MAXBR » DEPBR » WEIGHT-IDENT-BR. This ranking would correctly remove **papi-pap* and **papa-pap* as competitors in Pingilapese. Still, *paa-pap* can fully satisfy MAX-BR by having a correspondence situation in which its reduplicative *p* maximizes both consonants of the base; in such a case, its long prefix vowel incurs a violation of WEIGHT-IDENT. As a result it is tied with the other non-epenthetic competitors, such as the faithful **pap-pap* and the nasalized **pam-pap*, each of which has a moraic reduplicative consonant in correspondence with a non-moraic base consonant.

(45)	pap + CONTINUOUS	MAX BR	DEP BR	WEIGHT IDENT
a.	(pà . pi).(páp)		*!	
b.	(pàp).(páp)			*
c.	(pàm).(páp)			*
d.	(pàa).(páp)			*

To sort out the non-epenthetic candidates in Tableau (45), I add NOCODA, as defined in (46), to the Pingilapese hierarchy. NOCODA is more accurately a restriction against moraic consonants of any kind, and as a result, word-final consonants satisfy it by being extrametrical and non-moraic.

(46) NOCODA Moraic consonants are forbidden.

As long as Pingilapese has the ranking of CODACONDITION over WEIGHT-BY-POSITION, a coda in the prefix will be moraic and violates NOCODA, while a final

consonant may surface as non-moraic. I show this in Tableau (47) below. Even when ranked below CODA CONDITION, WEIGHT-BY-POSITION rules out forms like (47b) **pam-pap*, because it has two non-moraic codas, whereas the optimal (47d) *paa-pap* and the competitor (47c) **pam-pap* (with a moraic medial coda) each have one non-moraic consonant. NOCODA can then choose between them.

(47)	pap	CODA CONDITION	WEIGHT-BY- POSITION	NOCODA
a.	$\mu \mu \mu\mu$ (pam)(pap)	p!		mp
b.	$\mu \mu$ (pam)(pap)		mp!	
c.	$\mu \mu \mu$ (pam)(pap)		p	m!
d.	$\mu\mu \mu$ (paa)(pap)		p	

Given the effect of WEIGHT-BY-POSITION here, I assume in the remainder of this chapter that all medial codas are moraic, while final ones are not. The rank of NOCODA at this point is not motivated, but it must rank crucially above UNIFORMITY, defined in (48). The optimal *paa-pap* violates UNIFORMITY because its prefix *p* maximizes both consonants of the base—exactly the relationship of multiple correspondence that UNIFORMITY forbids.

(48) UNIFORMITY Each segment in a correspondence relation has one correspondent.

Structures that violate UNIFORMITY, such as *paa-pap*, are optimal since it outranks NOCODA, which is violated by the moraic reduplicative consonants of **pap-pap* and **pam-pap*. Note that *pap-pap* violates the formalization of NOCODA regardless of whether its medial geminate is a one-root or two-root representation: all it takes to violate NOCODA is an association between a mora and a consonant. The emergent effect of NOCODA is illustrated in Tableau (49).

(49)	pap + CONTINUOUS	MAX BR	DEP BR	WEIGHT IDENT	NO CODA	UNIFOR MITY
a.	(pà.pi).(páp)		*!			
b.	(pà.pa).(páp)		*!			
c.	(pàp).(páp)			*	*!	
d.	(pàm).(páp)			*	*!	
e.	\curvearrowright (pàa).(páp)			*		*

In non-homorganic CVC stems like *kusupæk*, it is not possible for the initial consonant of the reduplicant to correspond to multiple consonants in the base. A multiply-correspondent prefix *kuu-* would actually violate PLACE-IDENT-BR, since one of the reduplicant's *k* would correspond to both the *k* and *s* of the base, the latter of which has a different specification of Place. Another possible interpretation of **kuu-kusupæk*, in which the base *s* has no correspondent, is removed by MAX-BR.

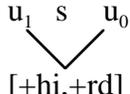
The only other non-insertive competitor has a closed syllable, **kus-kusupæk*, which is easily removed by NOCODA. Tableau (50) shows how the rank of NOCODA over DEP-BR ensures that the prefix is disyllabic rather than have a moraic consonant.

(50)	kusupæk + CONTINUOUS	MAX BR	NO CODA	DEP BR	WEIGHT IDENT
a.	(kùu).(<i>kùsu</i>)(pæk)	sup...!			*
b.	☞ (kùsu).(<i>kùsu</i>)(pæk)	up...		*	
c.	(kùsi).(<i>kùsu</i>)(pæk)	up...		*	
d.	(kùs).(<i>kùsu</i>)(pæk)	up...	*!		

Something to note about Tableau (50) is that it offers no clear account of why the specified second vowel in *kusu-kusupæk* is preferred over the excrescent vowel of **kusi-kusupæk*. While the choice of *kusu-kusupæk* might be made by ranking MAXBR » ALL-σ-RIGHT, it seems more accurate to say that the second vowel of the reduplicant is usually identical to the first, as forms like *ræpæ-ræpaaki*, *pili-pile*, and *wene-wen* suggest; only *keri-kerir* defies this generalization.

In fact, this pattern is allowed by the system, assuming the copy vowel of forms like *kusu-kusupæk* can satisfy ALL-σ-RIGHT as well as the default high vowel of **kusi-kusupæk* does. This conception of the copy vowel requires a representation in which the second prefix vowel is epenthetic, but shares a place specification with the preceding vowel. Since it is epenthetic, this copy vowel can remain unsyllabified and satisfy PARSE-VOWEL parallel to the Mokilese form *pɔdi-pɔdok*.

$$(51) \quad k \quad u_1 \quad s \quad u_0 \quad + \quad k \quad u_1 \quad s \quad u_2 \quad p \quad æ_3 \quad k$$



[+hi,+rd]

Now to distinguish this form from the default-vowel form **kusi-kusupæk*, it will suffice to allow DEP-BR to be violated less by place-sharing epenthetic vowels than by epenthetic vowels with their own specification. Alternatively, we could allow the forms to tie by their violation of DEP-BR, and leave the choice to a lower-ranking constraint against feature insertion. Regardless, the effect of ranking MAX-BR and NOCODA over DEP-BR is summarized in Tableau (52).

(52)	kusupæk + CONTINUOUS	ALL- σ RIGHT	MAX BR	NO CODA	DEP BR
a.	(kùu).(kùsu)(pæk)	***	s...!		
b.	(kùs).(kùsu)(pæk)	***	...	*!	
c.	(kùsi).(kùsu)(pæk)	***	...		i!
d.	 (kùsu).(kùsu)(pæk)	***	...		u

Another way of capturing the Pingilapese copy-vowel phenomenon would be to posit an AGREE constraint (Bakovic 2000) or a vowel-harmonic alignment constraint with similar effect to require all vowels in the reduplicant to be identical. Such a constraint would correctly rule out *(**kùsi**).(kùsu)(pæk), as long as it outranked ALL- σ -RIGHT. This introduces a harmonic process into the model, despite the fact that vowel-harmonic processes are rare (if attested) in Oceanic languages. While the universality of constraints allows this possibility, and it is exciting that harmony in the prefix could be an instance of the Emergence of the Unmarked, I would prefer to derive the pattern using the constraints already posited.

The Pingilapese continuous marker can now be summarized as follows: like the Mokilese progressive, it is invariantly bimoraic. It is a heavy syllable wherever it can be without copying the second consonant of the base; otherwise, it is separated from the base by an extra vowel. The extra vowel is not a default high vowel, but a copy of the reduplicant's first vowel. These facts follow from a constraint hierarchy that is very similar to that of Pohnpeian and Mokilese, with the addition of a high rank of NOCODA and a relaxation of UNIFORMITY. In the next subsection, I investigate vowel-initial forms, to further test the power of the Pohnpeic hierarchy.

5.3.2 Pingilapese vowel-initial forms

The interaction of the Pingilapese continuous morpheme with vowel-initial stems produces results quite like the Pohnpeian vowel-initial subset. Examples of such forms are provided in Table (53), and merit further comment.

(53)	Pingilapese continuous for vowel-initial forms			
aan	<i>be familiar with</i>	aa -yaan		<i>continuous</i>
akup ^w ung	<i>justify one's self</i>	akæ -akup ^w ung		<i>continuous</i>
alu	<i>walk</i>	ali -alu		<i>continuous</i>
awi	<i>waiting for</i>	awi -awi		<i>continuous</i>
uuk	<i>guide around</i>	uu -yuuk		<i>continuous</i>
uuk	<i>to blow through a whistle</i>	uk -uuk		<i>continuous</i>
u	<i>stand</i>	u -yu		<i>continuous</i>

First, it is fairly clear that the derived forms are two moras longer than their stems, with two exceptions: *ukuuk* 'blow through a whistle', and *u* 'stand'. These forms

show a contradiction: we could posit an underlying *uk* for ‘blow’ that augments when not reduplicated, in which case the reduplicated form is correctly two moras longer, as in *uku-uk*, but then we are left without an explanation of why *u* does not also augment. It could be that *u* and *uk* are underlyingly different parts of speech, and thus subject to different minimality requirements, as attested in Chuukese and Pohnpeian. Even so, the reduplicated form *uyu* is an additional mystery, but its representation could be (*u.i*).(u), in which the middle segment is moraic, is the actual output.

A second feature of note is that some forms have a default vowel, as in *ali-alu*, while others do not, as in *akæ-akup^wung*. In the latter form, I consider the second vowel to be a copy of the first, but shifted in place slightly to avoid an *a-a* sequence. This contrast is also seen in the consonant-initial forms like *keri-keri* and *pili-pile*, and suggests that the rank of DEP-BR against UNIFORMITY is not so firm.

These problems aside, the hierarchy for Pingilapese still predicts bimoraic reduplicants like in *ali-alu*. The rank of NOCODA prevents gemination as a means of achieving binary prefixes; as a result, *ali-alu* is preferred over **allalu*, even though they both can satisfy ALIGN-MORPHEME-FOOT. This result is summarized in Tableau (54). The rank of ALL-σ-RIGHT over MAX-BR prevents a third competitor, **alu-alu*, from emerging. Crucially, the optimal *ali-alu* violates ALL-σ-RIGHT only twice, since its epenthetic segment can remain unsyllabified, similar to the copy vowel of *kusu-kusupæk* and the default vowel in Mokilese *pɔdi-pɔdok*.

(54)	alu + CONTINUOUS	ALL-σ RIGHT	MAX BR	NO CODA	DEP BR	WEIGHT IDENT
a.	alu -alu	***				
b.	<u>ali</u> -alu	**	u		i	
c.	al.l -alu	**	u	l!		*

Curiously, the appearance of the default vowel instead of gemination, like in **all-alu*, makes Pingilapese look as if it obeys ALIGN-MORPHEME-SYLLABLE parallel to Pohnpeian *ami-amas*. However, Tableau (54) attributes the Pingilapese choice of *ali-alu* simply to the high rank of NOCODA. This does not mean there is no evidence of ALIGN-MORPHEME-SYLLABLE in Pingilapese, and in fact we need it to handle forms like *uu-yuuk*

While the hierarchy will predict the monomoraic stem /uk/ to reduplicate as *uku-uk* rather than **ukk-uk*, parallel to *ali-alu*, it will not be able to predict *uu-yuuk* from /uuk/ without ALIGN-MORPHEME-SYLLABLE. The form *uu-yuuk* is well-, unlike the more faithful **uu.k-uuk*, indicating that ALIGN-MORPHEME-SYLLABLE is ranked at the expense of MAX-BR. This result is summarized in Tableau (55).

(55)	uuk + CONTINUOUS	ALL-σ RIGHT	MORPHEME TO-SYLL	MAX BR
a.	(uu) k (uuk)	*	*!	
b.	<u>(uu)</u> (yuuk)	*		k

The hierarchy developed for the consonant-initial forms of Section 5.3.1 thus works well for the continuous aspect of Pingilapese vowel-initial forms. Like Mokilese, the prefix is always bimoraic, but like Pohnpeian, the language requires morpheme boundaries to coincide with syllable boundaries. In the following subsection, I extend the Pingilapese system to its denotative suffix.

5.3.3 *The Pingilapese denotative*

Pingilapese also uses a reduplicative suffix whose function is closely related to transitivity, and which I refer to as the denotative. In this subsection, I show how the Pingilapese suffix follows from the same hierarchy of Sections 5.3.1 and 5.3.2. It then seems reminiscent of the denotatives of its sister languages, both of which have a single constraint system that handles both prefixing and suffixing subpatterns. Examples of the Pingilapese denotative are provided in Tables (56-54).

The first group, in Table (56), consists of nouns ending in CVC; these receive CVC suffixes, as in *dip^wi-dip^w*. The denotative form *læpæla-pæla* has the odd property of having an additional final vowel, which may be an additional derivative suffix.

(56) Pingilapese denotative of CVC nouns

dip ^w	<i>grass, litter</i>	dip ^w i- dip^w	<i>to be grassy, littered</i>
læŋ	<i>sky, horizon</i>	læŋæ- læŋ	<i>to sparkle (intr)</i>
læpæl	<i>behind</i>	læpæla- pæla	<i>to be late in time (intr)</i>
war	<i>canoe</i>	wera- wer	<i>to own a canoe (tr)</i>

The second group of denotatives in Table (57) consists of verbs whose unreduplicated forms have final vowels. I consider these vowels to be reflexes of a transitivizing morpheme, which is why they are absent from the suffix of the denotative forms, much the Mokilese denotative subset in Table (29). For example, the stem /pina/ is *pina* in the transitive, its final vowel preserved by some zero-grade suffix. Since that suffix is not part of the denotative, the reduplicated form is *pina-pin*, in which the base-final *a* is preserved by the reduplicant, but not copied. Each stem in Table (57) is thus underlyingly CVCV final, and receives a CVC suffix.

(57) Pingilapese denotative, CVCV verbs

apærae	<i>to carry (tr)</i>	apæra- pær	<i>intr.</i>
dæwi	<i>to tell a tale or story</i>	dæwæ- dæu	<i>to tell a tale or story (intr)</i>
dōka	<i>to stab, poke (tr)</i>	dōka- dōk	<i>to be prickly (intr)</i>
pina	<i>to block or stop (tr)</i>	pina- pin	<i>to be blocked or stopped</i>
dækæ	<i>to take meat out of a coconut</i>	dækæ- dæk	<i>intr.</i>
dæp ^w æ	<i>to bathe</i>	dæp ^w æ- dæp^w	<i>intr.</i>
m ^w uŋæ	<i>reap (intr)</i>	m ^w uŋo- m^wuŋ	<i>feast when the first breadfruit is ready to be used; to reap (intr)</i>

The third group of stems in Table (58) consists of verbs with thematic consonants that are absent from the denotative. For example, *kidim* has a final *m* which is not reflected in the denotative form *kidi-kid*. I take the absence of the final consonant in the denotative as evidence that it is actually a transitive classifier and not part of the stem's lexical representation.

(58) Pingilapese denotative for verbs with thematic consonants			
dopuk	<i>to pay back, to reciprocate</i>	dopo- dop	<i>intr.</i>
kæraŋ	<i>to heat on top of a fire (tr)</i>	kare- kar	<i>to be hot (vi)</i>
kidim	<i>to wrap (tr)</i>	kidi- kid	<i>to wrap (intr)</i>
kɔdɔm	<i>to be husked (tr)</i>	kɔdɔ- kɔd	<i>to be husked (intr)</i>
nekid	<i>to save something</i>	neke- nek	<i>to keep or store (intr)</i>
		aŋede- ŋed	<i>to try hard (intr)</i>

The last group of stems consists of VC forms; examples are in Table (59). At least one of these forms, *æm^win*, has a thematic consonant that is absent from the denotative form *æm^wi-æm^w*, similar to the forms in Table (58). All the forms in Table (59) have a VC suffix that is set off from the base by an additional vowel, as in *alæ-al*. I consider forms like *æp^wæ-æp^w* and *upu-up* to be parallel to *æri-ær* in that the apparent long vowel is a sequence of a base vowel followed by a suffix vowel. These forms are thus footed like *(æp^wæ)(æp^w)* and *(upu)(up)*, in which case the form of VC suffix is clear. Note also that the form *uup* resembles *uuk* 'blow' in Section 5.3.2; that is, it reduplicates as *upu-up*, as if its stem vowel is short, but is long when not reduplicated, as in *uup*.

(59) Pingilapese denotative, VC forms			
æm ^w in	<i>to wipe, to wash</i>	æm ^w i- æm^w	<i>intr.</i>
al	<i>road</i>	alæ- al	<i>to be striped (intr)</i>
uup	<i>cover with a sheet (tr)</i>	upu- up	<i>be covered with a sheet (intr)</i>
		æp ^w æ- æp^w	<i>to be eager, to be enthusiastic</i>
		æri- ær	<i>to spread rocks in a stone oven</i>

For the Pingilapese denotative, I will attribute the shape of the suffix to the same hierarchy used for the language's aspectual prefix. In particular, the ranking of ALIGN-MORPHEME-FOOT » ALLFEETRIGHT » FOOTBINARITY predicts a monomoraic suffix to appear. This effect of ALLFEETRIGHT is shown in Tableau (60), which evaluates the denotative of *m^wuŋæ*. The medial vowel in *m^wuŋo-m^wuŋ* seems subject to a sequencing restriction, since it appears as *o* rather than *æ*. I leave this alternation aside; what is important in Tableau (60) is that the better suffix is the monomoraic one, since it better satisfies ALLFEETRIGHT, at the expense of violating FOOTBINARITY.

(60)	m ^w uŋæ + DENOTATIVE	ALIGN MORPH-FT	ALLFT RIGHT	FOOT BIN	ALL-σ RIGHT	MAX BR	NO CODA
a.	(m ^w uŋð)(m^wuŋó)		**!		***		
b.	(m ^w uŋð)(m^wuúŋ)		**!		**	o	
c.	☞ (m ^w ùŋo)(m^wúŋ)		*	*	**	o	

Denotatives like *m^wuŋo-m^wuŋ* raise an interesting point about how Pingilapese resolves its conflict with ALL-σ-RIGHT. In Section 5.3.1, I claim that wherever the reduplicant needs a second vowel, it will share features with the first vowel rather than use a default vowel; thus, *ræpæ-* makes a better prefix than **ræpi-*. This strategy may also be attested in the denotative, and even in unreduplicated forms. For example, the transitive form *kɔdɔm*, from Table (58), is posited to have a thematic final consonant. Two possible lexical entries could arrive at the same result: *kɔdɔ + m*, with the final vowel fully specified, as well as *kɔd + m*. In the latter case, a vowel would be inserted, and given the Pingilapese tolerance of violating UNIFORMITY, the inserted vowel should be *ɔ*. Thus, whether the stem is *kɔdɔ* or *kɔd*, it will appear as *kɔdɔ-kɔd* in the denotative. The hierarchy therefore predicts the CVC suffixes in Tables (57) and (58), regardless of whether the stem is underlying consonant-final.

A last point to be made is that the Pingilapese system also predicts the VC suffixes shown in Table (59). For example, the denotative form (*æm^wi*)-(***æm^w***) is preferred over competitors like **(æm^wi)-(æ:m^w)*, which is worse for ALLFEETRIGHT, and **(æm^w-æm^w)*, which violates ALIGN-MORPHEME-FOOT. This effect is summarized in Tableau (61).

(61)	æm ^w i + DENOTATIVE	ALIGN MORPH-FT	ALLFT RIGHT	FOOT BIN	ALL-σ RIGHT	MAX BR	NO CODA
a.	☞ (æm ^w i)-(æm^w)		*	*	**	i	
b.	(æm ^w i)-(æ:m^w)		**!		**	i	
c.	(æm ^w - æm^w)	*!			**		

Each subpattern of the Pingilapese denotative suffix thus follows from the same hierarchy developed in Sections 5.3.1 and 5.3.2 for the continuous prefix. Pingilapese thus shares the following trait with its sisters, Mokilese and Pohnpeian: it has two reduplicative affixes, a prefix and a suffix, both of which have a variety of subpatterns that all nonetheless follow from the same constraint hierarchy.

5.3.4 *Pingilapese: a summary*

The prefixing and suffixing pattern of Pingilapese discussed in this section follows from the basic hierarchy of Figure (29) shared by Pohnpeian and Mokilese. I repeat this hierarchy as Figure (62) below. The system predicts stress to occur strictly on alternating moras, and the effect of ALIGN-MORPHEME-FOOT's high rank is to ensure that

the reduplicant, whether a prefix or suffix, is footed by itself and receives some amount of stress. The rank of ALLFEETRIGHT » FOOTBIN ensures that the suffix will be monomoraic, and that the prefix will be no more than bimoraic. Last, the subhierarchy of ALL- σ -RIGHT » MAXBR » DEPBR predicts that the prefix will copy no more than the initial CVC of any stem, and that if the reduplicant's second consonant cannot directly precede the first consonant of the stem, then some sort of default vowel is preferred over reduplicating a second stem vowel. These patterns are true of each Pohnpeic language, including Pingilapese.

- (62) a. *CLASH,
*LAPSE, » ALLFEETRIGHT
ALIGN-MORPHEME-FOOT
- b. FOOTBIN,
ALL- σ -RIGHT, » DEP-BR » WEIGHT-IDENT » IDENT-NASAL
MAX-BR,
CODACOND
- c. ALLFEETRIGHT » FOOTBIN

The uniquely Pingilapese aspects of the reduplicative system require the following additions to the Pohnpeic system: NOCODA must rank above DEP-BR and UNIFORMITY, in order to predict the strategy of avoiding homorganic sequences shown by *paa-pap*. So must ALIGN-MORPHEME-SYLLABLE, to handle vowel-initial continuous forms like *ali-alu* and *uu-yuuk*. However, UNIFORMITY ranks below DEP-BR, in order to allow the copy-vowel pattern in forms like *kusu-kusupæk*.

5.4 Summary: Comparing reduplication across the Pohnpeic group

With three full analyses of reduplication in Pohnpeic languages, it is possible to examine the constraint hierarchies together to look for similarities and differences, to test the predictions of the Confluence hypothesis. I introduce some of the comparative issues in this section, but devote the next chapter to a deeper investigation.

As already suggested, the hierarchy in Figure (62) can be viewed as a system common to each Pohnpeic language. A number of differences between the languages can also be predicted by adjusting the rank of other constraints against this hierarchy.

In Pohnpeian, *HH must outrank FOOTBIN to predict the avoidance of adjacent heavy syllables, but the opposite ranking holds in Mokilese and Pingilapese. Pohnpeian must also rank NASALCODA over IDENTNASAL and DEP-BR to predict Nasal Substitution for homorganic consonant sequences, while Mokilese must not. There is no evidence in Pingilapese for their ranking since the potential for Nasal Substitution is obscured by the Pingilapese rank of NOCODA over DEP-BR.

Pohnpeian and Pingilapese share the rank of ALIGN-MORPHEME-SYLLABLE over DEP-BR, which, at least for reduplicated forms, will prevent morpheme boundaries from

occurring anywhere but in coincidence with syllable boundaries. Lastly, Pingilapese ranks NOCODA over UNIFORMITY, which allows homorganic base segments to share a single correspondent in the reduplicant. I summarize these contrasts in Table (63).

(63) Marked structures and Micronesian strategies for avoiding them

	Pohnpeian	Mokilese	Pingilapese
Homorganic sequences	Avoided with nasal substitution	Tolerated	Avoided, reflected with V-lengthening
Heterorganic sequences	Avoided with excrescent high vowel	Avoided with excrescent high V	Avoided with excrescent copy V
Morpheme- σ mismatch	Avoided with excrescent vowel	Tolerated	Avoided with excrescent V
Adjacent heavy syllables	Avoided through shortening	Nearly always tolerated	Tolerated

Table (63) provides the opportunity to draw striking parallels beyond shared constraint ranking. For example, although only Mokilese tolerates homorganic obstruent sequences, all three languages create heavy syllables in the same circumstances of potential homorganicity: Mokilese *pap-pap*, Pohnpeian *pam-pap*, and Pingilapese *paa-pap*. Conversely, they create disyllables in the same complementary circumstances, to avoid heterorganic sequences: Mokilese *dopi-dop*, Pohnpeian *tepi-tep*, and Pingilapese *sæŋæ-sæŋ*.

Furthermore, although the Pingilapese insert strategy is unique, it shares with the other languages a goal of using some unmarked vowel rather than a faithful vowel. In other words, of three ways of resolving ALL- σ -RIGHT violations—default vowel, copy vowel, or demoting the constraint—only the first two are attested in the Pohnpeic group.

The only remaining marked structure to discuss is the adjacency of heavy syllables, the avoidance of which seems to be a unique trait of Pohnpeian, save for isolated tokens in Mokilese. The Pohnpeian pattern of quantitative complementarity seems to be unrelated to other issues of sequencing restrictions, and one could imagine a Pohnpeian-like language that does everything the same, like nasal substitution and default high vowel insertion, except respect *HH. This independence of *HH from other aspects of the Micronesian continuum is neatly reflected in the fact that the rank of *HH only matters with respect to FOOTBIN, and not to DEP-BR, which figures in every other contrastive ranking in the language group.

Regardless of whether the differences between these languages can be captured with two rerankings or five, what is remarkable is how much of the constraint hierarchy they share. Rather than differing by a catastrophic rearrangement of constraints (one can imagine what a reduplicating language would look like if the constraints in Table (62) were radically re-ordered), the fact that they actually differ by so little suggests that the constraint grammar (independently of lexical changes) transmits very smoothly over time. This suggests that their divergence has been a fairly systematic process, and that much of the hierarchy is both stable over time and salient to the learner. This is exactly

what the Confluence hypothesis allows: some parts of the hierarchy are stable, while others are less so, and for principled reasons.

The previous and present chapters offer new and comprehensive analyses of the reduplication patterns of three individual languages. I hope each stands as an inherently interesting example of a formal account. An additional contribution, however, can emerge from a more comparative perspective, such as the present discussion hints at. In the next chapter I return to the issue of divergence within the Pohnpeic subgroup, with a focus on the formalized distinctions among the three languages. There, I offer an argument that the Confluence of individual changes in rank is not accidental.

6. Confluence in Pohnpeic

6.1. Introduction

In this chapter, I return to a number of features of the phonological systems of the Pohnpeic languages Pohnpeian, Mokilese, and Pingilapese. This chapter presents a first opportunity to test the Confluence model introduced in Chapter 1, repeated in (1) below.

(1) The Confluence model

Starting point: source grammar	<i>Caregiver-peers have a set of lexical items and ordered principles</i>
↓	<i>Articulatory, cognitive, cultural effects: Phonetic factors can induce variation; maintenance of contrast restricts it</i>
“ambient forms”	<i>These are the forms produced by the caregiver-peer system.</i>
↓	<i>Perceptual, cognitive, cultural effects: Perceptual effects can mask the interpretation and representation of ambient forms</i>
[perceived forms]	<i>This is the set of interpretations of ambient forms.</i>
↓	
Acquired grammar	<i>Learner uses the set of perceived forms as evidence for her own set of lexical items and ordered principles.</i>

The Confluence model offers a resolution between typological trends and what I refer to as the “Permutation Problem” in Chapter 1. The Permutation Problem refers to the overgenerative power of synchronic models such as Optimality Theory, which do not distinguish between possible and likely or widely attested systems.

The formal accounts developed in the previous chapters have uncovered a certain degree of formal similarity among these languages, as well as unique patterns in each. Moreover, because of the fact that they are closely related to each other, it is possible to attribute both the shared and individual patterns to the notion of Confluence.

Testing for Confluence requires a discussion of those properties that are shared among the languages, and those that make individual languages unique, where each property is formally expressible in terms of synchronic generalizations. Systematic differences between languages are formally expressible in Optimality Theory as differences in ranks of constraints. Arguments for the formal analyses of each language—and thus, individual constraint rankings—are provided in previous chapters, but I repeat some of them here as required.

The Pohnpeic languages share a reduplicative morphology that uses a prefix to indicate habitual aspect and a suffix to derive adjectives. The analysis of reduplication in each of these languages uncovers a number of phonological generalizations; for example, there is a shared tendency for the prefix to be bimoraic and the suffix to be monomoraic.

In addition, all three languages have a pattern of final-vowel lenition that deletes word-final vowels, and another of final-consonant extrametricality that allows word-final codas to be non-moraic. Last, they all have some restrictions on moraic consonants, and treat potential non-homorganic consonant sequences with vowel insertion.

They differ in several respects. First, they vary in the exact nature of restrictions on moraic consonants: Pingilapese allows none, Pohnpeian allows only sonorant moras, while Mokilese allows any moraic consonant as long as it is place-linked. Second, a possibly related pattern is seen in the Mokilese tolerance of morpheme boundaries to occur within syllables. Third, they vary in their means of choosing an insert vowel to disrupt the potential consonant sequences that arise in base-reduplicant concatenation. Independently, Pohnpeian alone has a regular avoidance of adjacent heavy syllables known as Quantitative Complementarity, which arises in isolated forms in the other languages.

This chapter is organized as follows. Rather than discuss all similarities first, then all differences, I instead order the argument by subsystems. I first discuss the system of moraic consonants, showing what the languages share and do not share. I also offer a proposal that Confluence can account for the nature of their divergence. I then discuss the prosody-morphology interface, again showing similarities and differences among the three languages, and again looking to Confluence for explanation. I conclude with a proposal to explain a link between the two aspects.

6.2. Consonant sequences

The Pohnpeic languages all adhere to some kind of restriction on the kinds of consonants that can occur in moraic positions.¹ Such restrictions are most easily exemplified in the emergent context of prefixing reduplication, which each language uses to indicate a habitual aspect. Because of overriding requirements of ALIGN-MORPHEME-FOOT alignment, this prefix always results in the addition of a bimoraic foot to a stem—except in a regular subset of Pohnpeian forms.

6.2.1 Potential non-homorganic sequences

Now, wherever the initial stem vowel is monomoraic, the prefix in all three languages copies the initial and peninitial consonants. Furthermore, the prefix includes a second vowel just in case its second consonant is not homorganic with the stem's first consonant. Thus, in Pohnpeian, we see epenthesis in *tep* → *tepi-tep* and *siped* → *sipi-siped*; epenthesis occurs instead of the non-homorganic sequences of **tep-tep* and **sip-siped*. Likewise, in Mokilese, we see epenthesis in *dop* → *dopi-dop* and *nekid* → *neki-*

¹ In fact, a fourth member of the group, Ngatikese (McClintock 1999), apparently has no such restrictions, and represents an extreme in a continuum of coda tolerance. Data, however, are not widely available. Rehg (1981) posits Ngatikese as a dialect of Pohnpeian.

nekid.² In Pingilapese, we see epenthesis of either a default vowel, as in ***keri-kerir***, or a copy vowel, as in ***wene-wen***. I repeat the data in Table (2).

(2) Prefixed reduplicatives, non-homorganic sequences

<i>Mokilese</i>	<i>Pohnpeian</i>	<i>Pingilapese</i>
<i>dopi</i> -dop <i>buying</i>	<i>tepi</i> -tep <i>beginning</i>	<i>keri</i> -kerir <i>loving in secret</i>
<i>neki</i> -nekid <i>saving</i>	<i>sipi</i> -siped <i>shaking out</i>	<i>wene</i> -wen <i>dancing</i>
<i>pili</i> -pilod <i>picking</i>		<i>pili</i> -pile <i>saying</i>
<i>breadfruit</i>		<i>sæŋæ</i> -sæŋ <i>cry</i>

The Pohnpeic restrictions on coda consonants are easily formalized into Optimality-Theoretic Constraints. The data in table (2) suggest that all three languages respect CODACONDITION, as defined in (3) below. Though I label this constraint in terms of coda positions, it is simply a restriction on moraic consonants. It is important not to attribute epenthesis to avoidance of all codas or moraic consonants, since they are allowed in a restricted context, as we will see shortly.

(3) CODACONDITION Moraic consonants with unique [place] are forbidden

Several crucial constraint rankings are necessary to arrive at the attested vowel-insertion pattern. For example, in Mokilese, CODACONDITION must outrank DEP-BR, in order to guarantee ***dopi-dop*** over ****dop-dop***, and so must MAX-BR, in order to guarantee ***dopi-dop*** over ****do-dop***. Both constraints are defined in (4).

(4) DEP-BR Every segment in the reduplicant has a correspondent in the base.

MAX-BR Every segment in the base has a correspondent in the reduplicant.

IDENT-PLACE, as defined in (5), must also be ranked highly, to prevent a form like ****dod-dop***, whose prefix's second consonant has an altered place of articulation that would satisfy CODACONDITION. I summarize these facts in Tableau (6). Furthermore, since vowels are inserted under similar circumstances in Pohnpeian and Pingilapese, I offer equivalent evaluations of Pohnpeian ***tepi-tep*** in Tableau (7) and Pingilapese ***pili-pile*** in Tableau (8).

(5) IDENT-PLACE Segments in correspondence have identical [place] specifications.

² As noted in the previous chapter, these excrescent vowels are acknowledged in Harrison (1976) but usually go untranscribed. Harrison provides a description of when and when not to expect vowel excrescence.

(6)	Mokilese <i>dop</i>	IDENT- PLACE	CODA CONDITION	MAX-BR	DEP-BR
a.	<u>don</u> -dop	*!			
b.	<u>dop</u> -dop		*!		
c.	<u>do</u> -dop			*!	
d. ☞	<u>dopi</u> -dop				*

(7)	Pohnpeian <i>tep</i>	IDENT- PLACE	CODA CONDITION	MAX-BR	DEP-BR
a.	<u>ten</u> -tep	*!			
b.	<u>tep</u> -tep		*!		
c.	<u>tee</u> -tep			*!	
d. ☞	<u>tepi</u> -tep				*

(8)	Pingilapese <i>pile</i>	IDENT- PLACE	CODA CONDITION	MAX-BR	DEP-BR
a.	<u>pip</u> -pile	*!			
b.	<u>pil</u> -pile		*!		
c.	<u>pii</u> -pile			*!	
d. ☞	<u>pili</u> -pile				*

The three languages thus share a common formal structure, which accounts for their shared treatment of potential non-homorganic sequences. In contrast, potential homorganic sequences (which are possible wherever the second consonant of the prefix is homorganic to the first consonant of the stem) receive different treatments in each language.

6.2.2 Potential homorganic sequences

The Pohnpeic languages are united in that none of them uses an inserted vowel to separate homorganic consonants. For example, Mokilese allows the homorganic consonants to remain adjacent, regardless of their features, as in ***kak-kak*** and ***ror-ror***. Pohnpeian allows their adjacency as well, but if the second is an obstruent, the first must be nasal.³ For example, ***mem-mem*** and ***rer-rer*** are fine, but nasal substitution occurs in ***don-dod*** and ***din-dilip***. Pingilapese has the curious pattern of lengthening the prefix vowel in any such case, as in ***paa-pap*** and ***dii-diraip***. Thus, while it may seem simple

³ For detailed treatments of Pohnpeian nasal substitution, see Rehg (1984), Blevins & Garrett (1993), Spaelti (1997), and Davis (1997, 2001).

enough to say that Pingilapese does not allow even homorganic sequences, it still treats *potential* homorganic sequences differently than potential non-homorganic sequences. I summarize the contrasts among the three languages in Table (9).

(9) Prefixed reduplicatives, homorganic sequences

<i>Mokilese</i>	<i>Pohnpeian</i>	<i>Pingilapese</i>
<u>kak</u> -kak <i>bouncing</i>	<u>don</u> -dod <i>frequenting</i>	<u>paa</u> -pap <i>swimming</i>
<u>rɔr</u> -rɔr <i>shuddering</i>	<u>din</u> -dilip <i>mending thatch</i>	<u>dii</u> -diraip <i>driving</i>
<u>kaŋ</u> -kaŋ <i>eating</i>	<u>mem</u> -mem <i>being sweet</i>	<u>dee</u> -dedei <i>sewing (tr)</i> .
	<u>rer</u> -rer <i>trembling</i>	

Unlike the non-homorganic forms of Table (2), the stems in Table (9) could receive fully faithful reduplicants that satisfy CODACONDITION, without any need for epenthesis. The system shown in Tableaux (6-8), however, is not precise enough to reflect the individual differences, as Tableau (10) shows below. For example, Mokilese would accurately copy the stem *pap* as **pap**-*pap*, while Pohnpeian would employ Nasal Substitution, as in **pam**-*pap*. Pingilapese, however, would lengthen the prefix vowel, as in **paa**-*pap*. All three forms fully satisfy CODACONDITION and the various faithfulness constraints.

(10)	All three languages <i>pap</i>	IDENT- PLACE	CODA CONDITION	MAX-BR	DEP-BR
a. Mokilese	<u>pap</u> -pap				
b. Pohnpeian	<u>pam</u> -pap				
c. Pingilapese	<u>paa</u> -pap				
d. <i>none</i>	<u>papi</u> -pap				*!

A quick point of clarification to be made concerns the manner in which **paa**-*pap* could satisfy MAX-BR. Such a result is possible if the reduplicant's *p* corresponds to both *p*'s of the Base. Such a relationship of multiple correspondence is possible, but violates UNIFORMITY as defined in (11) below. Note that if the reduplicant's *p* does not correspond to both Base consonants, it violates MAX-BR.

- (11) UNIFORMITY Each segment in a correspondence relation has one correspondent.

With this possibility established, we can explore the kinds of constraints that would distinguish the forms **pap**-*pap*, **pam**-*pap*, and **paa**-*pap*. Several Markedness constraints will come into play, each of which is defined in (12) below. First, *OBS/MORA will be needed to motivate Nasal Substitution in Pohnpeian, while NOCODA will be needed for Pingilapese. In Mokilese, both of these will need to be ranked lower than several other Faithfulness constraints. For example, to ensure Mokilese prefers **pap**-

pap over the nasally-substituted competitor *pam-pap*, the language must rank IDENT-NASAL over *OBS/MORA. Furthermore, to ensure that Mokilese chooses *pap-pap* over *paa-pap*, UNIFORMITY must be ranked over both *OBS/MORA and NOCODA. I summarize this in Tableau (13).

(12) *OBS/MORA Moraic obstruents are forbidden.

NOCODA Moraic consonants are forbidden.

IDENT-NASAL Segments in correspondence have identical [nasal] specification.

(13)	MOKILESE p_1ap_2	CODA COND	DEP BR	UNI FORMITY	IDENT NASAL	*OBST MORA	NO CODA
a. ☞	pap -pap					*	*
b.	pam -pap				*!		*
c.	p₁₂aa -pap			*!			
d.	papi -pap		*!				

Pohnpeian's higher degree of restriction on moraic consonants can be formalized as the ranking of *OBS/MORA over IDENT-NASAL. This ensures that the nasal-substitute form *pam-pap* is chosen over the more faithful *pap-pap*.

(14)	POHNPEIAN p_1ap_2	*OBST MORA	DEP BR	UNI FORMITY	IDENT NASAL	NO CODA
a.	pap -pap	*!				*
b. ☞	pam -pap				*	*
c.	p₁₂aa -pap			*!		
d.	papi -pap		*!			

For Pingilapese, NOCODA is the constraint that outranks the Faithfulness constraints. One could imagine an alternative in which we instead simply place the rank of UNIFORMITY below IDENT-NASAL, which would arrive at the same result. However, I prefer the NOCODA approach since it better captures the generalization. A high placement of NOCODA predicts stems like *mem* to reduplicate as *mee-mem* in Pingilapese, and prevents forms like *mem-mem*. In contrast, the reranking of UNIFORMITY would predict *mem-mem*, but geminate consonants are not attested at all in Pingilapese.

(15)	Pingilapese <i>p₁ap₂</i>	No CODA	DEP BR	UNI FORMITY	IDENT NASAL
a.	pap -pap	*!			
b.	pam -pap	*!			*
c. ☞	p₁₂aa -pap			*	
d.	papi -pap		*!		

To summarize, the Pohnpeic languages all have an asymmetry in their treatment of potential homorganic and non-homorganic consonants. They share the property of avoiding non-homorganic sequences through vowel insertion, as shown by Mokilese *dopi-dop*, Pohnpeian *tepi-tep*, and Pingilapese *pili-pile*. None uses insertion to resolve homorganic sequences, as shown by Mokilese *kak-kak*, Pohnpeian *pam-pap*, and Pingilapese *paa-pap*.

The empirical distinctions among these languages are expressible in terms of differences of constraint rank. First, each language uses epenthesis only to resolve potential non-homorganic sequences, basically because of the rank of CODACONDITION and MAX-BR over DEP-BR. In contrast, their means of resolving potential homorganic sequences seems more variable, since each language has a different strategy. Why would there be such stability for homorganic sequences, but not for non-homorganic sequences? I examine this question in greater depth in the following section.

6.2.3 A search for explanatory power

There are some interesting parallels among these three languages that I would prefer not to be lost amid the discussion of technical details of constraint ranking. Independently of theory, it is striking that each language treats potential non-homorganic sequences differently from potential homorganic ones; and perhaps more so, that vowel insertion is always used to resolve the former case, but never to resolve the latter.

This consistency across the family is easily expressed in terms of similarity in the formal system; that is, with shared constraint rankings. The rank of IDENT-PLACE and MAX-BR over DEP-BR across the family ensures the consistent use of vowel insertion in the case of non-homorganic sequences. Furthermore, the rank of IDENT-PLACE and DEP-BR over UNIFORMITY and IDENT-NASAL ensures some other process to appear for homorganic sequences.

Each language can have the same relative ranking of Faithfulness constraints, such as that provided in Figure (16a). It should be noted that not every ranking is a crucial one in each language; I therefore include crucial pan-Pohnpeic rankings separately as (16b).

- (16) a. IDENT-PLACE » MAX-BR » DEP-BR » UNIFORMITY, IDENT-NASAL
- b. IDENT-PLACE, MAX-BR >> DEP-BR
IDENT-PLACE, DEP-BR >> UNIFORMITY, IDENT-NASAL

The contrast among the three languages can be expressed by the degree of restrictedness on moraic consonants. In Mokilese, only CODACONDITION needs to outrank DEP-BR, while in Pohnpeian, *OBS/MORA does as well. In Pingilapese, NOCODA must outrank DEP-BR, and the rank of CODACONDITION and *OBS/MORA is irrelevant. Thus, the languages seem to share a consistently ordered backbone of reduplicative Faithfulness constraints, against which the rank of various coda restrictions may vary.

An important question, then, is why they have the same strategy for non-homorganic sequences, but not for homorganic sequences. In formal terms, this follows simply from the rank of CODACONDITION and MAX-BR over DEP-BR, but why is this ranking relationship robust across the family? If any particular constraint ranking is possible, as the Boggle model of OT predicts, epenthesis should emerge as a strategy for homorganic sequences—yielding forms like *papi-pap*—about a quarter of the time. Yet apparently, there is something about these constraints that exerts enough pressure to maintain CODACONDITION and MAX-BR over DEP-BR, regardless of how else these languages are divergent. Confluence offers an explanation.

Consider this situation: a learner of any Pohnpeic language has fairly clear evidence MAX-BR and CODACONDITION outrank DEP-BR. For example, because of the inserted vowel in a form like *tepi-tep*, with a potential *pt* sequence, both consonants in the spoken form are prevocalic, and thus provide salient evidence for the rank of MAX-BR and CODACONDITION over DEP-BR. A change of strategy from epenthesis to something like nasal substitution or vowel-lengthening is unlikely in this case, because the learner is never exposed to any evidence in the ambient form that would suggest the syllable *pi* is anything other than what it is. As a result, epenthesis remains a consistent strategy across the family for resolving non-homorganic sequences. I illustrate how the learner uses *tepitep* to set her rank of MAX-BR and CODACONDITION over DEP-BR in Figure (17).

(17) Stability of non-homorganic sequence avoidance throughout Pohnpeic

Source grammar	
↓	
“tepi-tep”	<i>Articulatory variants with mono-σ prefix unlikely, blocked by cognitive counterbalance (loss of C-place information): Thus no “tee-tep, ten-tep”</i>
↓	
[tepi-tep]	<i>Percepts with mono-σ prefix are unlikely since each consonant has its own release: thus no [tee-tep], [ten-tep]</i>
↓	
Acquired grammar	<i>Creates grammar that resolves non-homorganic sequences with epenthesis: CODACONDITION, MAX-BR » DEP-BR</i>

In contrast, the Pohnpeic languages differ in how they resolve homorganic sequences. Consider a form like *pa_pap*. The blank space represents the linear position in which Mokilese, Pohnpeian, and Pingilapese differ; Pingilapese fills it with vowel, Pohnpeian with nasal, and Mokilese with the same consonant. This position is pre-consonantal, which compromises a listener's accurate perception of the segment. Cross-linguistically, release features tend to be neutralized in coda and pre-consonantal positions (Lombardi 1995, Ohala 1990, Steriade 1997, 1999, 2000b). In addition, the nature of consonant release is an important, sometimes primary, cue for its accurate identification (Lieberman 1967, Stevens & Blumstein 1975, Stevens 1989), and likewise, place features also tend to be neutralized in coda positions (Côté 1997, Jun 1995, Kotchetov 1999). Aside from tendencies of neutralization, phoneticians have found onset consonants to be perceived more accurately than codas (Wang & Bilger 1973, Boothroyd & Nittrouer 1988, Benki 2002).

All these findings point to the relative difficulty in the perception of the segment that fills the gap in *pa_pap*. A listener could perceive it as a faithful coda, a nasalized one, or part of a long vowel. Depending on her percept, she will have evidence for a grammar that allows any moraic obstruent, only sonorant moraic segments, or only vocalic moraic segments. Figure (18) illustrates how the percept guides the setting of the constraint hierarchy.

(18) Instability of homorganic sequences throughout Pohnpeic

Conservative grammar ↓ “pap-pap, pam-pap” ↓ [pap-pap ~ pam-pap ~ paa-pap] ↓ Acquired grammar	← <i>Articulatory pressures may induce variation</i> <i>Each variant percept is a possible interpretation of the ambient forms</i> <i>Note how [papi-pap] is an unlikely percept</i> <i>Learner chooses a percept as the formally required form</i> <i>Thus, grammar either tolerates all geminates, requires nasalization, or requires vowel-lengthening</i>
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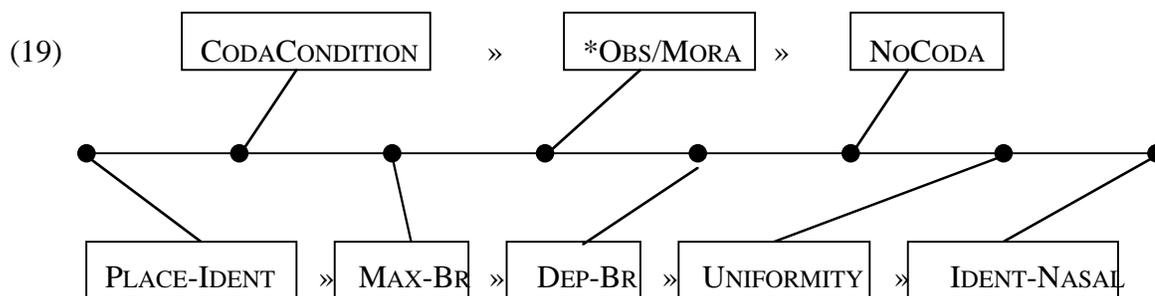
Because of this instability, there is *merely weak* evidence of the rank of MAX-BR and IDENT-PLACE against any coda restriction beyond a basic CODACONDITION. There are three plausible percepts of what begins as a single form, and each of these variants could occur frequently enough within a single speech community to become the default that learners decide must be the appropriately grammatical form.

Thus, a learner who settles on [pappap] acquires a grammar that tolerates all geminate consonants and has the formal ranking of *OBS/MORA » IDENT-NASAL; a critical mass of this process results in the Mokilese pattern. A learner who chooses [pampap] will acquire a grammar that requires nasalization, and adopts the ranking of IDENT-NASAL » *OBS/MORA; with enough learners adopting this approach, the Pohnpeian pattern results. A learner who settles on [paapap] will acquire a grammar that instead requires compensatory lengthening, which produces the Pingilapese pattern. There is no plausible variant with epenthesis, so no resultant grammar requires epenthesis.

In summary, it is simply easier to change the precise restriction on moraic consonants than it is to alter the structure of potential non-homorganic sequences. Given the more salient evidence for epenthesis in the previous case, and the less salient evidence for any kind of restriction here, we are left with the fact that Pohnpeic languages differ here (and not there) only because if they were to differ anywhere, it would be here.

In other words, the variability is random, but restricted to a limited context: there is an explanation for why the variability does not extend to potential non-homorganic sequences. Thus, as Confluence predicts, it is no accident that the languages treat homorganic and non-homorganic sequences differently: the rank of CODA-CONDITION and MAX-BR with respect to DEP-BR is more robust (and less likely to mutate) than the ranks of *OBS/MORA and NOCODA against UNIFORMITY and IDENT-NASAL.

If we also consider an alternative account, the Confluence model should appear more satisfactory. Another possible explanation for the homorganic/non-homorganic asymmetry would be to resort to a fixed Faithfulness scale and a fixed Coda scale and to allow these scales to interleave freely. Different languages would result from different intersections of these two scales, as illustrated in Figure (19), which corresponds to the Pohnpeian system.



As long as DEP-BR is below MAX-BR and PLACE-IDENT, epenthesis would not appear in any product of this typology—indeed, if these scales were cross-linguistically fixed, epenthesis simply could not arise ever.

Any model relying on the interaction of such fixed scales actually invites more questions than it provides answers. There is no explanation for the particular fixed relationships: why is one constraint always higher than another? In the Coda scale, the ranking reasonably seems to follow a rising gradience of restriction on moraic consonants, ranging from CODACONDITION (*place/mora) to *OBS/MORA

(*manner/mora) to NOCODA (*consonant/mora), but in the Faithfulness scale, the order of constraints shows no such logical order.

Furthermore, the use of fixed scales says nothing about tendencies in the interleaving of scales. A deeper claim than simple fixedness, and one that might offer more explanatory power, is that constraints or constraint scales have directional tendencies: some rise and others sink. An implication is that one of the end-point languages—Mokilese or Pingilapese—is historically conservative. If it were Mokilese, then we would have to conclude that the Coda scale tends to rise, and Mokilese has been able to suppress it while Pohnpeian and Pingilapese have not. If Pingilapese were conservative, then we would have to say the Coda scale tends to sink, and Pingilapese has propped it up, while Pohnpeian and Mokilese have not. Either way, there is no clear reason behind the connection between a fixed scale and its tendency to rise or sink.

Moreover, there is no reason why any of these systems could not develop out of any other; in other words, it is not clear from synchronic data which of the three languages is most historically conservative in its treatment of homorganic sequences. In fact, the Pohnpeian restriction seems to be the most historically conservative (Harrison 1973). Mokilese obstruent geminates and Pingilapese codaless-ness are both innovations. If we relax the claim of constraint-specific tendency, letting scales have the freedom to drift in any direction, we simply repeat the observation that some rankings are easily changed while others are not.

The appeal to fixed scales nevertheless offers a means of limiting the typological predictions of OT by restricting some of the permutability of constraint rankings. Even so, I reject the appeal to fixed scales, in part because it seems that whichever way we construe them, they add nothing to our understanding of the stability of particular sub-patterns across languages. In contrast, Confluence does have an account of such stability, and additionally, it too restricts the set of expected languages, not by preventing the generation of unattested languages, but by accounting for their unlikelihood. In the next section, I discuss another distinctive property of Mokilese, and use it as an additional evidence for the Confluence hypothesis.

6.3. *A possible consequence*

An interesting sidebar for this discussion arises in a closer look at Mokilese moraic restrictions and the prosody-morphology interface, for Mokilese seems to stand apart on an additional parameter which at first seems completely arbitrary. Its means of reduplicating vowel-initial stems is quite unique among the Pohnpeic languages; indeed, among all Micronesian languages. In formal terms, there are a number of ways of tackling the distinction, only one of which ultimately I find satisfactory. The position I adopt is that Mokilese tolerates morpheme-prosody misalignment.

The prefix in each of the Pohnpeic languages remains bimoraic for vowel-initial stems, but Mokilese geminates the reduplicant's second consonant to achieve this quantity, while Pohnpeian and Pingilapese instead follow it with an epenthetic vowel. In this discussion, I focus mainly on the contrast between Mokilese and Pohnpeian, since Pingilapese really avoids all moraic consonants in the reduplicative context.

(20)	Vowel-initial reduplicatives			
	Mokilese		Pohnpeian	
	onn -onop	<i>preparing</i>	ami -amas	<i>being raw</i>
	idd -idip	?	ini -inen	<i>straight</i>
	all -alu	<i>walking</i>	uku -uk	<i>fast</i>

The difference in strategy is curious because it cannot simply be a function of the languages' differing tolerance of moraic consonants. If the epenthesis pattern of Pohnpeian vowel-initial reduplicated forms were strictly a function of consonant restrictions, then we have the following erroneous consequence: because Pohnpeian still allows moraic nasals, it might reduplicate *amas* as **ammamas* and *uk* as **uŋkuk*. Both forms, strictly in terms of segmental restrictions, are well-formed in Pohnpeian, yet it still avoids them.

So there must be some constraint that prevents such forms from emerging. Further, it cannot be ALIGN-MORPHEME-FOOT, which allows *ami-amas* and *uku-uk* in Pohnpeian, but (given the notion of moraic feet, on which I expand in Section 6.3.1) also allows *onn-onop* and *all-alu* in Mokilese, and would allow **am.m-amas* and **uŋ.k-uk* in Pohnpeian. The difference is instead in ALIGN-MORPHEME-SYLLABLE, defined in (21), which the Pohnpeian forms obey, but which the Mokilese ones (and the illicit Pohnpeian ones) do not.

- (21) ALIGN-MORPHEME-SYLLABLE Morpheme boundaries align to syllable boundaries.

I provide below an argument for why ALIGN-MORPHEME-SYLLABLE must be the formal means of distinguishing the Mokilese and Pohnpeian patterns.

6.3.1 An argument for ALIGN-MORPHEME-SYLLABLE

The appeal to ALIGN-MORPHEME-SYLLABLE requires an acknowledgement of constraints that would be in opposition to it, and would motivate its violation. Observationally, Mokilese would rather use gemination and misalign its reduplicant than insert an epenthetic vowel, while Pohnpeian uses insertion for the benefit of proper alignment. Thus, the constraints that are in opposition to ALIGN-MORPHEME-SYLLABLE are WEIGHT-IDENT-BR and DEP-BR, both defined in (22).

- (22) WEIGHT-IDENT-BR Segments in correspondence have identical quantity.
(Quantity = moraicity)

DEP-BR Every Reduplicant segment has a correspondent in the Base.

In Mokilese, ALIGN-MORPHEME-SYLLABLE is ranked below DEP-BR, and as a result, gemination—which incurs misalignment—is preferred over vowel excrescence, as I show in Tableau (23).

(23)	MOKILESE <i>onop</i> + progressive	DEP-BR	ALIGN-MORPH- SYLL	WEIGHT IDENT
a. \rightarrow	<u>on.n</u> -o.nop		n	n
b.	<u>o.ni</u> .-o.nop	i!		

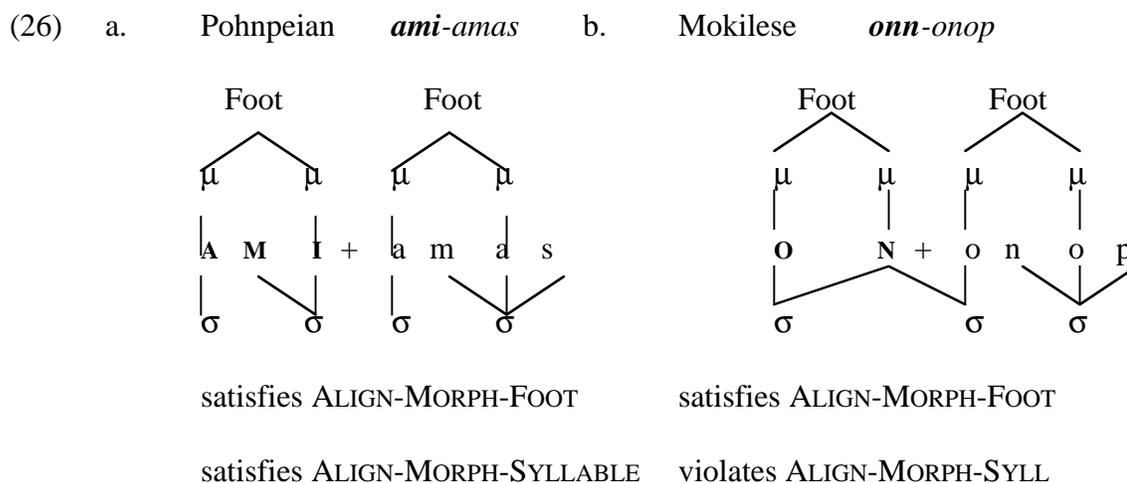
Pohnpeian, in contrast, has the opposite rank of DEP-BR and ALIGN-MORPHEME-SYLLABLE, and therefore avoids gemination. What is neat about this approach is that Pohnpeian's avoidance of gemination is not a result of a dispreference for moraic consonants themselves, but instead results from the accompanying misalignment of morpheme and syllable edges. I summarize this in Tableau (24).

(24)	Pohnpeian <i>amas</i> + durative	ALIGN-MORPH- SYLL	DEP-BR	WEIGHT IDENT
a.	<u>am.m</u> -a.mas	m!		m
b. \rightarrow	<u>a.mi</u> .-a.mas		i	

I should add that despite the violability of ALIGN-MORPHEME-SYLLABLE in Mokilese, the language is still bound by ALIGN-MORPHEME-FOOT. Indeed, forms like *onn-onop* violate ALIGN-MORPHEME-SYLLABLE, but satisfy ALIGN-MORPHEME-FOOT. In other words, I allow prosodic representations that do not follow the prosodic hierarchy, notably because feet are built only from moras, without intervening syllable nodes.

(25) ALIGN-MORPHEME-FOOT Morpheme boundaries align to foot boundaries.

The forms in Figure (26) show how ALIGN-MORPHEME-FOOT and ALIGN-MORPHEME-SYLLABLE make differing judgements of Pohnpeian and Mokilese structures. In particular, (26b) provides an example of a Mokilese representation that has misaligned syllables but well-aligned feet; it does so by having strictly moraic feet.



In both forms in (26), there is a morpheme boundary, indicated by a + sign, that does not occur between the moras of a single foot; as such, both forms satisfy ALIGN-MORPHEME-FOOT. However, the Pohnpeian morpheme boundary also occurs between two syllables, while the Mokilese boundary occurs within one. As a result, the Mokilese form violates ALIGN-MORPHEME-SYLLABLE.

Now we can say that the only unique thing about how Mokilese reduplicates vowel-initial forms is its rank of ALIGN-MORPHEME-SYLLABLE, regardless of any restrictions in possible geminates. ALIGN-MORPHEME-FOOT can remain highly ranked in both languages. The following tableaux illustrate this; in Tableau (27), the rank of DEP-BR over ALIGN-MORPHEME-SYLLABLE rules out the epenthetic candidate. As a result, the geminated form is optimal, even with ALIGN-MORPHEME-FOOT ranked above DEP-BR.

(27)	Mokilese <i>onop</i>	ALIGN-MORPH-FOOT	DEP-BR	ALIGN-MORPH-SYLL	WEIGHT-IDENT
a. ☞	on.n -o.nop			n	*
b.	o.ni .-o.nop		*!		

To arrive at the Pohnpeian pattern, we need only to posit ALIGN-MORPHEME-SYLLABLE above DEP-BR. This prevents the kind of gemination seen in Mokilese vowel-initial reduplicatives; the lower rank of DEP-BR allows epenthesis to occur, as Tableau (28) shows.

(28)	Pohnpeian <i>amas</i>	ALIGN-MORPH-FOOT	ALIGN-MORPH-SYLL	DEP-BR	WEIGHT-IDENT
a.	am.m -a.mas		m!		*
b. ☞	a.mi .-a.mas			*	

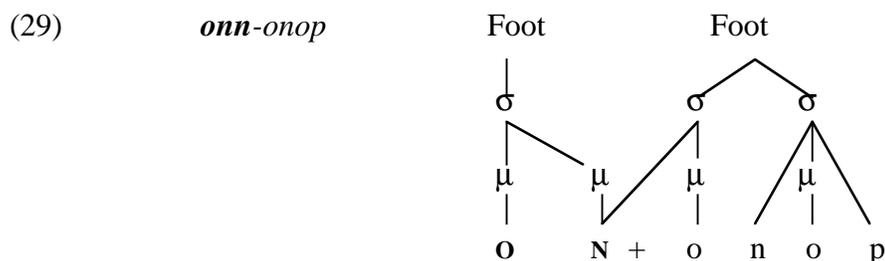
The appeal to ALIGN-MORPHEME-SYLLABLE thus offers a very neat picture of how the reduplicative systems of Mokilese and Pohnpeian differ. With its respective position in each language, it allows geminates to appear in vowel-initial progressives in Mokilese, but not in vowel-initial duratives in Pohnpeian. They otherwise have the same system: a high rank of ALIGN-MORPHEME-FOOT, which *all* reduplicants in both languages respect, produces the bimoraic tendency of the prefix.

In the remainder of this section, I show why the Mokilese forms must not be represented according to a strict interpretation of the prosodic hierarchy, and why the syllable alignment approach is superior to an alternative that relies on an opposition between epenthesis and lengthening.

6.3.2 Some consequences of the Prosodic Hierarchy in Mokilese

First, if we subscribe to the Prosodic Hierarchy, the Mokilese tolerance of ALIGN-MORPHEME-SYLLABLE violations forces a concomitant tolerance of ALIGN-MORPHEME-

FOOT violations. Consider the representation in Figure (29), in which syllable nodes intervene between feet and moras.



The morpheme boundary—indicated by the + sign—falls within a syllable, and likewise within a foot. As a result, ALIGN-MORPHEME-FOOT (the mechanism that achieves bimoraic reduplicants) must also be ranked lower than DEP-BR in Mokilese; otherwise, **oni-onop* would be optimal.

(30)	Mokilese <i>onop</i> , Prosodic Hierarchy	DEP-BR	ALIGN-MORPH- SYLL	ALIGN-MORPH- FOOT
a. ☞	on.n -o.nop		*	*
b.	o.ni -o.nop	i!		

This precipitates a further quandary, for ALIGN-MORPHEME-FOOT is the constraint used to motivate bimoraic prefixes. Yet with it ranked below DEP-BR, *(*do-dop*) would emerge instead of (*dopi*)(*dop*): given the established rank of MAX-BR over DEP-BR, and of ALLFEETRIGHT over both (this we know, since reduplication is only partial), a low-ranked ALIGN-MORPHEME-FOOT will allow reduplicated forms in which the prefix is monomoraic, stuffed into a single foot with the stem.

(31)	Mokilese <i>dop</i> , Prosodic Hierarchy	ALLFEET RIGHT	MAX-BR	DEP-BR	ALIGN- MORPH-FOOT
a. (☞)	(dopi) (dop)	*!		*	
b. ③	(do) -dop		*		*

A last gasp of a recourse to save this model—with ALIGN-MORPHEME-FOOT ranked low and the Prosodic Hierarchy intact—would be to appeal to some sort of Templatic constraint for Mokilese. It would need to be bimoraic (not a heavy syllable, given epenthetic forms like *dopi-dop*, which have bimoraic but disyllabic prefixes).

(32)	Mokilese <i>pa</i>	RED= μμ	ONSET	ALIGN-MORPH- SYLLABLE
a. ☞	(paa) (pa)			
b.	(pa) -pa	*!		

Even so it would not work for all forms: it is not clear how a template would evaluate vowel-initial prefixes in Mokilese, where the geminate spills into the second syllable. Several proposals exist for allowing these structures with a templatic model. Blevins (1996) argues for gradience in templatic evaluation, in which case, a heavy syllable plus an onset is preferred over a light syllable. Kennedy (2000) develops a one-sided template approach, as does Crowhurst (2002), with the added argument that the aligned morphemic boundaries exist on the moraic tier.

(33)	Mokilese <i>onop</i>	RED= μμ	ONSET	ALIGN-MORPH- SYLLABLE
a. (☞)	on.n -o.nop	?	*	n
b.	o.ni .-o.nop	?	**	

Even so, I reject the use of templates outright, for several reasons. Critically, the use of templates gives rise to the overgenerative problem of the Kager-Hamilton conundrum (McCarthy & Prince 1999) discussed in §3.4.5.1. That is, templates in Optimality Theory predict a typology of languages that includes systems in which bases reflect the required prosody of the reduplicant, otherwise known as prosodic back-copy, an unattested phenomenon.

In addition, as §4.6 shows, a template cannot work in Pohnpeian whatsoever, since some prefixes are CV while others are CVV or VCV. We then would be left with the unclean generalization that Mokilese is templatic (and messily so) while Pohnpeian is fundamentally different.

In contrast, the representations of moraic feet in Figure (24) allow Mokilese to maintain a high rank of ALIGN-MORPHEME-FOOT, which ensures the proper quantity for the prefix in *dopi-dop*. Moreover, it does so without a reduplicant-specific requirement of prosodic size or shape.

(34)	MOKILESE <i>dop</i>	ALIGN- MORPH-FOOT	ALLFEET RIGHT	DEP-BR	ALIGN- MORPH-SYLL
a. ☞	(dopi) (dop)		*	*	
b.	(do) -dop)	*!			

6.3.3 Other accounts of Mokilese misalignment

The previous section shows that an account of Mokilese vowel-initial progressives that simply attributes the pattern to a tolerance of morpheme-syllable misalignment works at the expense of the Prosodic Hierarchy. The misalignment story, however, is not the only one; in this section, I argue that it is the best one.

There are several alternative accounts for the appearance of gemination in Mokilese vowel-initials. One approach is to rely on the claim that Mokilese simply tolerates consonant-lengthening over epenthesis, while Pohnpeian does the reverse, and

that their constraint rankings should reflect that. Another is to attribute the Mokilese pattern to a maximization of onset consonants that emerges in reduplication.

The first option, choosing between lengthening and epenthesis, is insufficient. For Pohnpeian, it requires the ranking of WEIGHT-IDENT-BR, which forbids consonant lengthening, over DEP-BR, which forbids epenthesis. The opposite ranking must be posited for Mokilese.

(35)	POHNPEIAN <i>amas</i>	WEIGHT-IDENT	DEP-BR
a.	am.m -a.mas	m!	
b. ☞	a.mi .-a.mas		i

(36)	MOKILESE <i>onop</i>	DEP-BR	WEIGHT-IDENT
a. ☞	on.n -o.nop		n
b.	o.ni .-o.nop	i!	

While this may seem simple enough, it actually results in a ranking paradox in Pohnpeian. The ranking in Tableau (35) predicts the wrong output for forms such as *dod* and *pap* in Pohnpeian. Because their reduplicated forms include moraic consonants, like in *don-dod*, and because medial codas are moraic but final consonants are not, such forms violate WEIGHT-IDENT-BR. Ranking WEIGHT-IDENT-BR over DEP-BR predicts epenthesis even in these forms, as Tableau (36) shows.

(36)	POHNPEIAN <i>dod</i>	WEIGHT-IDENT	DEP-BR
a.	dod -dod	d!	
b. (☞)	don -dod	n!	
c. Ⓢ	dodi -dod		i

Therefore, the simple approach of attributing the Mokilese-Pohnpeian contrast to a reranking of these constraints does not have the proper effect on the systems. A second approach would be instead to formulate the difference in the languages to a difference in the degree to which they respect ONSET.

(37) ONSET Syllables have Onsets

We can clearly see more onsets in Mokilese *onn-onop* than in Pohnpeian *ami-amas*; the formal approach is thus that Mokilese ranks ONSET higher than Pohnpeian does. But this leaves open the question of what ONSET outranks in Mokilese to produce

the geminate pattern: presumably, it crucially must outrank WEIGHT-IDENT, as illustrated in Tableau (38) below.

(38)	MOKILESE <i>onop</i>	ONSET	WEIGHT-IDENT
a. ☞	on.n -o.nop	*	n
b.	o.ni -o.nop	**!	

Nevertheless, when we turn to Pohnpeian, this will resolve the conundrum of the previous approach: for though the Pohnpeian epenthetic pattern could follow quite simply from ranking WEIGHT-IDENT-BR over ONSET, it still must also rank over DEP-BR. Such a ranking is critical for the choice of *ami-amas* over **amm-amas*, as Tableau (39) shows.

(39)	POHNPEIAN <i>amas</i>	WEIGHT-IDENT	ONSET	DEP-BR
a.	am.m -a.mas	m!	*	
b. ☞	a.mi -a.mas		**	i

We then are in the same pickle as in Tableau (35): because of the rank of WEIGHT-IDENT over DEP-BR, the system that correctly predicts *ami-amas* also incorrectly predicts **dodi-dod*, as Tableau (40) shows.

(40)	POHNPEIAN <i>dod</i>	WEIGHT-IDENT	ONSET	DEP-BR
a.	dod -dod	d!		
b. (☞)	don -dod	n!		
c. Ⓢ	dodi -dod			i

In contrast, a happy consequence of the ALIGN-MORPHEME-SYLLABLE approach in Section 6.3.2 is that it allows both languages to maintain a rank of DEP-BR over WEIGHT-IDENT; as a result, we avoid the ranking paradox in Pohnpeian, correctly predicting *don-dod* instead of **dodi-dod*.

(41)	Pohnpeian <i>dod</i>	ALIGN-MORPHEME-SYLLABLE	DEP-BR	WEIGHT-IDENT
a. ☞	don -dod			n
b.	dodi -dod		i!	

6.4. Divergence in ALIGN-MORPHEME-SYLLABLE ranking

In this section, I appeal to Confluence to explain the use of gemination (and misalignment) in Mokilese. To return to the original problem of Section 6.3, Mokilese

and Pohnpeian differ in how they reduplicate vowel-initial stems: Mokilese with geminate consonants, as in *onn-onnop*, and Pohnpeian with epenthetic vowels, as in *ami-amas*. Furthermore, as I have mentioned, their difference cannot be a function of the languages' differing tolerance of moraic consonants. If it were, Pohnpeian would reduplicate *amas* as **amm-amas* and *uk* as **uŋ-kuk*. Both forms, strictly in terms of segmental restrictions, are well-formed in Pohnpeian, yet it still avoids them. The constraint that prevents such forms from emerging is ALIGN-MORPHEME-SYLLABLE, which the Pohnpeian forms obey, but which the Mokilese ones (and the illicit Pohnpeian ones) do not.

We can imagine the contraposition of this situation: one language would have a Mokilese-like permissive inventory of possible geminates, but would be Pohnpeian-like by allowing none in vowel-initial progressives. Conversely, the other language would have Pohnpeian's restricted set of moraic consonants, but would nonetheless extend Nasal Substitution to vowel-initial duratives. I summarize these imaginable languages in Table (42), where I also provide predicted hypothetical forms of each. Logically each cell in Table (42) is a possible system, but we should question why the real situation is instead as it is.

(42) Contrapositive languages

	Nasal substitution	Obstruent geminates tolerated
Morpheme-syllable misalignment	emm-emes, aŋk-ak den-ded, sipi-sip	<i>Mokilese</i>
Morpheme and syllables well-aligned	<i>Pohnpeian</i>	eme-emes, aki-ak ded-ded, sipi-sip

A goal of Confluence is to account for why Pohnpeian and Mokilese systems exist, while the other cells in Table (42) do not correspond to attested languages of the Micronesian family. In fact, the Confluence claim that some collocations of subpatterns are expected to co-occur provides an explanation.

In this case, let us observe that, limiting the argument only to consonant-initial forms, and irrespective of lexical frequency effects, Mokilese will have at least twice as many geminates at morpheme junctures as Pohnpeian will, because of its larger inventory of geminates. That is, both languages will allow gemination to persist for *mm*, *nn*, *mm^v*, *ŋŋ*, *ll*, and *rr*, but only Pohnpeian will invoke nasal substitution for *pp*, *pp^v*, *tt*, *dd*, *ss*, *kk*, *lt*, *st*, *ld*, *lt*, *rt*, and *rd*; Mokilese will leave these sequences intact.

The application of Nasal Substitution in Pohnpeian results in a clear sequence of two segments, a nasal and an obstruent. In the event of reduplicative concatenation, a morpheme boundary falls between those segments, and thus between syllables. As a result, the learner often has evidence in favour of maintaining a high rank of ALIGN-MORPHEME-SYLLABLE, as Figure (43) illustrates.

(43) Evidence of alignment for the Pohnpeian learner

Conservative grammar	
↓	
“pap-pap, pam-pap”	
↓	
[pap-pap ~ pam-pap ~ paa-pap]	<i>← Articulatory pressures may induce variation</i>
↓	
Acquired grammar	<i>Each variant percept is a possible interpretation of the ambient forms</i>
	<i>Learner chooses [pam-pap] as the formally required form: Thus, grammar requires nasalization and maintains high rank of ALIGN-MORPHEME-SYLLABLE</i>

In Mokilese, the existence of two distinct segments is not nearly as apparent for the learner. Even if medial geminates are given two-root representations that satisfy ALIGN-MORPHEME-SYLLABLE, it is not obvious at an empirical level whether one or two roots are involved, and likewise it is not obvious if ALIGN-MORPHEME-SYLLABLE is to be respected. Thus, the higher incidence of morpheme-juncture geminates in Mokilese *for consonant-initial stems only* could precipitate a development in which ALIGN-MORPHEME-SYLLABLE sinks (even needlessly) enough for its apparent laxness to show up in vowel-initial forms—which, unlike consonant-initial forms, formally must be analyzed as violators. I summarize this process in Figure (44).

(44) Evidence of misalignment for the Mokilese learner

Conservative grammar	
↓	
“pap-pap, pam-pap”	
↓	
[pap-pap ~ pam-pap ~ paa-pap]	<i>← Articulatory pressures may induce variation</i>
↓	
Acquired grammar	<i>Each variant percept is a possible interpretation of the ambient forms</i>
	<i>Learner chooses [pap-pap] as the formally required form: Thus, grammar tolerates obstruent geminates and violations of ALIGN-MORPHEME-SYLLABLE</i>

In short, there is a strong possibility that the emergence of a larger set of possible geminates in Mokilese actually caused its tolerance of ALIGN-MORPHEME-SYLLABLE violations. In formal terms, the new rank of IDENT-NASAL over *OBS/MORA precipitated

the additional innovation of ranking DEP-BR over ALIGN-MORPHEME-SYLLABLE. This is the kind of collocation of phonological patterns that Confluence claims is expected.

Let us return then to the logical permutations of languages in Table (42), which I repeat as Table (45) below. It is a prediction of Confluence that one Mokilese innovation, the allowance of obstruent geminates, begat another innovation, the tolerance of misalignment. Likewise, Pohnpeian's conservative geminate inventory helps maintain a high rank of Alignment.

(45) Computable languages

	Nasal substitution	Obstruent geminates tolerated
Morpheme-syllable misalignment	emm-emes, aŋk-ak, den-ded, sipi-sip	<i>Mokilese</i>
Morpheme and syllables well-aligned	<i>Pohnpeian</i>	<i>Pre-Mokilese</i> eme-emes, aki-ak, ded-ded, sipi-sip

As a result, the misaligning/nasal-substituting language in (45a) is unlikely to have developed out of a well-aligning language like (45c). However, an aligning language tolerant of obstruent geminates, (45d), is predicted to be a possible descendent of a nasal-substituting language; Confluence predicts this, as Section 6.2.3 shows. We may call this language 'Pre-Mokilese', out of which true Mokilese developed. Confluence accounts for the likelihood that (45d) would become (45c).

Thus we have a reasonable explanation of how Mokilese misalignment may have come about. It is a satisfying one as well: Pohnpeian is known for its Nasal Substitution, and Mokilese for its vowel-initial progressives, and the two patterns seem at first blush unconnected. After all, one is a matter of moraic restrictions, the other, of Alignment, and the relevant formal constraints for each are separate entities. But now we can say it is no accident that Mokilese tolerates both moraic obstruents and morpheme-juncture gemination. The hypothetical contrapositive (in which all cells of Table (45) represent attested languages) is typologically possible, but reasonably unlikely.

6.5. Summary

In this chapter I have described and analyzed a difference in the set of allowable moraic consonants in the Pohnpeic languages of Mokilese, Pohnpeian, and Pingilapese. I have identified an interesting subpattern which they share to some extent: each treats potential non-homorganic sequences with epenthesis, but each uses some other strategy to resolve homorganic sequences. I have attributed the stability in avoiding non-homorganic sequences, as well as the variability in the treatment of homorganic ones, to the effects of phonological Confluence.

Furthermore, Mokilese has the distinction of allowing geminates at morpheme-junctures, but as Confluence predicts, this is related to its tolerance of a greater set of geminate consonants. From another point of view, the distribution of geminates in

Pohnpeian and Mokilese is half a function of restriction on moraic consonants, half of morphology-prosody alignment.

Each of these patterns is easily formalized, and differences between these languages are simply expressed in terms of differences in the rank of the same set of constraints. In doing so, I have acknowledged that the typologically possible languages generated by these constraints are far greater than what is actually attested. However, the absence of particular systems is not a random one, but one that is actually expected. Confluence accounts for why no Pohnpeic language resolves homorganic sequences with epenthesis, and why only Mokilese allows morpheme-syllable misalignment.

These generalizations are expected because certain constraint rankings are salient enough to be more robust than others. For example, the rank of CODACONDITION and MAX-BR over DEP-BR is more likely to transmit accurately from caregiver to learner than the rank of *OBS/MORA or NOCODA over IDENT-NASAL or UNIFORMITY. Likewise, a language that employs Nasal Substitution is likely to maintain a high rank of ALIGN-MORPHEME-SYLLABLE, while a language that tolerates obtruent geminates is likely to let it slide.

Thus, with close scrutiny, it is possible to account for typological gaps and near-gaps in the Pohnpeic family with Confluence, which offers more explanation than the circularity of fixedness. By understanding why certain ranking relationships are more stable than others, and why certain innovations may precipitate others, there is no need to stipulate cross-linguistically fixed rankings to account for such gaps. As a result, we can add the restricted divergence within the Pohnpeic group to a growing body of knowledge about why certain phonological systems are more or less likely. For example, Maddieson (2002) offers an understanding of gaps in consonant inventories across languages, while Myers (2002) discusses the absence of systems that resolve NC clusters with epenthesis. Instead of rigging a theory like OT to force such gaps, it is possible to attribute them to other factors outside the domain of constraint permutation.

7. Stress and Allomorphy in Woleaian Reduplication

7.1. Introduction

This chapter is the first of three that comprise a unit that focuses on the Chuukic subgroup of Micronesian languages. The chapter that follows turns to its sister languages Puluwat and Chuukese, while Chapter 9 summarizes the results of the analyses of each. As such it provides an opportunity to make comparisons that support the predictions of Confluence.

Woleaian is a Chuukic language spoken in western Micronesia, on and around the atoll of Woleai. Its geographic position is geographically peripheral in comparison to the eastern Chuukic languages, such as Puluwat and Chuukese, and the Ponapeic languages (see map, §2.2). Woleaian nonetheless shares the progressive and denotative affixes seen in other Chuukic and Ponapeic languages (Harrison 1973, Sohn 1975). The progressive is invariably a prefix, and like in other Chuukic languages, such as Chuukese, Puluwat (Elbert 1974), and Ulithian (Sohn & Bender 1973), it is bimoraic, with the second mora realized by geminating the initial consonant of the stem (*fati* → *faf-fati* ‘being angular’, *fili* → *fif-fili* ‘choosing’). While this resembles a templatic operation, I will propose that the shape of the prefix emerges from general constraints on prosodic and segmental structure.

The denotative marker, however, occurs unpredictably as a suffixed disyllable (*fati* → *fati-fati* ‘be angular’, *perase* ‘splash’ → *perase-rase* ‘scatter’) or initial gemination (*fili* → *ffili* ‘choose’, *feragi* → *fferagi* ‘spread’). In this chapter, I argue that the shape and position of the denotative allomorphs can be predicted from the interaction of a morphological diacritic with the language’s stress pattern. I show further that this same diacritic actually helps guarantee the size and shape of the progressive. Thus, while each reduplicative shape resembles a templatic operation, I will propose that the patterns of reduplication in Woleaian result from an emergent effect of general constraints on prosodic and segmental structure. I provide a theoretical analysis using Optimality Theory (Prince & Smolensky 1993, McCarthy & Prince 1993a,b) to do so.

The mapping of morphemes to prosodic constituents is something that I attribute to a general constraint requiring the alignment of morpheme boundaries to foot boundaries. I will show that each reduplicative morpheme (including the initial-geminate variant of the denotative) respects such a requirement.

The analysis has implications for the study of Woleaian in particular, for Micronesian languages at large, and for reduplication theory in general. For Woleaian, it offers a principled account for the denotative allomorphy, as well as for the absence of bare-consonant or monomoraic suffixes, and for the absence of bivocalic prefixes. For Micronesian languages, it stands as another example of languages diverging only by the drift of a small number of constraints. For reduplication theory, it strengthens the case for modeling reduplication as the emergence of unmarked prosody. It also offers an account of morpheme ordering that can generalize to any language with multiple reduplicative affixes, particularly one with both prefixing and suffixing reduplication.

This chapter is organized as follows. In Section 7.2, I present the data and describe the relevant phonological and reduplicative generalizations. In Section 7.3, I present an Optimality-Theoretic account that captures the denotative allomorphy with the manipulation of an abstract diacritic. In Section 7.4, I argue that assigning this diacritic to the progressive morpheme predicts its invariantly word-initial bimoraic form. In Section 7.5, I investigate in greater detail the segmental realization of the progressive prefix.

7.2. *Data and Generalizations.*

In this section, I first provide a description of general phonological traits in Woleaian, such as segmental alternations, gemination, and the stress pattern. I then present Woleaian's two reduplicative morphemes, describing the allomorphy of the denotative affix and the invariantly bimoraic progressive prefix. All data in this section are from Sohn (1975) and Sohn & Tawerilmang (1976).

7.2.1 *Aspects of Woleaian phonology*

Before presenting an analysis of the denotative and progressive reduplicants, it is necessary to describe several other traits of Woleaian phonology. There are some segmental alternations that, if unacknowledged, would render the reduplicative data rather messy. It is also necessary to determine the prosodic status of initial and medial geminate consonants, and to describe the stress pattern.

First, Woleaian does not tolerate sequences of low vowels; which it avoids by raising alternate vowels.¹ Thus underlying *parasa* 'splash' arises as *perase*; and the reduplicated intransitive form is *perase-rase*. Although this pattern occurs independently of reduplication, the process motivating it is one of overriding priority, as can be seen in reduplicated forms like *ceccane* 'apply powder'. In Sections 7.3 and 7.4, I will only consider output candidates that respect this dissimilative alternation.

Second, all word-final vowels are voiceless in Woleaian; the analysis will depend on these nonetheless being moraic and figuring in the foot structure, but it otherwise has no consequence except for any reader who is accustomed to seeing forms like *perase* transcribed as *peras*. It does have some importance for the discussion of pan-Micronesian phonology, since the final-vowel devoicing here is reflected as total deletion elsewhere in Chuukic languages and in Ponapeic languages, and historical reanalysis (loss) in Kosraean. I return to the issue of lenition in Woleaian in Chapter 9.

Third, all consonants may be geminated, but a number of them have an articulatory change when lengthened. These changes are laid out in Table (1). A generalization to be made is that each of these consonants is a continuant when short but a stop when long; the segment transcribed as *g* is phonetically (γ). A similar change actually occurs with *b*, which is phonetically (β), but whose long version is a stop.² It

¹ See Blust (1996) Suzuki (1997) for a full discussion of the dissimilatory process.

² I follow Sohn's orthography, except I replace all digraphs as follows: *ü* for *iu*, *ö* for *eo*, *ʃ* for *sh*, *c* for *ch*, and *ŋ* for *ng*.

should be noted that although Sohn (1975) transcribes these stops as single symbols, he claims that they are still roughly twice the length of their short counterparts.

(1) Consonants that change manner when long:

$l \rightarrow nn$	lütü	→	nnütü	<i>to be jumping</i>
$\gamma \rightarrow kk$	ɣaʃee-y	→	kkaʃe	<i>to throw</i>
$r \rightarrow cc$	raɣo-mi	→	ccaɣo	<i>to hug</i>
$f \rightarrow cc$	ʃaɣee-y	→	ccaɣe	<i>to chase</i>
$\beta \rightarrow bb$	βuɣa	→	bbuɣa	<i>to boil</i>

Fourth, it will be necessary to treat the first member of all geminates as moraic, even if word initial. This is consistent with other Chuukic languages like Chuukese (Davis 1999, Muller 1999); furthermore, the fossilized reflex of initial gemination in Pohnpeian is a syllabic nasal (Harrison 1973) which is treated in Chapter 4 as moraic. For example, the Pohnpeian form *nda* ‘to say’ reduplicates as *ndi-nda*; in which the initial nasal helps satisfies a bimoraic requirement.

Lastly, the stress pattern will be important for the analysis in Sections 7.3 and 7.4. I propose an assignment of stress for Woleaian similar to that in other Micronesian languages: primary stress is attracted to the right edges of words, and the stress system counts moras. More specifically, primary stress occurs on the penultimate mora—the element that receives a salient pitch drop, which is typical of stressed units in the language family (Rehg 1993). Secondary stress then occurs on alternate preceding moras, regardless of syllabification. I return to the issue of stress and feet in Section 7.3, but introduce the mechanism of stress assignment here. The rightward pressure of footing is achieved with ALLFEETRIGHT, which also functions in Section 7.3 as the means of limiting the size of reduplicative affixes.

(2) ALLFEETRIGHT All feet are final: assess a violation for every mora occurring between each foot and the right edge of the word.

If we consider forms with more than two moras, some additional constraint work is necessary. In four-mora forms, the initial mora ought to receive secondary stress, but placement of a foot there—as in $(\acute{\mu}\mu)(\acute{\mu}\mu)$ —will incur a violation of ALLFEETRIGHT. Although the relative prominence of stress as primary or secondary is of little consequence in this chapter—what matters is only its alternation—I provide a means of ensuring that primary stress occurs on the final foot. I do so with the constraint HEADRIGHT (Pater 1995), which formalizes this requirement.

I attribute the requirement of a second foot to the constraint *LAPSE, which has the indirect effect of ensuring all moras in a sequence are footed. *LAPSE rules out a form like $\mu\mu(\acute{\mu}\mu)$, which is superior by ALLFEETRIGHT. Another competitor can still emerge, however: $\mu(\acute{\mu}\mu)(\acute{\mu})$, which beats the desired output on ALLFEETRIGHT and is no worse by *LAPSE. I therefore also include FOOTBINARITY to avoid this result.

(3) HEAD-RIGHT The foot that contains primary stress is final

*LAPSE Unstressed moras must not be adjacent.

FOOTBINARITY Feet are bimoraic.

I summarize the system in Tableau (4). In order for the proper form to emerge, FOOTBINARITY and *LAPSE both must outrank ALLFEETRIGHT.

(4)	μμμμ	*LAPSE	FOOT BINARITY	HEAD RIGHT	ALLFEET RIGHT
a.	μμ(μμ)	*!			
b.	μ(μμ)(μ)		*!		*
c.	(μμ)(μμ)			*!	**
d.	☞ (μμ)(μμ)				**

7.2.2 The Woleaian denotative

The Woleaian denotative affix creates what Sohn (1975) labels as “neutral” verbs; in more specific terms, it derives intransitives from transitives. Harrison (1973) uses the term “denotative” because the resulting form is like a predicative adjective; moreover, the affix can also attach to nouns and adjectives. While a suffix with a similar function can be seen in Ponapeic languages, as well as in Kosraean, Gilbertese, and Marshallese, Woleaian stands out since its denotative can occur as a suffix, like in other Micronesian languages, or as gemination of the initial consonant of the stem.³

Table (5) provides examples of forms with initial gemination. For each verb in Table (5), I provide the unreduplicated transitive with its object suffix, as this is how Sohn (1975) cites unreduplicated forms. The Woleaian object suffix should be considered as equivalent, if not cognate, to the thematic consonants of Pohnpeian, in that there is a consonant in the transitive form that is absent from the corresponding intransitive. For example, the transitive form *βüñü-ti* has a suffix *ti* that is not reflected in the denotative form *bbüñü*; likewise, Pohnpeian has transitive forms like *wenid* whose denotative, *wenj-wenj*, does not have the final *d* of the unreduplicated form.

Each verb in Table (5) has a denotative form with an initial long consonant, and in some forms, the lengthened variant of both *r* and *f* is *c*; the lengthened variant of *γ* is *k*; and the lengthened variant of *l* is *n*. In this table and elsewhere I transcribe long consonants doubly, as in *cc*, *kk*, and *nn*. Although Sohn’s custom is to transcribe single symbols for *c*, *k* and *n*, he describes such segments as inherently long, having roughly twice the duration of *r*, *f*, *γ*, and *l*.

³ Other Micronesian languages show some evidence of initial gemination, but not to indicate the denotative (Harrison 1973).

(5) Woleaian denotative as initial geminate

<i>transitive</i>	<i>gloss</i>	<i>denotative</i>	<i>gloss</i>
βünjü-ti	<i>fall on it</i>	bbünjü	<i>to fall on</i>
βuɣa	<i>boil it</i>	bbuɣa	<i>to boil</i>
faa-ti	<i>kick it</i>	ffa	<i>to kick</i>
fili	<i>choose it</i>	ffili	<i>to choose</i>
foori	<i>make it</i>	ffoori	<i>to make</i>
ɣafee-y	<i>throw it</i>	kafe	<i>to throw</i>
ñüsü-ri	<i>snort it</i>	ññüsü	<i>to snort</i>
pefa-ñi	<i>stick to it</i>	ppafa	<i>to stick to</i>
raɣo-mi	<i>hug it</i>	ccaɣo	<i>to hug</i>
sawee-y	<i>go along side of it</i>	ssawe	<i>to go along side of</i>
ɣayee-y	<i>chase it</i>	ccaɣe	<i>to chase</i>
tafee-y	<i>follow it</i>	ttafe	<i>to follow</i>
lütü	<i>to jump</i>	nnütü	<i>to be jumping</i>
ferayi	<i>spread</i>	fferayi	<i>to be spread</i>
yaariyer	<i>stripes</i>	kkaariyer	<i>to have stripes</i>
pileyü-w	<i>bundle it</i>	ppileyü	<i>to be bundled</i>
taariña	<i>be ripped (vulgar)</i>	ttariña	<i>to be ripped off</i>
taliñiliñi	<i>to become free</i>	ttaliñi	<i>to be snapped off</i>

Table (6) provides examples of suffixed denotatives. Note that the order of stem and affix is not immediately certain for forms like *fati-feti* and many others, in which a complete bivocalic stem is reduplicated. I treat these forms as suffixed to be uniform with trivocalic denotatives like *perase-rase*, which are clearly suffixed.

(6) Woleaian denotative as suffix

<i>transitive</i>	<i>gloss</i>	<i>denotative</i>	<i>gloss</i>
fañofo	<i>current</i>	fañofo- <u>ñofo</u>	<i>to have a little current</i>
fitiye-li	<i>marry him</i>	fitiye- <u>tiye</u>	<i>to marry</i>
ɣofetii-y	<i>chip it off</i>	ɣofeti- <u>feti</u>	<i>to chip off</i>
masowe	<i>hard</i>	masowe- <u>sowe</u>	<i>to be strong</i>
perase	<i>to splash</i>	perase- <u>rase</u>	<i>to scatter</i>
tafiñi	<i>to trap</i>	tafiñi- <u>fiñi</u>	<i>to sparkle</i>
βalü-w	<i>cover it</i>	βalü- <u>βelü</u>	<i>to cover</i>
βuro-ñi	<i>peel it</i>	βuro- <u>βuro</u>	<i>to peel</i>
βuɣo-si	<i>tie it</i>	βuɣo- <u>βuɣo</u>	<i>to tie</i>
fati	<i>corner</i>	fati- <u>feti</u>	<i>to be angular</i>
file-ti	<i>stir it</i>	file- <u>file</u>	<i>to stir</i>
lape	<i>big, great</i>	lape- <u>lape</u>	<i>greater</i>
mañii-y	<i>remember it</i>	mañii- <u>meñi</u>	<i>to remember</i>
misi	<i>fool</i>	misi- <u>misi</u>	<i>tell lies</i>

To establish that the choice of suffix or initial gemination is an arbitrary allomorphic one, it is necessary to show that the form of the denotative affix cannot be predicted from the form of the stem to which it attaches. That is, neither the stem-initial consonant, nor the vowels of the stem, nor the object-suffix class of the verb can predict whether the denotative is realized as a suffix or an initial geminate.

First, the initial consonant of the stem would predict the position of the affix only if there was a clear restriction on what could be geminated. Such a scenario would be clear if some kinds of initial consonants were always geminated, while stems with other initial consonants always receive suffixes. However, this is not the case, as seen by comparing *ffili* with *file-file*, *ɣare-ɣare* with *kaʃe*, *bbuga* with *ʃuɣo-ʃuɣo*, and *ttaβe* with *tafiʃi-fiʃi*.

(7) Denotative not predictable from stem's initial consonant

<i>f...</i>	<i>fili</i> → <i>ffili</i>	<i>choose</i>	<i>file</i> → <i>file-<u>file</u></i>	<i>stir</i>
<i>ɣ...</i>	<i>ɣaʃe</i> → <i>kaʃe</i>	<i>throw</i>	<i>ɣare</i> → <i>ɣare-<u>ɣare</u></i>	<i>broil</i>
<i>β...</i>	<i>βuɣa</i> → <i>bbuɣa</i>	<i>boil</i>	<i>βuɣo</i> → <i>βuɣo-<u>βuɣo</u></i>	<i>tie</i>
<i>t...</i>	<i>taβe</i> → <i>ttaβe</i>	<i>follow</i>	<i>tafiʃi</i> → <i>tafiʃi-<u>fiʃi</u></i>	<i>trap/sparkle</i>

Second, the vowels of the stem cannot predict the form of the denotative, so it is not the case that the initial gemination is a strategy for avoiding the copy of certain vowels or sequences. For example, we see *lape* → *lape-lape* but *taβe* → *ttaβe*, and *fili* → *ffili* but *misi* → *misi-misi*.

(8) Denotative not predictable from stem's final vowel

<i>...e</i>	<i>taβe</i> → <i>ttaβe</i>	<i>follow</i>	<i>lape</i> → <i>lape-<u>lape</u></i>	<i>great(er)</i>
<i>...i</i>	<i>fili</i> → <i>ffili</i>	<i>choose</i>	<i>misi</i> → <i>misi-<u>misi</u></i>	<i>fool</i>
<i>...o</i>	<i>raɣo</i> → <i>caɣo</i>	<i>hug</i>	<i>βuro</i> → <i>βuro-<u>βuro</u></i>	<i>peel</i>
<i>...ü</i>	<i>βünjü</i> → <i>bbünjü</i>	<i>fall on</i>	<i>βalü</i> → <i>βalü-<u>βelü</u></i>	<i>cover</i>

Third, verbs can be classified by the specific object suffix they receive, but the form of any verb's denotative does not correlate with its particular object suffix. For example, the corresponding transitives of *file-file* and *bbünjü* are *file-ti* and *βünjü-ti*; both have *-ti* as an object suffix, but they have different denotative patterns. Similarly, the transitives of *ppeʃa* and *βuro-βuro* are *peʃa-ɲi* and *βuro-ɲi*; both have *-ɲi* as an object suffix.

(9) Denotative not predictable from verb's transitive suffix class

<i>-ti</i>	<i>βünjü-ti</i> ~ <i>bbünjü</i>	<i>fall on</i>	<i>file-ti</i> ~ <i>file-<u>file</u></i>	<i>stir</i>
<i>-ɲi</i>	<i>peʃa-ɲi</i> ~ <i>ppeʃa</i>	<i>stick to</i>	<i>βuro-ɲi</i> ~ <i>βuro-<u>βuro</u></i>	<i>peel</i>
<i>-Ø</i>	<i>βuɣa-Ø</i> ~ <i>bbuɣa</i>	<i>boil</i>	<i>perase-Ø</i> ~ <i>perase-<u>rase</u></i>	<i>scatter</i>
<i>-y</i>	<i>taβee-y</i> ~ <i>ttaβe</i>	<i>follow</i>	<i>maɲii-y</i> ~ <i>maɲi-<u>meɲi</u></i>	<i>remember</i>

Given these three sets of facts, the shape and position of the denotative affix cannot be predicted from the form of the stem to which it attaches. As a result it is necessary to attribute the allomorphy to some learned arbitrary distinction between verbs that geminate and verbs that take suffixes. A classical way of formalizing such distinctions in a grammar is to assign a morphological diacritic to one group, setting off a specific process, or “Minor rule” (as in Lightner 1968, Halle & Vergnaud 1987), which results in a particular allomorph being realized. The other allomorph then follows from more general “Elsewhere” rules (after Kiparsky 1973).

Optimality Theory is not restricted from using morphological diacritics, but doing so introduces the need for constraints over the distribution of such features. I leave open for now the question of which verbs are so marked, but return to it in Section 7.3, where it is proposed that suffixing verbs are the lexically marked class.

7.2.3 The Woleaian progressive

The progressive prefix in Woleaian inflects verbs for the habitual aspect. It invariably appears as a heavy syllable which is closed by a geminate that shares all its features with the initial consonant of the stem. Examples of progressives are provided in Table (10).

(10) The progressive prefix

<i>Stem</i>	<i>Gloss</i>	<i>Progressive</i>	<i>gloss</i>
metafe	<i>to be clear</i>	mem -metafe	<i>to become clear</i>
mili	<i>stay</i>	mim -mili	<i>to be staying</i>
mm ^w utu	<i>to vomit</i>	m^wum -m ^w utu	<i>to be vomiting</i>
m ^w oŋo	<i>eat</i>	m^wom -m ^w oŋo	<i>to be eating</i>
pirafe	<i>steal</i>	pip -pirafe	<i>to be stealing</i>
sa ee-y	<i>scrutinize it</i>	ses -sa e	<i>to scrutinize</i>
tagee-y	<i>ride it</i>	tet -tage	<i>to ride</i>
tela-ti	<i>discuss it</i>	tet -tale	<i>to discuss</i>
tülee-w	<i>talk about it</i>	tüt -tüle	<i>to talk about</i>
toro-fi	<i>catch it</i>	tot -toro	<i>to catch</i>
gematefa	<i>explain it</i>	kek -kematefa	<i>be explaining it</i>
gettape	<i>touch</i>	kek -katepa	<i>to be touching it</i>
lii-y	<i>hit him</i>	nin -niiy	<i>to be hitting him</i>
lüwanee-y	<i>think (it)</i>	nün -nüwane	<i>to think</i>
raŋe	<i>yellow powder</i>	cec -ceŋe	<i>apply powder</i>
ro-si	<i>decorate it</i>	coc -co	<i>to decorate</i>
ʃalü-w	<i>water</i>	cec -calüw	<i>to stick to</i>

The progressive verbs in Table (10) show the same effect of gemination on *g*, *l*, *r*, and *ʃ* that is seen in Tables (5) and (6). Not only do they lengthen, but there is also an articulatory change, with long *g* appearing as *k* (*gettape* → *kekatepa*), and long *r* and *ʃ*

both becoming *c* (*raŋe* → *ceccaŋe*, *ʃalü* → *ceccalü*). In each of these cases, the reduplicated consonant also reflects this articulatory change, so there are no forms like **recaŋe* or **gekatape*. I return to the issue of gemination in the progressive in Section 7.4.

A last descriptive point is that the heavy-syllable prefix is clearly not a third allomorph of the denotative affix. This can be shown by a number of stems that can derive both a heavy-syllable prefixed form and a denotative with one of the two allomorphs. I provide a number of such examples in Table (11) below.⁴

(11) Stems that appear with either affix

<i>Stem</i>	<i>Progressive</i>	<i>Denotative</i>	<i>gloss</i>
βuʎa	bub -buʎa	bbuʎa	<i>boil</i>
fase-ŋü	feŋ -fesa-ŋü	ffaso	<i>call</i>
ʎara	kek -kara	kkara	<i>broil, dry</i>
raʎomi	cec -caʎo	ccaʎo	<i>hug</i>
ʃalü	cec -calü	ccalü	<i>be filled w/ water</i>
ʃeŋaʎi	cec -ceŋaʎi	cceŋaʎi	<i>hang</i>
tali	tet -tali	ttali	<i>rope, draw</i>
tewaa	tet -tewa-si	ttewa-si	<i>be destroyed</i>
toro	tot -toro	ttoro	<i>catch</i>
ʎeraʎe	kek -keraye	ʎeraʎe- raʎe	<i>crawl</i>
kepate	kek -kepate	kepate- pate	<i>word, language</i>
metafe	mem -metafe	metafe- tafe	<i>become clear</i>
raŋe	cec -caŋe	raŋe- raŋe	<i>apply yellow powder</i>

7.3 The Woleaian denotative: an Optimality Theoretic account

In Section 7.2.2, I show that the denotative morpheme has two surface variants in Woleaian: the gemination of the stem's initial consonant, or the addition of a bimoraic suffix. I also show that the choice of one or the other for any particular verb is not a predictable one, and we cannot use the shape or segmental content of a stem to predict the application of a particular process. In this section, I develop an account of the affix and its allomorphy.

Since the choice of gemination or suffixation is unpredictable, there must be something else about individual stems that helps determine the choice of allomorph. In other words, speakers cannot know whether to use one process or the other unless they know the particular stem to be made denotative. Throughout this discussion, I will refer to stems that receive the suffix as 'suffixing stems', while stems that undergo initial gemination I refer to as 'initial gemination stems.'

⁴ While some stems can receive either a denotative or progressive affix, it seems unusual for a stem to receive both at once. However, a few forms do exist that have both variants of denotative formation *at once*. Such forms resemble the Marshallese iterative (Bender 1969), which is realized regularly with the combination of final-syllable reduplication and initial-consonant gemination.

ALIGN-[LEXSTR]-LEFT will prefer forms in which the stem is initial over forms in which other material precedes the stem. In other words, any affixal material placed before the [LEXSTR] stem could cause misalignment of the [LEXSTR] autosegment.

Note for the interim that a vacuous way for [LEXSTR] stems to satisfy ALIGN-[LEXSTR]-LEFT is by not realizing the feature at the surface. I avoid such a result by positing the faithfulness constraint MAX-[LEXSTR], as defined in (13), which is violated by a failure to realize the autosegment.

- (13) MAX-[LEXSTR] Every [LEXSTR] in the input has a correspondent in the output.

The verb *_uro* ‘to peel’ is an example of a suffixing verb, as its denotative is *_ùro-úro*. The specification of the stem as [LEXSTR], in tandem with ALIGN-[LEXSTR]-LEFT, ensures that the denotative is realized as a suffix. Any placement of moraic material before the stem, as in *_u-Uro* or *bbUro*, will incur a violation of ALIGN-[LEXSTR]-LEFT, as summarized in Tableau (14). In this and subsequent tableaux, the mora to which [LEXSTR] associates is indicated as a stress-bearing capital letter.

(14)	βuro [LEXSTR] + DENOT	MAX LEXSTR	ALIGN LEXSTR-L
a.	☞ (βÛro)(βúro)		
b.	(βùro)(βÚro)		**!
c.	h (bÚro)		*!
d.	(bùb)(bÚro)		**!
e.	h (búro)	*!	

If the input had no [LEXSTR] autosegment, each candidate in Tableau (14) would be equally viable, since each would fully satisfy both constraints. It is in such a case that the effect of other constraints can emerge to produce initial gemination as the default exponent of the denotative.

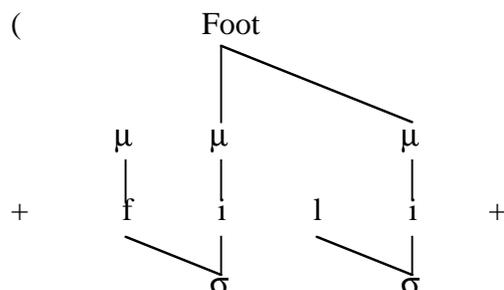
7.3.1 The default denotative of bivocalic stems

The denotative of *fili* ‘choose’ is *ffili*, which I analyze as containing a final bimoraic foot. The mora of the initial geminate is not footed. I provide a representation of such a structure in (15) below. What is important about this form is that the morpheme boundary (evaluated at the segmental level) is well-aligned to the foot boundary, as the foot does not branch across the morpheme boundary.

In this representation, there are no internal morpheme boundaries between segments; all segments belong to the root. This follows from the fact that the exponent of the denotative is only the initial mora. The initial morpheme boundary, indicated by a + sign, does not occur within a foot; it does not occur between two moraic segments

belonging to the same foot. The representation therefore satisfies the alignment constraint ALIGN-MORPHEME-FOOT, as defined in (16).

(15) Prosodic representation of *ffili*



(16) ALIGN-MORPHEME-FOOT: Morphemes are aligned to foot boundaries.

Other logically possible parsings of the string *ffili* include $*(ffi)(li)$, in which primary stress does not occur on the penult, and $*(f)(fili)$, whose initial mora is parsed into its own foot. Both structures can satisfy ALIGN-MORPHEME-FOOT, but there are several possible strategies for ruling them out: one is to forbid monomoraic feet, while the other is to minimize the number of feet in the word. I choose the second strategy, since it will also help rule out longer candidates like $*(fili)(fili)$. To achieve this size restriction, I appeal to ALLFEETRIGHT, defined in (17).

(17) ALLFEETRIGHT All feet are final: assess a violation for every mora occurring between each foot and the right edge of the word.

The effect of ALLFEETRIGHT is to prefer candidates with fewer feet. Thus, a reduplicated form in which the affix does not require an additional foot would be preferred over one with an affix that comprises its own foot. Only one other candidate satisfies both ALIGN-MORPHEME-FOOT and ALLFEETRIGHT: $*fi-(fili)$, with an unparsed initial syllable. Its morpheme boundaries do not occur within feet, and it contains only one foot. I propose that this form is ruled out by a low-ranking constraint of size-restriction, ALL- σ -RIGHT, which is defined in (18).

(18) ALL- σ -RIGHT Every syllable is final.

The form *ffili* incurs fewer violations of ALL- σ -RIGHT because it contains only two syllables, whereas $*fi-(fili)$ contains three. An alternative approach would be to appeal to PARSE-SYLLABLE (syllables are footed) to rule out $*fi-(fili)$, but given the moraic nature of Woleaian feet, this constraint is uninterpretable since no syllables are footed in a formal sense. The constraint would instead need to be PARSE-MORA (morae segments are footed), and this formalization cannot choose between $*fi-fili$ and *ffili*.

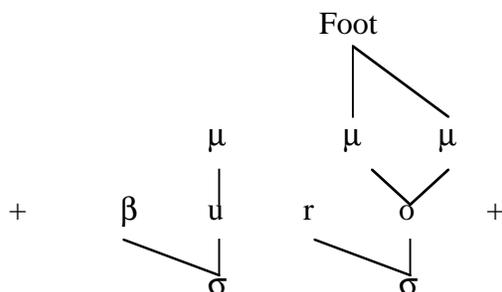
I summarize the effects of ALLFEETRIGHT and ALL- σ -RIGHT in Tableau (19), where it is shown that regardless of the shape of the prefix, the best forms are those with single feet.

(19)	fili + DENOTATIVE	ALIGN MORPH-FOOT	ALL- σ - RIGHT	ALLFEET RIGHT
a.	fi(lí- li)	*!	**	
b.	(f)(fíli)		*	*!*
c.	(fili)(fíli)		***!	**
d.	(fíli)(fíli)		***!	**
e.	(fi)(fíli)		**!	**
f.	(ffi)(lí)		*	*!
g.	fí -(fíli)		**!	
h.	 f(fíli)		*	

The introduction of ALLFEETRIGHT into the system has potentially undesirable consequences for the suffixing stems in Section 7.3.1, which are handled with the lexical stress feature [LEXSTR]. For example, most of the candidates for the denotative of *βuro* in Tableau (14) above contain two feet; however, it is no stretch to imagine a suffixed form with a minimally-sized exponent of the denotative. That is, one can imagine an output **βuroo* which better satisfies ALLFEETRIGHT than the actual *βuro-βuro* does. This is especially worrisome since it must be considered that if an initial geminate consonant in *ffili* can satisfy ALIGN-MORPHEME-FOOT, then so could a final geminate vowel in **βuroo*.

There are two possible ways of parsing **βuroo*. One, **βu(rÓo)*, has its [LEXSTR] on a non-initial mora *Ó*; we cannot simply expect ALIGN-MORPHEME-FOOT to rule this form out, as the representation in (20) shows. Like the initial gemination in *ffili*, the exponent of the denotative affix in *βu(rÓo)* is the mora that represents lengthening of the final vowel. Thus, the morpheme boundary that follows the root morpheme is word final, and does not occur within a foot.

(20) Prosodic representation of **βu(rÓo)*



Regardless of this form's satisfaction of ALIGN-MORPHEME-FOOT, it is worse by ALIGN-[LEXSTR]-LEFT than $\beta\grave{U}ro$ - $\underline{\beta}uro$, in which [LEXSTR] is associated to the leftmost moraic element \grave{U} . The form with the full suffix will be chosen as long as ALIGN-[LEXSTR]-LEFT outranks ALLFEETRIGHT.

The other parse of $*buroo$, $*(\beta\acute{U}ro)o$, has its [LEXSTR] well-aligned in satisfaction of ALIGN-[LEXSTR]-LEFT, but at the expense of not having penultimate stress. To rule this form out, I appeal to the constraint LAPSE, which forbids adjacent unstressed moras.

(21) LAPSE Unstressed moras must not be adjacent

These effects are summarized in Tableau (22). Note that every candidate listed satisfies ALIGN-MORPHEME-FOOT, including the forms with final long vowels discussed above in figure (20). Furthermore, $*b(b\acute{U}ro)$ is well-aligned in the same way that *ffili* is in Figure (15). In both forms, the actual morpheme boundaries are at the absolute left and right peripheries of the segmental strings, and thus do not fall within feet. The same is true of both parses of $\beta ur\acute{O}o$; the final vowel is a single segment, and the morpheme boundary that follows does not occur within a foot.

(22)	$\beta ur\acute{O}o$ [LEXSTR] + DENOTATIVE	LAPSE	ALIGN MORPH-FOOT	ALIGN [LEXSTR]-L	ALL- σ - RIGHT
a.	$\underline{b}(b\acute{U}ro)$			*!	*
b.	$\beta\grave{U}ro(\underline{\beta}uro)$				***
c.	$\beta u(r\acute{O}o)$			*!	*
d.	$(\beta\acute{U}ro)o$	*!			*

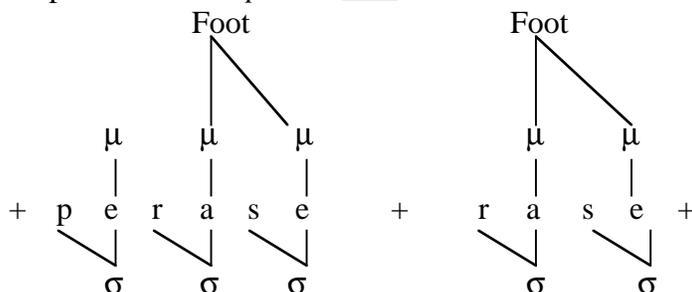
The constraint hierarchy developed in this section makes the following generalization: the choice of allomorph of the denotative affix depends on whether the verb is specified with a [LEXSTR] autosegment, which is realized as a stress-bearing moraic segment. Verbs specified with the [LEXSTR] autosegment must receive a suffix to derive denotative forms, because Alignment of the autosegment pressures the stem to be initial. Despite the activity of ALLFEETRIGHT and ALL- σ -RIGHT, the suffix allomorph it must be realized as its own foot. If the stem is not specified as [LEXSTR], the affix is realized as initial gemination, in order to minimize violations of ALL- σ -RIGHT. As yet, the only crucial constraint ranking is the position of ALIGN-[LEXSTR]-LEFT, MAX-[LEXSTR], and LAPSE over ALL- σ -RIGHT and ALLFEETRIGHT. In the next section, I show that this analysis obtains similar results for the denotatives of trivocalic stems.

7.3.2 The denotative affix and trivocalic stems

Trivocalic stems in Woleaian show the same positional allomorphy that bivocalic ones show for the denotative affix. Unpredictably, some receive a suffix, as in *parasa* → *perase-rase*, while others undergo initial gemination, as in *fetayi* → *ffetayi*. Like $\beta ur\acute{O}o$, I

propose that suffixing trivocalic stems like *parasa* are specified with the [LEXSTR] autosegment, the effect of which is to force the denotative affix to follow the stem. I illustrate the footing of *perase-rase* in Figure (23) to show how it satisfies ALIGN-MORPHEME-FOOT.

(23) Prosodic representation of *perase-rase*



The medial morpheme boundary clearly is well-aligned to foot boundaries, but crucially, so is the initial morpheme boundary, since it does not occur between two moraic segments of the same foot. In other words, no foot branches across any morpheme boundary in (23).

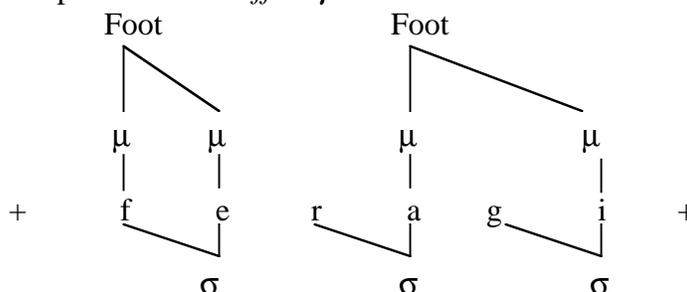
The evaluation of the denotative form of *parasa* is illustrated in Tableau (24). Prefixed forms like (24c) **pera-perAse* are ruled out by ALIGN-[LEXSTR]-LEFT, because the affixal material precedes the stem and thus renders its [LEXSTR], associated to A, too far from the left edge. This is also true of the initial-geminate competitor (24d) **(ppe)(rAse)*; the gemination renders the [LEXSTR] autosegment two moras away from the left word-edge. Note that neither of these competitors violates ALIGN-MORPHEME-FOOT, nor does the optimum, because in each case there are never any morpheme boundaries occurring within feet.

(24)	parasa [LEXSTR] + DENOTATIVE	LAPSE	ALIGN MORPH-FOOT	ALIGN [LEXSTR]-L	ALL-σ- RIGHT
a.	(pÈra)(sé-se)		*!		***
b.	(pèp)pe(rÁse)			***!	***
c.	(perà)pe(rÁse)			***!	****
d.	(ppe)(rÁse)			**!	**
e.	☞ pe(rÁse)(ráse)			*	****

It is crucial for ALIGN-MORPHEME-FOOT to be ranked over ALIGN-[LEXSTR]-LEFT; otherwise, the system might choose a suffixed candidate like (24a) **(pÈra)(sé-se)*, whose [LEXSTR] is rightmost, but which violates ALIGN-MORPHEME-FOOT. In contrast, the optimal form *pe(rÁse)(ráse)* satisfies ALIGN-MORPHEME-FOOT, but alternating stress forces [LEXSTR] to associate to its second mora, occurring a single violation of ALIGN-[LEXSTR]-LEFT.

In Tableau (24) it appears that if the input were not specified as [LEXSTR], then (24d) **(ppe)(rÁse)* would emerge as the optimal candidate. In other words, the initial gemination pattern follows simply from the absence of the [LEXSTR] autosegment; this result is addressed in Tableau (26), which evaluates the denotative of the trivocalic stem *ferayi*. As is true of *ffili*, the form *(ffe)(rayi)* satisfies ALIGN-MORPHEME-FOOT. I illustrate this in Figure (25)

(25) Prosodic representation of *fferaγi*



Again, like in *ffili*, all segmental material is associate to the root morpheme; as a result, the only morpheme boundaries are at the absolute right and left word edges. In this case, the initial morpheme boundary does not occur between the two moraic segments of a single foot, so there is no violation of ALIGN-MORPHEME-FOOT in this representation.

However, the gemination pattern does not minimize violations of ALLFEETRIGHT, as was true of *ffili* in Section 7.3.1. Since the stem is itself trivocalic, any exponent of the denotative will result in a form with at least four moras, and thus at least two feet. Tableau (26) shows that ALLFEETRIGHT evaluates the optimal (26d) *(ffe)(rayi)* equally with (26e) **fe(rayi)(ráyi)*. Nevertheless, in a manner parallel to the choice of *ffili* over **fī-fili*, ALL-σ-RIGHT can choose among these candidates. As a result, *(ffe)(rayi)* merges, since it has three syllables, compared to the five in **fe(rayi)(ráyi)*.

(26)	ferayi + DENOTATIVE	LAPSE	ALIGN MORPH-FOOT	ALIGN [LEXSTR]-L	ALL-σ- RIGHT	ALLFEET RIGHT
a.	(fèra)(γí-γí)		*!		***	**
b.	(ferà)fe(ráyí)				****!	***
c.	(fèf)fe(ráyí)				****!	***
d.	☞ (ffe)(ráyí)				**	**
e.	fe(ráyí)(ráyí)				****!	**

The denotative pattern can thus be summarized as follows: the choice of allomorph of the denotative affix depends on whether the verb is specified with a [LEXSTR] autosegment, which is realized as a stress-bearing moraic segment. An unspecified stem will realize the denotative affix as initial gemination by default, in order

to minimize violations of ALIGN-MORPHEME-FOOT, ALLFEETRIGHT and ALL- σ -RIGHT. However, if a stem is specified with [LEXSTR], the constraint ALIGN-[LEXSTR]-LEFT prevents it from having any additional prosodic structure on its left side; as a result, it emerges with a suffix for the denotative. This is true whether the stem contains two or three vowels. In the next section, I provide an analysis of the progressive affix. Given that some verbs are specified as [LEXSTR], which indirectly forces them to be word-initial in the denotative, the account must be able to predict progressive prefixes even with such stems.

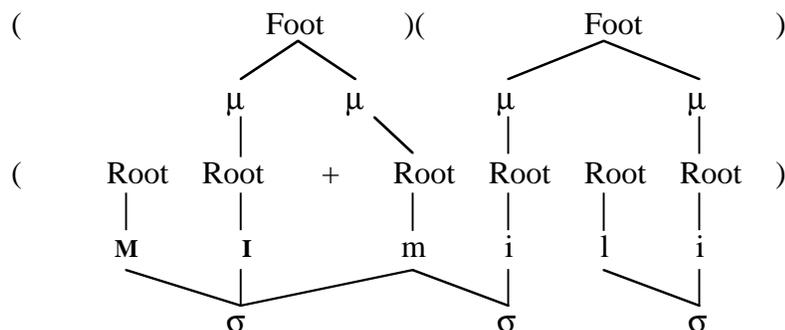
7.4. An Optimality Theoretic account of the progressive affix

In the preceding section, I attribute the shape of the denotative affix to ALIGN-MORPHEME-FOOT, a non-morpheme-specific constraint that requires morphemes to be well-aligned to feet. Neither allomorph of the denotative violates this constraint. Since the progressive is also a morpheme, it is important to ensure that it too can satisfy ALIGN-MORPHEME-FOOT.

The fact that gemination occurs at a morpheme boundary may suggest that Woleaian progressives cannot satisfy ALIGN-MORPHEME-FOOT. For example, in a form like (*mim*)-(mili), the medial geminate branches into two feet. However, there are two possible representations of the geminate in this form: single-root and two-root geminates. Selkirk (1990) and Davis (1999) offer some discussion of the advantages of single-root and two-root representations of geminates. Ringen & Vago (2002) support a notion of non-moraic, [long] segments, while Rose (2003) favours two-root non-moraic representations. I follow Davis (1999) by allowing both one-root and two-root geminates to appear, in accordance with demands put on them by formal constraints. The analysis of the denotative in Section 7.3 relies on the representation of initial geminates as moraic single root consonants.

However, a single-root geminate for (*mim*)-(mili) would violate ALIGN-MORPHEME-FOOT, as the representation in (27) shows. Since there is only one *m* (the stem's) medially, the medial morpheme boundary must occur before it, between the two moraic segments of the first foot.

(27) Prosodic representation of single-root *mim*-mili



(29)	fili + RED	ALIGN MORPH-FOOT	ALIGN [LEXSTR]-L	ALL- σ - RIGHT	ALLFEET RIGHT
a.	(fi f)(fíli)			*!	**
b.	 f(fíli)				

(30)	ferayi + RED	ALIGN MORPH-FOOT	ALIGN [LEXSTR]-L	ALL- σ - RIGHT	ALLFEET RIGHT
a.	(fe f)fe(ráyí)			*!	***
b.	 (ffe)(ráyí)				**

(31)	parasa [LEXSTR] + RED	ALIGN MORPH-FOOT	ALIGN [LEXSTR]-L	ALL- σ - RIGHT	ALLFEET RIGHT
a.	(pèp)pe(rÁse)		***!	*	***
b.	 pe(rÁse)(r áse)		*	**	**

(32)	misi [LEXSTR] + RED	ALIGN MORPH-FOOT	ALIGN [LEXSTR]-L	ALL- σ - RIGHT	ALLFEET RIGHT
a.	(mim)(mÍsi)		**!	*	**
b.	 (mÌsi)(m ísi)			**	**

Tableaux (29) and (30) clearly show the problem: for *fili* and *feragi*, no ranking can choose the progressive form. Furthermore, although we could appeal to a constraint requiring the progressive to be a prefix (presumably, a formal Alignment constraint), this would be satisfied by both *ffili* and *fferagi*. It may then be impossible for any augmentation of the constraint hierarchy to produce the progressive reduplicant's shape. One recourse would be an appeal to a templatic constraint of the form $\text{PROG} = \sigma_{\mu\mu}$, but I reject this since it is a morpheme-specific alignment constraint, which makes the typological prediction of prosodic back-copy (McCarthy & Prince 1999).

The alternative I propose is to posit that the progressive affix itself is specified as [LEXSTR], which means that the morpheme must contain at least one stress-bearing mora. The remainder of this section will show that the heavy prefix form of the progressive follows from this specification, regardless of whether the verb stem itself is [LEXSTR].

7.4.1 The progressive of unmarked stems

If the progressive affix is associated to a [LEXSTR] autosegment and is attached to a bivocalic stem like *mili*, two facts follow: the progressive must be a prefix, and it must be bimoraic. Its status as a prefix is a result of ALIGN-[LEXSTR]-LEFT, which is violated by suffixed forms like **(mili)(míli)*. The high rank of MAX-[LEXSTR] ensures that a stress occurs somewhere in the reduplicant, ruling out forms like **mi-(míli)* and, crucially, **m(míli)*.

This result is summarized in Tableau (33). Note that only the prefixed forms (33d) (**m̀li**)(míli) and (33e) *(**m̀li**)(míli) are satisfactory by MAX-[LEXSTR] and ALIGN-[LEXSTR]-LEFT, and are ultimately differentiated by ALL- σ -RIGHT.

(33)	mili + PROG [LEXSTR]	MAX [LEXSTR]	ALIGN [LEXSTR]-L	ALL- σ - RIGHT	ALLFEET RIGHT
a.	mi -(míli)	*!		**	
c.	(m̀li)-(m̀li)		*!*	***	**
d.	(m̀li)-(míli)			***!	**
e.	☞ (m̀li)-(míli)			**	**
f.	m(míli)	*!		*	

The progressive form of trivocalic stems is also a heavy syllable prefix for as well, as I show in Tableau (34). As was the case for Tableau (33), the number of plausible candidates is restricted by constraints like ALIGN-MORPHEME-FOOT and MAX-[LEXSTR]. Of the three prefixed forms, only (34c) (**meM**)me(táfe) and (34b) *(**metÀ**)me(táfe) satisfy ALIGN-MORPHEME-FOOT, since neither has a morpheme boundary occurring within a foot. However, they both incur a single violation of ALIGN-[LEXSTR]-LEFT, since the [LEXSTR] autosegment must occur on the second mora in order to ensure alternating stress. Because of the rank of ALIGN-MORPHEME-FOOT over ALIGN-[LEXSTR]-LEFT, the prefix must be bimoraic, and ALL- σ -RIGHT chooses the optimal (**meM**)me(táfe).

(34)	metafe + PROG [LEXSTR]	ALIGN MORPH-FOOT	ALIGN [LEXSTR]-L	ALL- σ - RIGHT	ALLFEET RIGHT
a.	(m̀E -me)(táfe)	*	**	***	**
b.	(metÀ)-me(táfe)		*	****!	****
c.	☞ (meM)-me(táfe)		*	***	****
d.	me(táfe)-(t̀ A fe)		***!	****	*

I omit candidates with initial gemination, as in **mmetafe*, as possible progressive forms in Tableau (34). Such forms are avoided in one of two ways: if the initial geminate were a single-root geminate, MAX-[LEXSTR] would be violated, since the prefix's [LEXSTR] autosegment would be associated to the stem's segmental material and not to the prefix. If the initial geminate were a two-root form, as in *(**m**-me)(táfe), then the morpheme boundary would not be well-aligned to a foot. Hence, neither representation could compete with the prefixed forms in Tableau (34).

Thus, stems without [LEXSTR], like *metafe* and *mili*, receive a heavy prefix for the progressive, regardless of how many vowels are in the stem. In the next section, I show how the same result obtains for stems that are specified as [LEXSTR]; that is, even if both

the stem and affix are [LEXSTR], the progressive affix still inevitably appears word-initially.

7.4.2 The progressive of [LEXSTR] stems

Tableau (34) shows how the progressive of the [LEXSTR] stem *misi* would be evaluated. The process is nearly identical to the evaluation of *mili* in Tableau (33), but because there is an additional [LEXSTR] specified in the input, there are more violations of ALIGN-[LEXSTR]-LEFT to assess. Interestingly, since both the stem and affix are [LEXSTR], the suffixed form (34b) $*(m\grave{I}si)(m\grave{I}si)$ and the prefixed form (34c) $*(m\grave{I}si)(m\grave{I}si)$ are both tied with the optimal (34d) $(m\grave{I}m)(m\grave{I}si)$ by ALIGN-[LEXSTR]-LEFT, but the heavy-syllable form emerges through its better satisfaction of ALL- σ -RIGHT.

(34)	misi [LEXSTR] + PROG [LEXSTR]	MAX [LEXSTR]	ALIGN [LEXSTR]-L	ALL- σ - RIGHT	ALLFEET RIGHT
a.	mi -(m ^h Ísi)	*	*	**	*
b.	(m ^h Ísi)(m Ísi)		**	***!	**
c.	(m Ísi)(m ^h Ísi)		**	***!	**
d.	 (m Ím)(m ^h Ísi)		**	**	**

One candidate I omit from Tableau (34) is $*(m\grave{I})(m\grave{I}si)$, which contains a prefix that forms a monomoraic foot. This form satisfies ALIGN-[LEXSTR]-LEFT better than the actual output does, but I exclude it because it does not contain alternating stress.

The system also predicts a heavy-syllable prefix for trivocalic [LEXSTR] stems like *parasa*. As was the case for *metafe* in Tableau (34), a monosyllabic prefix like in (36a) $*(p\grave{E}-pe)(r\acute{A}se)$ violates ALIGN-MORPHEME-FOOT, since a foot branches across the medial morpheme boundary. Since the remaining candidates all contain both a stem [LEXSTR] and an affix [LEXSTR], they are tied by ALIGN-[LEXSTR]-LEFT, regardless of the position of the affix. As a result, they are sorted out by ALL- σ -RIGHT, which prefers (36c) $(peP)-pe(r\acute{A}se)$ over the other remaining candidates. Furthermore, I should add that a candidate with initial gemination would not compete with the candidates in Tableau (36), since, like **mmetafe*, it would violate either MAX-[LEXSTR] or ALIGN-MORPHEME-FOOT.

(36)	perase [LEXSTR] + PROG [LEXSTR]	ALIGN MORPH-FOOT	ALIGN [LEXSTR]-L	ALL- σ - RIGHT	ALLFEET RIGHT
a.	(p È-pe)(rÁse)	*	**	***	**
b.	(per À)-pe(rÁse)		****	****!	***
c.	 (peP)-pe(rÁse)		****	***	***
d.	pe(rÁse)-(rÁse)		****	****!	**

The progressive can thus be summarized as follows: the affix is specified underlyingly with the feature [LEXSTR]. This is the same feature that, if associated to a verb, forces the denotative to be a suffix. The effect of this feature on the progressive affix is that the morpheme will always be realized as a prefix, regardless of whether the verb to which it attaches is also [LEXSTR]. Furthermore, since the feature represents lexical stress, the prefix always forms its own foot, and as a result is consistently bimoraic.

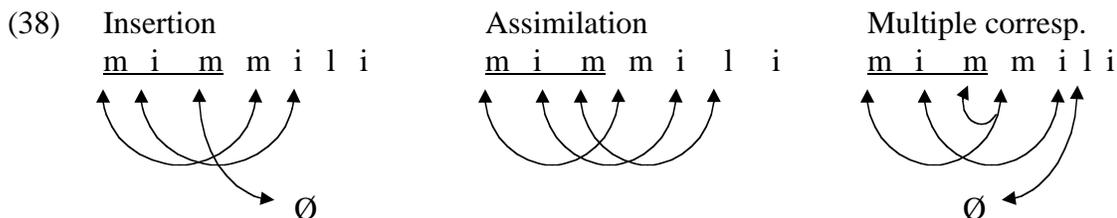
7.5 *On the use of gemination in the progressive*

The account of the bimoraic prefix in Section 7.4 only predicts the quantity of the reduplicant; it leaves aside the appearance of geminated consonants at the juncture of the stem and affix. In this section, I enrich the Woleaian system to account for the precise segmental realization of the progressive prefix.

For example, the stem *mili* in Tableau (29) is reduplicated as *mim-mili* in the progressive. The constraint hierarchy in its current state predicts a bimoraic prefix, and ALL- σ -RIGHT emerges to rule out the other bimoraic competitor, **mili-mili*. Nevertheless, several other bimoraic competitors are possible; for example, **m̄il-mili*, with a more faithful prefix, **mit-mili*, with a default consonant, and **m̄ii-mili*, with a lengthened vowel. Each of these is tied with the real output, since the system really evaluates only the quantity of the prefix. I summarize this situation in Tableau (37).

(37)	mili + PROG [LEXSTR]	MAX LEXSTR	ALIGN [LEXSTR]-L	ALL- σ - RIGHT	ALLFEET RIGHT
a.	(<u>m̄il</u>)-(m̄ili)			***	**
b.	(<u>m̄li</u>)-(m̄ili)			***	**
c.	(<u>m̄lt</u>)-(m̄ili)			***	**
d.	(<u>m̄lm</u>)-(m̄ili)			***	**

Clearly, several constraints will need to be added to the system. There is a compromise of faithfulness that results in the failure to accurately copy the second consonant of the base, resulting in the prefix being *mim-* and not *mil-*. Moreover, there are three plausible correspondence representations for the morpheme-juncture geminate. In one interpretation, the second consonant of the prefix *mim-* is epenthetic, with no corresponding segment in the stem. In the second possibility, this consonant corresponds to the second consonant of the stem, which is *l*. In other words, the base *l* is reflected by a reduplicative *m*; this is like a complete Consonant Substitution that emerges in the context of reduplication. In either case, the consonant in question shares all its features with the consonant that follows, the first consonant of the stem. A third representation is possible in which the second *m* of the prefix is actually a correspondent of the base's first consonant; in other words, the first segment of the base has two correspondents in the reduplicate. I illustrate the three possibilities in Figure (38).



Regardless of which of the representations in (38) we adopt, two constraint relationships are certain, and are needed for avoiding forms like **mili-mili* and **mil-mili*. First, CODACONDITION, as defined in (39), is respected without question. This is the constraint that rules out the most faithful form **mil-mili*, in which the reduplicant ends with a fully specified consonant. CODACONDITION also rules out a form with a default consonant such as **mit-mili*. Second, ALL- σ -RIGHT must outrank MAX-BR, in order to prevent the totally faithful **mili-mili* from being chosen over the less faithful output *mim-mili*.

- (39) CODACONDITION Moraic consonants with their own [place] specification are forbidden

The high rank of CODACONDITION and ALL- σ -RIGHT is illustrated in Tableau (40). Four candidates remain plausible: the vowel-lengthened candidate **mii-mili*, and the three versions of *mim-mili*.

(40)	mili + PROG [LEXSTR]	CODA COND	ALL- σ - RIGHT	MAX BR
a.	(<u>m</u> l̄i)-(m̄li)	*!	**	i
b.	(<u>m</u> li)-(m̄li)		***!	
c.	(<u>m</u> l̄i)-(m̄li)		**	li
d.	insertive (<u>m</u> l̄m)-(m̄li)		**	li
e.	assimilative (<u>m</u> l̄m)-(m̄li)		**	i
f.	multiplistic (<u>m</u> l̄m)-(m̄li)		**	li

The candidate (40c) **mii-mili* contains a lengthened prefix vowel, and needs to be avoided. There are two means of ensuring such a result: one is to appeal to MAX-BR to rule out **mii-mili*, while the other is to appeal to WEIGHT-IDENT.

The simplest means of obtaining the correct output is to leave the hierarchy as is, which predicts the output to be the assimilative version of *mim-mili*. Thus, any other constraints that would rule out the assimilative *mim-mili*, such as those defined in (41), must be ranked below MAX-BR. These constraints include PLACE-IDENT, which is violated by the correspondence relationship between the reduplicant *m* and the stem *l*, and

WEIGHT-IDENT, which is violated by the same pair, since only one member (the assimilated *m*) is moraic.

(41) PLACE-IDENT Segments in correspondence are identical for their [place] specification.

WEIGHT-IDENT Segments in correspondence are identical for their moraic quantity.

The low rank of these constraints for allowing the assimilative *mim-mili* is illustrated in Tableau (42). Since PLACE-IDENT is ranked below MAX-BR, the assimilated geminate of *mim-mili* is preferred over the long vowel of **mii-mili*; likewise, since WEIGHT-IDENT is ranked below MAX-BR, the assimilated version emerges instead of the epenthetic one.

(42)	mili + PROG [LEXSTR]	MAX BR	DEP BR	PLACE IDENT	WEIGHT IDENT
a.	(<u>mli</u>)-(mli)	li!			*
b.	insertive (<u>m̄lm</u>)-(mli)	li!	*		
c.	assimilative (<u>m̄lm</u>)-(mli)	i		*	*
d.	multiplistic (<u>m̄lm</u>)-(mli)	li!			*

So the hierarchy as posited in Tableau (42) predicts the assimilative candidate (42c) *mim-mili*, in which the first member of the geminate *mm* is actually a correspondent of the stem *l*. This resounds with a diachronic story of the prefix's origin (Goodenough & Sugita 1980) in the Chuukic group, that claims that the gemination pattern emerged first in truncations of the suffixed denotative in CVCV stems with homorganic consonants; for example, *nana*. Such a form would be suffixed as *nana-nana*, but in many cases truncation occurred, yielding *nan-nana*. These truncated forms were then reanalyzed as prefixed, and the appearance of the medial geminate became regular, spreading to non-homorganic stems (like *mili*).

However, such a diachronic theory does not rule out a synchronic situation in which the geminate is actually insertive or multiplistic. Even so, the exact representation turns out to be inconsequential; in other words, regardless of which story we adopt for the synchronic origin of the progressive geminate, there are no dire predictions for other aspects of Woleaian reduplication.

The result of this discussion is that the appearance of gemination in the Woleaian progressive is attributed primarily to the bimoraic tendency of the prefix, in tandem with the rank of two markedness constraints: ALL- σ -RIGHT and CODACONDITION. ALL- σ -RIGHT prevents the prefix from realizing its second mora as a vowel, while CODACONDITION prevents the second consonant from having any featural specification of

its own. Moreover, the second moraic segment incurs some kind of faithfulness violation, but the exact relationship is both unclear and inconsequential.

7.6 Discussion

In this chapter, I have provided an account that predicts the position and shape of two Woleaian reduplicants, including one that has two unpredictable allomorphs. I also offer a way of predicting the appearance of morpheme-juncture gemination in the progressive prefix.

The positional and prosodic qualities of Woleaian reduplication are consequences of the ability of both verbs and reduplicants to be specified with the [LEXSTR] feature. The progressive reduplicant is [LEXSTR] and is thus always both stress-bearing and word-initial. However, since the denotative is not [LEXSTR], its position depends on the verb stem to which it attaches. A [LEXSTR] verb receives a denotative suffix; otherwise, the denotative is realized as an initial geminate. These generalizations are summarized in Table (43).

(43)		Stem	
		unspecified	[LEXSTR]
Affix	unspecified	initial gemination	suffix
	[LEXSTR]	heavy syllable prefix	heavy syllable prefix

There are several important consequences of this analysis. First, three different shapes of reduplicants follow from the same system, with no explicit templatic requirement whatsoever. Second, allomorphy is handled simply by the presence of a morphological feature, and the ordering of the progressive and denotative affixes is a function only of this lexical feature, and not of a morpheme-specific constraint like ALIGN-PROGRESSIVE. Third, an apparently complicated system is shown to follow from a set of uncomplicated constraints.

The notion that the three reduplicative shapes are all functions of the same constraint hierarchy is an important result, especially since no shape variant is the product of a templatic requirement. Thus, despite the apparent morpheme-specific prosody of each affix, the allomorphy of the denotative and the consistent shape of the progressive are both emergent effects of the interaction between the [LEXSTR] autosegment and Markedness constraints like ALIGN-MORPHEME-FOOT, ALLFEETRIGHT and ALL- σ -RIGHT. As such, the analysis characterizes Woleaian reduplication as a prosodic case of the Emergence of the Unmarked (McCarthy & Prince 1994, 1999). A templatic approach would be dogged by a number of problems; particularly, its mechanism for dealing with the denotative allomorphy would no doubt be cumbersome.

The major problem for a templatic approach to the denotative is this: while the choice of initial gemination or suffixed foot is a function of the stem, a templatic requirement holds over the affix. We would then have to posit a constraint DENOTATIVE=FOOT, which is satisfied only in some cases. There would be no account for why the left-side allomorph of the denotative is simply gemination rather than an

initial foot. It would therefore be a complete accident that disyllabic feet can only be suffixes, and conversely that gemination can only occur stem-initially. Add a second reduplicative morpheme to the system, and further complication arises: it is then also an accident that the progressive is never a suffix.

The fact that the ordering of affixes follows simply from the requirements of realizing and aligning [LEXSTR] is also a satisfying result. The alternative would be to appeal to specific ordering constraints like ALIGN-ASPECT, ALIGN-STEM, and ALIGN-DENOTATIVE. However, Woleaian suggests that these morpheme-ordering constraints are not necessary, since ALIGN-[LEXSTR]-LEFT is sufficient to achieve the proper order. It remains to be seen whether a [LexStr] feature is present in other Micronesian languages, and can be used for the same effect.

What is admittedly odd about the analysis (although, not necessarily a drawback) is its appeal to the placement of lexical stress, despite the fact that the stress pattern itself remains unchanged by the presence of the diacritic. Nevertheless, there is a satisfying asymmetry in the placement of lexical stress with respect to foot structure: as a generality, feet and primary stress are attracted to the right edges of words, but [LEXSTR] – marked and exceptional – is oriented to the left.

Lastly, except for the addition of those constraints that operate over the feature [LEXSTR], the analysis in this paper has made use of a small and uncomplicated set of constraints, such as *LAPSE, ALIGN-MORPHEME-FOOT, ALLFEETRIGHT, and ALL- σ -RIGHT. These same constraints appear with different priorities in the reduplicative systems of other Micronesian languages (Kennedy 2002), which illustrates the capacity of a constraint-based theory to characterize linguistic divergence simply as the reordering of formal priorities.

In fact, the sub-system that models the progressive-boundary gemination also refers to constraints which are attested in other Micronesian languages. In the next chapter, I will show how a similar system is motivated for the Chuukic languages Chuukese and Puluwat. Following that is a discussion in which the three represented languages of the Chuukic subgroup offer a second opportunity to test the claims of the Confluence hypothesis.

8. Puluwat and Chuukese: reduplication in the Eastern Chuukic languages

8.1 *Puluwat and Chuukese*

Puluwat (Elbert 1973) and Chuukese—also called Trukese or Lagoon Trukese (Goodenough & Sugita 1980)—are eastern Chuukic languages spoken in the Caroline Islands; the islands on which they are spoken are shown on the map in Section 2.2. They are similar enough to each other to allow some mutual intelligibility. Goodenough & Sugita (1980), in fact, suggest a dialect continuum exists for Puluwat, Mortlockese, and Chuukese (also known as Lagoon Trukese), but that syntactic properties of Mortlockese motivate its consideration as a separate language. In this chapter I treat the phonology of Puluwat and Chuukese as the same system; they seem to differ mainly in their consonant inventory. Their reduplication patterns are well described—more exhaustively for Chuukese, but they basically have the same pattern. Only Puluwat’s stress system is documented, but given other similarities in the languages, notably in their manifestation of final-vowel lenition, I assume that they basically adhere to the same system of stress assignment.

I begin the chapter by reviewing the phonological properties of Puluwat and Chuukese that characterize them as typically Chuukic and typically Micronesian. I then describe their reduplicative paradigm, with special attention to the way in which it parallels the Woleaian (western Chuukic) system. Lastly, I offer an Optimality-Theoretic picture of the languages, which will allow for a discussion of formal phonological divergence within the Chuukic family.

8.2 *Eastern Chuukic phonology*

In terms of their phonology, Puluwat and Chuukese are typically Chuukic in a number of ways, including their consonant inventory and their tolerance of geminates. Both have the Chuukic feature of having *f* as a reflex of proto-Micronesian *p*, as in Chuukese *fɔto* ~ Mokilese *pɔd(ok)* ‘plant’. There are some distinctions to be made between Puluwat and Chuukese: for one, Puluwat has *h* wherever Chuukese has *s*, as in Puluwat *maah*, *mahan* and Chuukese *maas*, *masan* ‘eye / his eye’. Puluwat also distinguishes between *l* and *n*, while Chuukese has only *n*; consider Puluwat *fili* and Chuukese *fini*, both meaning ‘choose’; we saw in Chapter 7 that Woleaian alternates between them, where *n* is the long variant of *l*. For example, in reduplication-induced gemination, Woleaian derives *nnütü* ‘be jumping’ with initial lengthening from *lütü*. Likewise, Puluwat has a palatalized variant of *r*, which is reflected in Woleaian’s synchronic alternation of short *r* with long *c*.

As for geminates, Puluwat and Chuukese allow all consonants to occur doubled, both medially and initially, and syllables may only be closed by geminates. These facts suggest that geminate consonants are always associated to a mora. Davis (2000) argues for the moraic status of initial geminates in Chuukese, since forms like *siin* ‘skin’ (from *sini-*) and *tiip* (from *tipa-*) ‘emotion’ are augmented to meet a minimal-word requirement for nouns, but forms with initial geminates like *cca* ‘blood’ and *ffən* ‘advice’ need not

augment. The restriction on what can close medial syllables is easily expressed as a limitation on what can associate to a mora. I provide a formal version in (1):

- (1) CODACONDITION Moraic consonants with unique [place] features are forbidden.

CODACONDITION, as elsewhere in this work, is formalized as a constraint on moraic consonants, not simply on codas. As such, it holds over initial geminates as well; just as it allows *fef-fen* and prevents **feffen*, it allows *ffɔt* and prevents **nfɔt*. In addition, it does not care about absolute word-final consonants, which are extrametrical by virtue of being non-moraic. A means of formalizing such extrametrical representations is suggested in Sections 3.5.2 and 4.1.

Puluwat and Chuukese both differ from Woleaian in having a strong adherence to stem-final vowel lenition, in a synchronic manner actually quite parallel to that found in the Pohnpeic languages. In Puluwat and Chuukese, stem-final short vowels are deleted and long vowels are shortened, whereas such vowels in Woleaian are simply devoiced. The Chuukese deletion pattern is seen in forms like *siin* ‘skin’ and *tiip* ‘emotion’, both derived from stems with final vowels, which are preserved in suffixed forms like *tipen* ‘his emotion’ and *sinin* ‘his skin’. The shortening of stem-final long vowels is seen in similar alternations like *pece* ‘foot’ ~ *peceen* ‘his foot’ and *cca* ~ *ccaan* ‘his blood’.

I attribute this pattern to the activity of FREE-VOWEL as defined in (2). Free-Vowel formally requires devoicing of the vowel that follows the primary stress, but in Puluwat and Chuukese, its satisfaction is met with the deletion of short vowels and shortening of long vowels.

- (2) FREE-VOWEL The vowel following the primary stress is not voiced.

I return to the ways of formalizing and satisfying FREE-VOWEL in the following chapter, in which I discuss Confluence in the Chuukic subgroup. Here is a preview: final-vowel devoicing, as applied in Woleaian, will be an alternative way of satisfying FREE-VOWEL. Woleaian will prefer the devoicing of final vowels, in violation of VOICEVOWELS, to the extrametricality of final consonants, which (through non-moraicity) violates WEIGHT-BY-POSITION.

Given the stem-final deletion pattern, it should be no surprise that primary stress occurs on the final vowel in Puluwat (Rehg 1993), unlike Woleaian, in which stress occurs on the penult. Yet in a way, stress targets “the same” vowel: since Woleaian retains final vowels and Puluwat does not, the languages actually assign stress to historically equivalent vowels, as seen in related pairs like Woleaian *fānefāne* and Puluwat *fānefān*.

Furthermore, the application of final-vowel deletion in Puluwat and Chuukese coincides with a wide tolerance of word-final consonants, despite the high position of CODACONDITION, as a number of already cited forms like *maas*, *tiip*, *siin*, and *ffɔt* suggest. Rather than stipulate that such final consonants are simply immune to

CODACONDITION, I claim that they are extrametrical because they are not moraic, and hence they do not incur any violation of CODACONDITION. Further evidence for this claim is seen in the fact that **mas*, **tip*, and **sin* are quantitatively sub-minimal, despite having final consonants. An additional consequence is that forms like *fanefan* clearly must contain a final monomoraic foot, which supports a ranking of FREE-VOWEL and ALLFEETRIGHT over FOOTBINARITY, both of which are defined in (3).

- (3) FOOTBINARITY Feet are bimoraic.
- ALLFEETRIGHT The right edge of every foot is aligned to the right edge of the word.

I illustrate the ranking of FREE-VOWEL and ALLFEETRIGHT over FOOTBINARITY in Tableau (4). The fully reduplicated form **fane-fane* violates FREE-VOWEL, while the fully binary *fane-faan* violates ALLFEETRIGHT more than the optimal *fane-fan* does.

(4)		FREE-VOWEL	ALLFEETRIGHT	FOOTBINARITY
a.	(fane)(fane)	*!	**	
b.	(fane)(faan)		**!	
c.	☞ (fane)(fan)		*	*

8.2.1 Puluwat and Chuukese reduplication

The eastern Chuukic languages resemble Woleaian in that they have two clear patterns of reduplication and a third morphological operation, initial consonant lengthening, which is vaguely reduplicative. For Chuukese, Goodenough & Sugita (1980) classify the two clearly reduplicative patterns as “double-base”, in which the entire base is copied, but without its final vowel, as in *nuku-nuk* and *tuko-tuk*, and “double-syllable”, in which the first syllable is doubled and the initial consonant of the base is geminated, as in *kuk-kuus* and *ses-sepi*.

The double-base pattern appears to derive verbs of repetitive action. It actually only results in full copy if the base consists of two or fewer syllables; otherwise, it copies only from the final two syllables, as in *meteki-tek* and *fatane-tan*. I take this as evidence that the entire double-base system is a suffixing pattern. The reduplicative suffix can be considered a cognate of the pan-Micronesian denotative suffix. I provide more examples of the Chuukese suffixing pattern in the following tables. Table (5) has examples of the basic pattern, in which a CVC element is added to a CVCV base.

(5) Double base (i.e. suffixing) reduplication in Chuukese.¹

cīik	<i>basket made of coconut leaves</i>	ciki- cik	<i>put in baskets</i>
kin	<i>separated</i>	kini- kin	<i>partition</i>
man	<i>have divine power</i>	mana- man	<i>power</i>
mən	<i>blow</i>	məni- mən	<i>severe storm</i>
mic	<i>deceived</i>	mici- mic	
m ^w ara-	<i>something carried on shoulders</i>	m ^w ara- m^war	<i>garland</i>
m ^w əc	<i>gift to sweetheart</i>	m ^w əcu- m^wəc	<i>dist.</i>
nam	<i>be on one's mind</i>	nama- nam	<i>character, morals</i>
ŋon	<i>behold appreciatively</i>	ŋono- ŋon	<i>ogling</i>
nop ^w	<i>clap</i>	nop ^w o- nop^w	
nuk	<i>haul on line</i>	nuku- nuk	<i>dist.</i>
pək	<i>coped</i>	pəku- pək	<i>cope</i>
p ^w uc	<i>crazy</i>	p ^w uco- p^wuc	
ref	<i>be divided</i>	refi- ref	<i>partition</i>
roŋ	<i>hear</i>	roŋo- roŋ	<i>dist.</i>
saam	<i>father</i>	sama- sam	
saf	<i>be in a condition of lichenification</i>	safa- saf	
səp ^w u-	<i>division</i>	səp ^w ɔ- səp^w	<i>turmeric prepared in half-coconut</i>
taam	<i>outrigger float</i>	tama- tam	<i>orientation</i>
tiip ^w	<i>rods</i>	tip ^w e- tip^w	<i>use rods</i>
tuk	<i>scoop</i>	tuko- tuk	

One could imagine an analytical alternative for these forms, whereby instead of the CVCV-CVC sequence containing an initial stem and CVC suffix, they are composed of a CVCV prefix and CVC stem. However, in Table (6), I provide reduplicatives of longer stems, which ought to indicate that the –CVC element is indeed a suffix.

(6) Double base (i.e. suffixing) reduplication for longer stems in Chuukese.

fætæn	<i>walking, progress, history</i>	fætæne- tæn	<i>see fátán</i>
kurup ^w	<i>joint</i>	kurup ^w u- rup^w	<i>full of nodes</i>
metek	<i>painful</i>	meteki- tek	
paraŋ	<i>flying sparks</i>	paraŋa- raŋ	
saram	<i>be bright</i>	sarama- ram	
seniŋ	<i>earlobe</i>	seniŋe- niŋ	<i>hear only what one wants to hear</i>

A third subpattern creates –CV suffixes; these appear predictably in stems that have a final CVV. If the stem-final CVV includes a long vowel, as in *nɔɔ*, the suffix is shortened in a manner consistent with right-side lenition. Likewise, if the CVV instead

¹ I replace Chuukese orthographic *ch* with *c* and *ng* with *ŋ*, in order to maintain single symbols for single segments. I also replace *á* with *æ*, *é* with *ə*, *ó* with *ɔ*, and *ú* with *i*, and reserve diacritics to indicate stress.

consists of two vowels, as in *ciya-* (which we can analyze as *cia-* underlyingly; the glide surfaces in the stem to interrupt the vowel sequence), the second vowel is absent from the suffix, again lenitively.

(7) Double base (i.e. suffixing) reduplication in Chuukese, -CVV stems.

<i>ciya-</i>	<i>accompany</i>	<i>ciye-ci</i>	<i>companion</i>
<i>m^wo</i>	<i>be sunk</i>	<i>m^woo-m^wo</i>	<i>dist.</i>
<i>nəə</i>	<i>oil</i>	<i>nəə-nə</i>	<i>liquid contents</i>
<i>ŋi</i>	<i>hum</i>	<i>ŋii-ŋi</i>	<i>tune</i>
<i>nɔɔ</i>	<i>wave</i>	<i>nɔɔ-nɔ</i>	<i>wavy</i>
<i>pæ</i>	<i>poo</i>	<i>pææ-pæ</i>	<i>poopoo</i>
<i>pə</i>	<i>blow (as wind)</i>	<i>pəə-pə</i>	<i>dist.</i>
<i>ro</i>	<i>assembled (of crabs)</i>	<i>roo-ro</i>	<i>dist.</i>
<i>si</i>	<i>flee</i>	<i>sii-si</i>	<i>fly (of birds)</i>
<i>tə</i>	<i>crawl</i>	<i>təə-tə</i>	<i>track of animal</i>
<i>ti</i>	<i>dive</i>	<i>tii-ti</i>	<i>bathe</i>

According to Goodenough & Sugita, the first-syllable pattern also indicates repetitive action, but in a habitual aspect; that is, while the suffix indicates repetition of an action at a specific time, the prefix indicates the repetition of an action over many instances. Given its function and its phonological shape—a consistent two moras—I consider the pattern to be a cognate of the pan-Micronesian aspectual prefix. I provide additional examples of the first-syllable pattern in the Tables (8-10) below.

(8) Bimoraic prefixing reduplication in Chuukese

<i>fən</i>	<i>bleed, be bruised</i>	<i>fəf-fən</i>	<i>bruises, see fən1</i>
<i>kak</i>	<i>ring</i>	<i>kak-kak</i>	<i>dist</i>
<i>kuus</i>	<i>sheet</i>	<i>kuk-kuus</i>	<i>use a blanket</i>
<i>mɔɔt</i>	<i>sit</i>	<i>mɔm-mɔɔt</i>	
<i>m^wiit</i>	<i>be quick</i>	<i>m^wim-m^wiit</i>	
<i>nan</i>	<i>chatter</i>	<i>nan-nan</i>	
<i>nec</i>	<i>tapped</i>	<i>nen-nec</i>	
<i>riir</i>	<i>search for scattered objects</i>	<i>rir-riir</i>	
<i>saf</i>	<i>be in a condition of lichenification</i>	<i>sas-saf</i>	
<i>siin</i>	<i>be known</i>	<i>sis-siin</i>	<i>dist</i>
<i>soor</i>	<i>morning</i>	<i>sos-sor</i>	<i>dist</i>
<i>rar</i>	<i>be warm</i>	<i>rar-rar</i>	<i>dist.</i>
<i>sær</i>	<i>be moving</i>	<i>sæs-sær</i>	
<i>sen</i>	<i>intermittent, coming and going</i>	<i>ses-sen</i>	
<i>sət</i>	<i>try</i>	<i>səs-sət</i>	<i>trial</i>
<i>ten</i>	<i>be in a line</i>	<i>tət-tən</i>	

- (9) Bimoraic prefixing reduplication in Chuukese, longer stems
- | | | | |
|-----------------------|-----------------------------------|-----------------------------------------------|----------------------|
| faneey | <i>shape or cut with adze</i> | faf -faneey | <i>dis of faneey</i> |
| fætæn | <i>walking, progress, history</i> | fæf -fætæn | <i>dis of fætæn</i> |
| feyin | <i>course</i> | fef -feyin | <i>dis of feyin</i> |
| fini | <i>choose, select</i> | fif -fini | <i>dis of fini</i> |
| kina | <i>see, behold</i> | kik -kina | |
| makkeey | <i>write</i> | mam -makkeey | |
| mettip | <i>spit</i> | mem -mettip | |
| peyinit | <i>paint</i> | pep -peyinit | |
| p ^w ucæ̀ər | <i>cry out</i> | p^wup -p ^w ucæ̀ər | |
| særæ | <i>be tiered</i> | sæs -sær | |
| sepi | <i>use a bowl</i> | ses -sepi | <i>use a bowl</i> |
| sukuun | <i>school</i> | sus -sukuun | <i>dist</i> |
| tæriŋeey | <i>tear</i> | tæt -tæriŋeey | |
| tɔ̀ɔfi | <i>caress</i> | tɔ̀t -tɔ̀ɔfi | |
- (10) Bimoraic prefixing reduplication in Chuukese, CV and CVV stems
- | | | | |
|------------------|---------------------------|------------------------------------------|--------------|
| cu | <i>meet</i> | cuc -cu | <i>dist.</i> |
| mi | <i>be full of emotion</i> | mim -mi | |
| m ^w o | <i>be sunk</i> | m^wom -m ^w o | |
| pə | <i>empty</i> | pəp -pə | |

The third pattern can be considered reduplicative since its exponence is seen through the addition of structure to the base, without any fixed segmental content. However, since it is simply achieved by the lengthening of the initial consonant, it is not the addition of a string of copied segments so much as the association of the base to an additional mora. Regardless, I consider it a reduplicative morpheme since its form can be derived with the same set of prosodic and correspondence constraints that I use for the other two affixes. Goodenough & Sugita describe the consonant-doubling pattern as creating “stative adjectives” from verbs and nouns. Examples of the double-consonant pattern are provided in Tables (11-13) below.

- (11) Initial consonant gemination in Chuukese
- | | | | |
|---------------------|----------------------|-------------------|----------------------------|
| cip ^w a- | <i>bending</i> | ccip ^w | <i>warped</i> |
| ci- | <i>needlework</i> | cci | <i>embroidery</i> |
| fəər | <i>deed, action</i> | ffəər | <i>making, manufacture</i> |
| fɔ̀to- | <i>plant</i> | ffɔ̀t | <i>be planted</i> |
| kak | <i>ring</i> | kkak | <i>ringing aloud</i> |
| kus | <i>spurt, escape</i> | kkus | <i>spurt, be spit</i> |
| mit | <i>slip</i> | mmit | |
| natə | <i>ladder</i> | nnatə | |
| ŋin | <i>hand</i> | ŋŋin | |
| nici | <i>leak</i> | nnic | |

nowu-		nnow	<i>lasso; be twirled; twirl (as a rope)</i>
pan	<i>be tilted</i>	ppan	<i>hillside, steep slope</i>
p ^w as		pp ^w as	<i>dry, light</i>
p ^w uur		pp ^w ur	<i>be planted</i>
rup	<i>be carved</i>	rrup	
tafa-	<i>combed</i>	ttaf	<i>be combed</i>
tap ^w a-	<i>next</i>	ttap ^w	<i>be next</i>
tini-	<i>smell</i>	ttini	<i>smell, perceive odor</i>
tom ^w	<i>squashed</i>	ttom ^w	<i>fall and burst</i>
tur	<i>fall, dive</i>	ttur	<i>be fallen</i>
sət	<i>try</i>	ssət	<i>be attempted</i>
suup ^w	<i>dripping</i>	ssup ^w	<i>drip</i>
fires	<i>braid</i>	ffires	<i>be braided</i>
seyim	<i>whetstone</i>	sseyim	<i>be sharpened</i>
m ^w i	<i>have a cough</i>	mm ^w i	<i>asthma, shortness of breath</i>
rə	<i>grope</i>	rrə	<i>groping with the hands (as reaching in a hole)</i>
pə	<i>empty</i>	ppə	<i>hollow ball</i>

8.2.2 Three morphemes or two?

It is not immediately clear whether the Chuukese and Puluwat use of consonant doubling should be considered a third morpheme with a function that differs from those of the other reduplicative affixes. In contrast, Woleaian has a strong case for considering the consonant-doubling process as an unpredictable allomorph, alternating with the suffixing pattern, of the denotative, or what Sohn (1976) calls the pseudo-transitive. Stems that can undergo both initial-consonant doubling and final-foot suffixing are exceedingly rare in Woleaian, to the point of being exceptional.

Likewise, forms that can derive either way are unattested in Puluwat (though the data are scant), and Chuukese shows a similar lack of them. In fact, there are about 30 of some 460 stems that show both initial gemination and suffixation: in nearly all such cases, either the simple form is not a free morpheme, is morphologically complex, or does not exist (i.e., the stem is underlying geminate-initial). In the rarest of examples, both patterns can apply to a free morpheme, like *pan* ‘be tilted’, but the derived forms are never interchangeable—the suffixing pattern in such cases tends to be ‘more’ derivative, often metaphorically extended. In this case, *panapan* is listed as the distributive of *ppan* ‘hillside, steep slope’, and is not directly derived from *pan*.

The fact that verbs, as a generality, can undergo but one of these processes suggests that the patterns have an allomorphic distribution in all three languages. However, the means of describing the functions of each process are not as clear for the eastern Chuukic languages as they are for Woleaian. For example, while Sohn boldly and simply claims that some pseudo-intransitives in Woleaian are made with double-

consonants and others with suffixing reduplication, Goodenough & Sugita (1980) seem to consider the two processes as separate functions in Chuukese. They associate the consonant-doubling pattern of Chuukese with stative adjectives, and the suffixing pattern with repeated actions. Still, I cling to the interpretation that the two processes have similar (if not identical) interpretations, both deriving adjectival predicates. My position is that the difference between a “stative adjective” and a “repeated action” is not strong enough to necessitate two separate morphemes (especially since adjectives behave as verbs anyway), and that the specific interpretation of any derived adjectival predicate will have more to do with the semantics of the stem than of the affix.

I maintain the same position for Puluwat, in which the apparent purpose of reduplication is a little more elusive. Some Puluwat reduplicated forms have a possessive interpretation; even so, I maintain that this can be seen as an extension of predication, of “having the property of X” extending to “have a provisional/full title over X” (the latter case, Elbert’s (1973) own words, as in *mwær* ‘lei’ → *mwæramwær* ‘have a provisional title of a lei’; *haam* ‘father’ → *hamaham* ‘have a full title of father’).

Between the distributional evidence, that few forms in any Chuukic language can undergo both consonant doubling and foot suffixing, and the semantic evidence (or lack of it, insofar as for maintaining two categories), I maintain the position that the two processes are equivalent and create allomorphs in every Chuukic language. I return to the possibility that this is not the case in the discussion at the end of this chapter; it ultimately will not pose a problem for the formal analysis proposed in the following sections.

Working with the reduplicative paradigm reduced to two morphemes, we can now establish a formal account of the system. The story for Chuukese and Puluwat will resemble Woleaian in that an autosegmental feature, [LEXSTR], will be used to determine whether a verb receives a double consonant or a suffix for its denotative. Likewise, the specification of the prefix itself as [LEXSTR] will ensure that it is always word-initial and bimoraic. I pursue this account in the following section.

8.3 *An Optimality Theoretic account of the denotative affix*

In the previous section, I argued that Chuukese and Puluwat both have a denotative morpheme that has two surface variants: it appears either as the doubling of the stem’s initial consonant, or as a suffix. The choice of one or the other for any particular verb is not a predictable one: one cannot use the shape or segmental content of a stem to predict the application of a particular process. First, one cannot use the initial consonant to predict whether gemination or suffixation applies; for example, *kus* and *kin* both have an initial *k*, but reduplicate as *kkus* and *kini-kin*; likewise, *suup^w* and *saam* both have an initial *s*, but reduplicate as *ssup^w* and *sama-sam*. Moreover, one cannot use the final vowel for the same prediction: *tuk* and *fɔto-* both have an underlying final *o*, but reduplicate as *tuko-tuk* and *ffɔt*. Similarly, *m^wi* and *ŋi* both have a final *i*, but reduplicate as *m^wii-m^wi* and *ŋŋi*.

So there must be something about individual stems that helps predict the choice between suffixation and initial gemination. In other words, speakers cannot know

- (15) MAX-[LEXSTR] Every [LEXSTR] in the input must have a correspondent in the output.
- IDENT-[LEXSTR] For every pair of strings A and B in correspondence, A is associated to [LEXSTR] if and only if B is associated to [LEXSTR].

The role of ALIGN-[LEXSTR]-LEFT, MAX-[LEXSTR], and IDENT-[LEXSTR] in choosing the appropriate affix for the suffixing verb *tuk* is summarized in Tableau (16). In this and subsequent tableaux, the mora to which [LEXSTR] associates is indicated as a stress-bearing capital letter.

(16)	tuko [LEXSTR] + DENOTATIVE	MAX [LEXSTR]	IDENT [LEXSTR]	ALIGN [LEXSTR]-L
a.	$\text{t}^{\text{H}}\text{Uko}(\text{t}^{\text{H}}\text{Uk})$			
b.	$(\text{t}^{\text{H}}\text{Uko})(\text{t}^{\text{H}}\text{Uk})$			**!
c.	$\text{t}^{\text{H}}(\text{t}^{\text{H}}\text{Uk})$			*!
d.	$(\text{t}^{\text{H}}\text{U})\text{t}^{\text{H}}(\text{t}^{\text{H}}\text{Uk})$			**!
e.	$\text{t}^{\text{H}}(\text{t}^{\text{H}}\text{Uk})$		*!	
f.	$\text{t}^{\text{H}}(\text{t}^{\text{H}}\text{Uk})$	*!		

In Tableau (16), the presence of the [LEXSTR] specification prevents any affix material from intervening between the left word-edge and the stem. Anything that does precede the stem necessitates the projection of additional moraic structure, and since IDENT-[LEXSTR] requires the [LEXSTR] autosegment to associate to the stem, it inevitably is poorly aligned. The result is that the suffixed form $(\text{t}^{\text{H}}\text{Uko})(\text{t}^{\text{H}}\text{Uk})$, in which the [LEXSTR] appears on the leftmost mora, is the optimum.

At this point it will help to acknowledge the activity of FREE-VOWEL in this form, as I have omitted from Tableau (16) any candidates with final vowels, such as $*(\text{t}^{\text{H}}\text{Uko})(\text{t}^{\text{H}}\text{Uko})$, which is obviously a more faithful candidate, but which can be avoided by ranking FREE-VOWEL over MAX-BR and FOOTBINARITY. Furthermore, a candidate like $*(\text{t}^{\text{H}}\text{Uko})(\text{t}^{\text{H}}\text{Uuk})$ must be prevented³, and can be ruled out by the rank of ALLFEETRIGHT over FOOTBINARITY.

The output $(\text{t}^{\text{H}}\text{Uko})(\text{t}^{\text{H}}\text{Uk})$ violates the lower-ranked FOOTBINARITY, but its initial foot is better-aligned to the right, as its right edge is only one mora away from the word edge. I summarize these ranking relationships in Tableau (17).

³ A very small number of stems do reduplicate in this manner, as in *kisi-* ‘small’ → *kisi-küis*. I address this as a residual issue in § 9.5.

(17)	tuko [LEXSTR] + DENOTATIVE	MAX [LEXSTR]	ALIGN [LEXSTR] LEFT	FREE VOWEL	ALL FEET RIGHT	MAX BR	FOOT BIN
a.	$\text{t}^{\text{h}}(\text{t}\ddot{\text{U}}\text{ko})(\text{t}\acute{\text{u}}\text{k})$				*	o	*
b.	$(\text{t}\ddot{\text{U}}\text{ko})(\text{t}\acute{\text{u}}\text{k})$				***!	o	
c.	$(\text{t}\ddot{\text{U}}\text{ko})(\text{t}\acute{\text{u}}\text{ko})$			*!	**		
d.	$(\text{t}\ddot{\text{u}}\text{ko})(\text{t}\acute{\text{U}}\text{k})$		***!		*		*

A last candidate to prevent is the form $*(\text{t}\ddot{\text{U}}\text{ko}-\underline{\text{k}})$, which is better than the actual output $(\text{t}\ddot{\text{U}}\text{ko})(\text{t}\acute{\text{u}}\text{k})$ since it is superior to the output by ALLFEETRIGHT and matches it on the other highly-ranked constraints, as Tableau (18) shows.

(18)	tuko [LEXSTR] + DENOTATIVE	MAX [LEXSTR]	ALIGN [LEXSTR] LEFT	FREE VOWEL	ALL FEET RIGHT	MAX BR	FOOT BIN
a.	$(\text{t}^{\text{h}})(\text{t}\ddot{\text{U}}\text{ko})(\text{t}\acute{\text{u}}\text{k})$				*	o	*
b.	$(\text{t}\ddot{\text{U}}\text{ko}-\underline{\text{k}})$					tuo	

We cannot resolve this problem by ranking MAX-BR over ALLFEETRIGHT, since three-mora stems do not fully reduplicate—consider, for example, *meteki-tek*—but we can rule out the single-consonant suffix by forbidding morpheme boundaries from occurring within syllables. This is achieved with the alignment constraint defined in (19), which requires morpheme boundaries to be aligned to syllable boundaries, and which $*(\text{t}\ddot{\text{U}}\text{ko}-\underline{\text{k}})$ violates.

- (19) ALIGN-MORPHEME-SYLLABLE Morpheme boundaries are aligned to syllable boundaries.

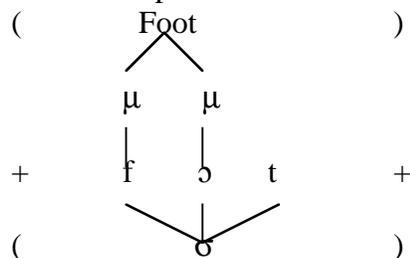
As long as ALIGN-MORPHEME-SYLLABLE outranks ALLFEETRIGHT, the proper two-foot form $(\text{t}\ddot{\text{U}}\text{ko})(\text{t}\acute{\text{u}}\text{k})$ will emerge instead of the single-foot $*(\text{t}\ddot{\text{U}}\text{ko}-\underline{\text{k}})$, as can be seen below in Tableau (20).

(20)	tuko [LEXSTR] + DENOTATIVE	ALIGN- MORPH-SYLL	ALLFEET RIGHT	MAX BR	FOOT BINARITY
a.	$\text{t}^{\text{h}}(\text{t}\ddot{\text{U}}\text{ko})(\text{t}\acute{\text{u}}\text{k})$		*	o	*
b.	$(\text{t}\ddot{\text{U}}\text{ko}-\underline{\text{k}})$	*!		tuo	

However, now it is necessary to clarify how ALIGN-MORPHEME-SYLLABLE can be active in the system without upsetting double-consonant denotatives like *ffɔt*: is it not the case that a morpheme boundary in such a form is within a syllable? In fact, such forms can fully satisfy ALIGN-MORPHEME-SYLLABLE since they actually have no internal morpheme boundaries: that is, on the segmental tier, their phonological content is $+f \text{ } \text{ɔ} \text{ } t$ +, with boundaries existing only at the periphery. The exponence of the denotative affix

in the consonant-doubling pattern is simply the projection of an additional mora from the initial segment. I provide a formalization of the prosodic organization of *ffɔt* in figure (21) below. Note that the morpheme boundaries coincide with syllable and foot edges, even though the form contains two morphemes stuffed into a monosyllabic foot.

(21) Prosodic representation of double-consonant *ffɔt*



Thus, the form *ffɔt* satisfies ALIGN-MORPHEME-SYLLABLE, as it does ALIGN-MORPHEME-FOOT, which will appear in Section 8.4. As a result, initial-geminate forms can emerge as the optimal denotative form just in the case the verb carries no [LEXSTR] autosegment. Indeed, reconsidering the candidates of Tableau (16), each candidate—including the double consonant form—would be equally viable by MAX-[LEXSTR] and ALIGN-[LEXSTR]-LEFT if the input had no [LEXSTR]. Tableau (22) contains candidates for *fɔto-* that are parallel to the competing forms of *tuko-* in Tableau (16). In this case, the effect of other constraints—notably ALLFEETRIGHT—can emerge to produce initial gemination as the default exponent of the denotative.

(22)	fɔto + DENOTATIVE	MAX [LEXSTR]	ALIGN [LEXSTR]-L	ALIGN- MORPH-σ	ALLFEET RIGHT	MAX BR
a.	(fɔto)(fɔt)				*!	o
b.	(fɔto)(fɔt)				*!	
c.	\leftarrow (ffɔt)					fɔto
d.	(fɔf)(fɔt)				*!	to
e.	(fɔto-t)			*!		fɔo

The double-consonant process emerges instead of the suffixing pattern for several reasons. Primarily, it allows a denotative with one less foot than the suffixing pattern would produce, as Tableau (22) shows. This tableau also corroborates the finding, from partial suffixation of forms like *meteki-tek*, that ALLFEETRIGHT must outrank MAX-BR, as the optimal form, (22c) *ffɔt*, actually fully violates the correspondence constraint. However, whether it can be said that the initial *f* actually *does* have a correspondent in the reduplicant, namely itself, is moot, as it bears no consequence on the output of the evaluation.

Now, another option not included in Tableau (22) is a genuinely prefixed form *(fɔ-fɔt), which can exist as a single foot and thus fully satisfy ALLFEETRIGHT, but which then would emerge on account of better satisfying MAX-BR. There are two ways of

avoiding the prefixed form, both of which are actually motivated in the account of the bimoraic prefix in Section 8.4 below, and both of which can be helpful here.

One approach is the appeal to ALIGN-MORPHEME-FOOT, as defined in (23). ALIGN-MORPHEME-FOOT is violated by $*(f\sigma-f\sigma)$ since a morpheme boundary falls between two moraic segments belonging to the same foot.

(23) ALIGN-MORPHEME-FOOT Morpheme boundaries are aligned to foot boundaries.

The independent need for ALIGN-MORPHEME-FOOT is motivated in Section 8.4 by the bimoraic requirement of the aspectual prefix. Including it here will not disrupt the model developed for the double-consonant pattern; initial-geminate forms like $ff\sigma$ can satisfy ALIGN-MORPHEME-FOOT since they have no inter-segmental morpheme boundaries which can be misaligned, as Figure (21) above illustrates.

Nevertheless, some double-consonant forms could still satisfy ALIGN-MORPHEME-FOOT; imagine, for example, a two-foot competitor $*(f\sigma)(f\sigma)$, which can be disposed of without so much difficulty as an appeal to *CLASH. More alarming are stems that remain bimoraic at the surface, such as *fires*, which has a denotative in *ffires*. Such a form could instead appear as $*(fi)(fires)$ —a competitor which is tied with the actual output by ALIGN-MORPHEME-FOOT⁴, in which case MAX-BR would really be a problem. Even so, the unwanted form can be ruled out by a size-limiting constraint, which the output *ffires* violates only slightly less, as Tableau (24) illustrates. In the following section, we will see that this size-restrictor is independently motivated in the aspectual system.

(24)	fires	SIZE-RESTRICTOR	MAX-BR
a.	fiifires	**!	res
b.	σ ffires	*	ires

8.4 The Chuukese/Puluwat aspectual prefix

The aspectual prefix—or what I will refer to as the habitual—of the eastern Chuukic languages does not show the allomorphic variation of its denotative counterpart. Invariably, the aspectual morpheme is a prefix, bimoraic, with its second mora projected from a geminate shared with the initial consonant of the stem, as in *sos-sor*, *kuk-kuus*, and *fiif-fini*. There are thus two formal problems related to this morpheme: how to ensure its quantity, and how to ensure its position. However, given the system developed in Section 8.3, reduplicants in Chuukese or Puluwat can only be single-foot suffixes or initial geminates.

Still, a way exists to ensure the habitual morpheme attains its consistent form. If we posit that its lexical entry itself includes a [LEXSTR] autosegment, then a solution is

⁴ It is not obvious whether *ffires* need be two feet; if it does, the initial mora would presumably bear stress. The alternative is that it is footed as $f(fires)$, which would motivate some discussion on the kinds of stress lapses that are possible and not possible in this system.

possible. Placing a [LEXSTR] autosegment on the habitual morpheme will force it to include a stressed mora in its surface form. Moreover, because of MAX-[LEXSTR] and IDENT-[LEXSTR], at least some (indeed, all) of the prefix will be footed, and likewise bimoraic. Furthermore, the presence of the [LEXSTR] autosegment on the prefix will result in ALIGN-[LEXSTR]-LEFT playing a role, and in fact, it will ensure that the habitual morpheme is always a prefix, even if attached to a stem that itself carries the [LEXSTR] autosegment.

To see the effect of this specification, consider first the combination of the non-[LEXSTR] stem *sɔt* with the [LEXSTR] affix HABITUAL. To realize the habitual with initial gemination would violate MAX-[LEXSTR], because MAX-[LEXSTR] and IDENT-[LEXSTR] require the autosegment to be associated to the prefix. Consequently, **ssɔt* is not a possible habitual. A suffixed form like **sɔto-sɔt* would also not suffice for the habitual, since its [LEXSTR], which is associated to the suffix, is too far from the left edge of the word, in violation of ALIGN-[LEXSTR]-LEFT. This leaves only prefixed options, including the real output, *sɔs-sɔt*. A competitor, **sɔ-sɔt*, would be viable without a constraint requiring ALIGN-MORPHEME-FOOT alignment; a similar form arose as a serious alternative in the denotative examples of Section 8.3. Nevertheless, here is a situation in which foot-alignment is well-motivated; with alignment, we can require the prefix to be well-aligned at both edges to foot boundaries, which is a requirement that **sɔ-sɔt* does not meet. Tableau (25) illustrates how the system produces a bimoraic prefix when the affix is specified as [LEXSTR].

(25)	sɔto- + HAB [LEXSTR]	MAX [LEXSTR]	ALIGN [LEXSTR] LEFT	ALIGN MORPH FOOT	ALL FEET RIGHT	MAX BR	FOOT BIN
a.	(^σ sɔs)(sɔt)				*	to	*
b.	(sɔto)(sɔt)				*		*
c.	(sɔ-sɔt)			*!		to	
d.	(ssɔt)	*!				sɔto	
e.	(sɔto)(sɔt)		**!			o	*

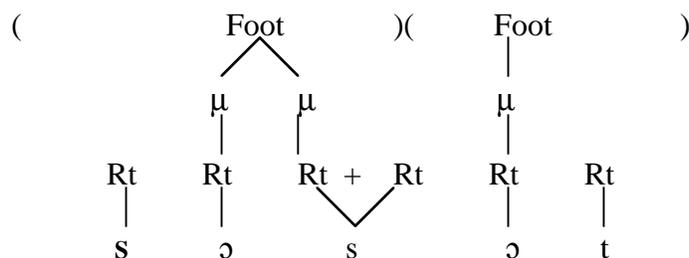
Even so, the story is incomplete: Tableau (25) is only sufficient to achieve the proper quantity and position of the habitual affix, not its content. The exact segmental form of the bimoraic prefix is essentially up for grabs, and the system in its current state would actually choose the incorrect form, (25b) **(sɔto)(sɔt)*, because of MAX-BR. There must be some means of ruling this form out, but we cannot leave it to ALLFEETRIGHT, since this and the optimal (25a) *(sɔs)(sɔt)* are tied by it. At least some of the work can be carried out by ALL-σ-RIGHT, defined in (26) below, which can at least limit the prefix to a single syllable. A similar dispreference for copying a second vowel in a reduplicative prefix is seen widely throughout Micronesian languages.

- (26) ALL-σ-RIGHT Align-Right (Syllable, Word)
All syllables are final.

Ranking ALL- σ -RIGHT over MAX-BR will ensure that $(s\dot{O}s)(s\acute{o}t)$ emerges instead of $*(s\dot{O}to)(s\acute{o}t)$; however, it will not rule out $*(s\dot{O}t)(s\acute{o}t)$, in which a moraic t fills out the initial foot. This last problem candidate cannot be the output, though, given the high rank of CODACONDITION. Thus, $(s\dot{O}s)(s\acute{o}t)$ is the best possible form.

Nevertheless, it might not be obvious how this could be, since $(s\dot{O}s)(s\acute{o}t)$ has a medial geminate that could quite possibly violate ALIGN-MORPHEME-FOOT. Should we not presume that the morpheme boundary—perhaps segmentally before the geminate—is poorly placed within a foot? In fact we should not: unlike the initial geminates of the denotative, which must be single-root forms, these geminates can be two-root forms, as discussed in Sections 7.3 and 7.4. It is exactly such a representation that could satisfy ALIGN-MORPHEME-FOOT, as illustrated in Figure (27) below. Since the morpheme boundary, represented by + in Figure (27), falls between two root nodes, which are not parsed into the same foot, the form is well-aligned. Note that sub-segmental features like [place] and [manner] are abbreviated simply with symbols like s and \acute{o} ; this is not meant to imply that segments occupy a separate tier from root nodes.

(27) Prosodic representation of two-root $(s\dot{O}s)(s\acute{o}t)$



An issue not to be ignored is the idea that a single language could motivate both one-root and two-root geminates; typically, representational proposals only allow one structure for all languages (e.g. Selkirk 1990, Ringen & Vago 2002, Rose 2003), or only one representation in any single language (Davis 1999). Still, the situation is parallel to initial and medial geminates in Woleaian: one-root and two-root geminates can be subject to the same constraint, CODACONDITION (which, remember, is actually a consonant/mora restriction), so long as it forbids the specific association between moras and consonantal place features—which it can do regardless of the number of roots.

Thus, the best possible prefix is bimoraic, as it must comprise its own foot; furthermore, of all bimoraic possibilities, the best includes a geminate which satisfies both CODACONDITION and ALIGN-MORPHEME-FOOT. At least this seems easy enough for non-[LEXSTR] stems, but the situation is potentially more complicated for [LEXSTR] stems, which need to compete with their own [LEXSTR] prefixes for proper leftward alignment.

Interestingly, prefixed and suffixed habituals for [LEXSTR] stems end up being tied in their missatisfaction of ALIGN-[LEXSTR]-LEFT. Consider the stem *saf*, which we know is itself [LEXSTR] since its denotative is *safa-saf*: for its habitual, the optimum *sAs-*

sAf and its competitor **sAfa-sAf* both have one well aligned left-most [LEXSTR] and one poorly aligned [LEXSTR]. However, a complication arises in that the suffixed form **sAfa-sAf* is a better habitual than *sas-saf* by MAX-IO, since the suffixed form can retain its final vowel.

Critically, ALL- σ -RIGHT cannot sort this pair out, since MAX-BR must outrank ALL- σ -RIGHT to allow polysyllabic underived forms. A way around this is to appeal to ANCHOR in the edgemost-correspondence sense⁵, which only the prefixed form satisfies.

- (28) ANCHOR The edgemost (outer) segment of the reduplicant corresponds to the edgemost segment of the base

The suffixed form **sAfa-sAf* violates ANCHOR because its edgemost (right) segment, the final *f*, is not in correspondence with the edgemost segment of the stem, an *a*. In contrast, the edgemost (left) consonant of the prefixed form is always in correspondence with the edgemost segment of the stem. Thus, the best habituals are prefixed ones, which Tableau (29) summarizes. As with the non-[LEXSTR] stem *sot* above, other constraints are necessary to rule out base-faithful competitors like (29b) **sAfa-sAf*, dispatched by ALL- σ -RIGHT, and (29d) **sAf-saf*, handled by CODACONDITION.

(29)	safa [LEXSTR] + HAB [LEXSTR]	ALIGN [LEXSTR] LEFT	CODA COND	ANCHOR	ALL FEET RIGHT	ALL- σ - RIGHT	MAX BR
a.	☞ (s \hat{A} s)(s \hat{A} f)	**			*	aa	f
b.	(s \hat{A} fa)(s \hat{A} f)	**			*	aaa!	
c.	(s \hat{A} fa)(s \hat{A} f)	**		*!	*	aaa	a
d.	(s \hat{A} f)(s \hat{A} f)	**	*!		*	aa	

The Chuukese-Puluwat reduplicative system has been shown to follow from a single, uniform constraint hierarchy. The introduction of the [LEXSTR] autosegment has the effect of allowing stems to receive either suffixes or double consonants for their denotative form, while the habitual is consistently a prefix because of its own [LEXSTR] specification. In the remainder of this section, I discuss the precise correspondence relationship between the stem and affix of habitual forms.

8.4.1 On the use of gemination in the habitual

There are three ways of construing the correspondence indexation of the geminated consonant in habitual forms. As argued above, necessarily this geminate must be a two-root structure, but the correspondence relationship of the first root node in this

⁵ Suffixed denotatives of [LEXSTR] stems like *tuko-tuk* violate ANCHOR, but the rank ALIGN-[LEXSTR], FREE-VOWEL >> ANCHOR ensures a suffix in such forms—see Tableau (16) to confirm this. Double-consonant forms (i.e., non-[LEXSTR] denotatives) vacuously satisfy ANCHOR, or otherwise do even if the leftmost consonant is in correspondence with itself.

- (32) UNIFORMITY No segment in a correspondence relationship has more than one correspondent.

The choice of specific representation hardly matters, because of the role of higher constraints like CODACONDITION, ALLFEETRIGHT, and ALL- σ -RIGHT. The prefix *must* be bimoraic, but without a second vowel (because of ALL- σ -RIGHT) and also without a second distinct consonant, because of CODACONDITION. This is fairly clear in Tableau (29), which I repeat below as (33); note that *any* representation in (30), be it insertive, assimilative, or multiplistic, can stand in as the optimal (33a) and emerge as the winner in the tableau.

(33)	safa [LEXSTR] + HAB [LEXSTR]	ALIGN [LEXSTR] LEFT	CODA COND	ANCHOR	ALL FEET RIGHT	ALL- σ - RIGHT	MAX BR
a.	$\text{(s}\hat{\text{A}}\text{s)}(\text{s}\hat{\text{A}}\text{f})$	**			*	aa	f
b.	$\text{(s}\hat{\text{A}}\text{fa)}(\text{s}\hat{\text{A}}\text{f})$	**			*	aaa!	
c.	$\text{(s}\hat{\text{A}}\text{fa)}(\text{s}\hat{\text{A}}\text{f})$	**		*!	*	aaa	a
d.	$\text{(s}\hat{\text{A}}\text{f)}(\text{s}\hat{\text{A}}\text{f})$	**	*!		*	aa	

Nevertheless, I reject the assimilative variant outright because of forms like *cuc-cu*; obviously, there is no second consonant being copied in such forms, so the choice can only be between multiplistic and insertive approaches. In fact, this choice is largely inconsequential, except that an additional appeal to *LONGVOWEL is necessary, because it is necessary to avoid candidates whose habitual prefixes are bimoraic by having long vowels.

For example, another competitor for the habitual of *safa* is **saa-saf*. Preliminarily, we could rule this out with WEIGHT-IDENT-BR, as its reduplicative vowel is lengthened. The rank of WEIGHT-IDENT-BR over DEP-BR would then choose the Insertive form, as Tableau (34) illustrates.

(34)	safa + HABITUAL [LEXSTR]	MAX BR	WEIGHT IDENT-BR	DEP BR	UNIFORM
a.	$\text{insertion (sas)(saf)}$	f		s	
b.	$\text{multiplistic (sas)(saf)}$	f	s!		s
c.	(saa)(saf)	f	a!		

However, there are stems like *siin* with underlying long vowels that are reflected by short vowels in the habitual, as in *sis-siin*. The ranking in Tableau (34) will not sufficiently handle this, because such forms violate WEIGHT-IDENT-BR. To avoid this, I turn simply to a markedness constraint against long vowels, defined in (35).

- (35) *LONGVOWEL Vowels are monomoraic.

This constraint cannot be collapsed with ALL- σ -RIGHT because they have different opinions of initial syllables. That is, *LONGVOWEL does not tolerate the initial syllable of *si-siin, whereas ALL- σ -RIGHT does.

With *LONGVOWEL ranked above WEIGHT-IDENT-BR, the form sis-siin emerges over the more faithful *si-siin, as Tableau (36) shows. Moreover, the internal rank of WEIGHT-IDENT-BR, DEP-BR, and UNIFORMITY is irrelevant as the two competitors that satisfy *LONGVOWEL are segmentally identical, sis-siin.

(36)	siin + HABITUAL [LEXSTR]	*LONG VOWEL	MAX BR	WEIGHT IDENT-BR	DEP BR	UNIFORM
a.	insertion (<u>sis</u>)(siin)		n		s	
b.	multiplistic (<u>sis</u>)(siin)		n	s		s
c.	(<u>si</u>)(siin)	ii!	n			

I will leave aside any more discussion of the insertive and multiplistic representations of Chuukese habituais, as the exact choice between them seems not to matter. There is, however, an interesting residual prediction of the representations of (30), which nearly exposes an unexplained gap in the surface variation of the denotative suffix. There is an apparent gap in the Chuukese lexicon such that no underlying stems end in consonants. This, however, is actually a gap in surface forms: no forms behave unequivocally at the surface as if they have final consonants, and Richness of the Base suggests that we must account for the lack of such forms with output-oriented constraints and not with stipulative restrictions on input structure.

Thus, we must concede that CVC forms like a hypothetical *fur* are possible underlyingly, and that for reasons of moraic restrictions like CODACONDITION, receive epenthetic vowels in “combining” forms. Such forms would appear as *fur* or *fuur* if unsuffixed; their final consonants are allowable because of final extrametricality. Suffixed, however, we would expect them to come out as *furi-n*, with whatever vowel serves as a default being inserted to resolve the consonant cluster, and likewise as *furi-fur* in their denotative. In other words, an underlying *fur* would always look like underlying *furi* in its surface pattern—so there is no more unexplained gap in the lexicon.

Now, admitting such forms into the lexicon creates a problem, in that there is at least a potential that their denotatives take some other form—say, *fur-rur*, which could be an insertive or multiplistic representation! That is, the initial *r* of the suffix could be inserted, and take the features of the stem-final *r* that precedes it, or it could simply correspond to that stem-final *r*. Either representation is possible, given the sub-systems laid out in Sections 8.4.2 and 8.4.4. Yet, derived forms like *fur-rur* seem too rare to have been noticed as a systematic and productive means of creating denotatives.

8.5 Discussion

In this chapter I have provided an argument for the constraint hierarchy responsible for three reduplicative patterns in Puluwat and Chuukese. Although these languages have distinct segment inventories and differ in the exact semantic

interpretation of reduplicated forms, they show the same tripartate patterning which phonologically can be handled by collapsing two patterns—the initial-consonant doubling and final-foot suffixation—into a single lexical entry corresponding to the pan-Micronesian denotative morpheme, the surface form of which is at the mercy of the stem to which it attaches. Lexically marked stems realize their denotative with a suffix, which allows the stem to be initial, while unmarked stems realize it with consonant doubling, which minimizes the amount of material to be copied, in maximal satisfaction of ALL- σ -RIGHT and ALLFEETRIGHT. The third pattern, heavy-syllable prefixation, is treated as a separate morpheme, itself lexically specified with [LEXSTR], which ensures its bimoraic form.

A number of residual issues remain, however, that ought to be addressed. First, I have relied here on the use of both single and double-root geminates; single-root representations are motivated by the initial gemination allomorph of the denotative, while double-root representations are motivated by the habitual pattern. This is at odds with a body of representational literature that suggests either that only one such representation is possible in language at all, or more moderately, that only one such representation is possible in any single language. Second, the leftward alignment of the [LEXSTR] autosegment seems at odds with the rightward tendency of stress and feet in general. Third, the position that the double-consonant and the suffix are allomorphs of the same morpheme is an arguable one, and it is important to consider how to handle the alternative. Fourth, the system developed in Sections 8.3 and 8.4 may appear to have some duplication of formalisms, for the constraints ALLFEETRIGHT, FREE-VOWEL, and ALL- σ -RIGHT all seem to have similar goals, in the minimization of structure, especially at the right edges of words. Though I address each issue below, the first two—of geminates, and the direction of [LEXSTR]—should be familiar from the discussion of Woleaian in the previous chapter. The other two are more pertinent to the eastern Chuukic languages, but they also pertain to Woleaian.

8.5.1 *One root or two?*

A first issue is the use of two distinct representations for geminates in this language. It is typical for an individual phonologist to subscribe to a one-root or two-root theory of representation, yet I have proposed that initial geminates in all Chuukic languages are single-root structures, while medial ones are two-root structures. This position is necessitated by my insistence on the use of non-morpheme-specific constraints like ALIGN-MORPHEME-FOOT to derive reduplicative prosody; such constraints are easily satisfied by initial geminates, even if derived, as long as they contain a single root node. Section 8.3 treats this in detail, particularly in reference to the representation in Figure (21).

Nevertheless, all Chuukic geminates are subject to the requirement that the first member be identical to the second: a requirement that favours the single-root theory. Moreover, Woleaian geminates are further restricted to a subset of consonants, with most continuants (save *f* and *s*) being replaced with affricates or nasals. Is it not odd that the same restriction would apply to one-root and two-root structures?

In fact, I maintain the position that the Chuukic distribution of geminates, as I have proposed, is a uniform one. The restrictions on geminates in Woleaian, Chuukese, and Puluwat are merely restrictions on the association between moras and consonantal place features. Thus, despite the possibly misleading adherence to the constraint name ‘Coda Condition’, I have subscribed to restrictions on moraic consonants only. The single-root geminate in Chuukese *ffɔt* and the two-root structure in *sɔssɔt* are both subject to CODACONDITION in that both have consonantal place features associating ultimately to a mora; both satisfy it because such consonantal features also associate to a non-moraic onset position.

Likewise, the Woleaian restriction against, say, *rr* (which is replaced by *cc*, as in *roso* → *coccoso*) is also expressible in terms of moraic association, and again, regardless of the number of root nodes involved. The single root geminate in **rroso* and the double-root one in **rorroso* both have features of *r* associated to a mora—in Woleaian, verboten, regardless of whether the same features associate to a non-moraic onset position.

Thus, the use of CODACONDITION as I have formalized it (and which might better be called *MORA/C-PLACE) actually has little to do with the true Coda position of the syllable (although, it does seem aware of the Onset position). This is fine, for though I have denied the role of the syllable in the foot in the Chuukic languages, I have not denied the role of the syllable elsewhere, as here, and as in ALIGN-MORPHEME-SYLLABLE.

Moreover, it remains a prediction of this approach that some language might actually show a Woleaian-type limitation on geminates, but only, say, on medial ones. This would be the case if a language that allowed single and double root geminates, but had an additional restriction on true Coda root nodes—which single-root geminates satisfy regardless of their feature content.

8.5.2 Whither [LEXSTR]?

The second issue is no less worthy of discussion. In deciding upon the direction of Alignment of [LEXSTR] for deriving the allomorphy of the denotative affix in Section 8.3.1, I admit two options: one, that [LEXSTR] is leftward, and forces a suffixed denotative, or two, that it is rightward, and forces a double-consonant denotative. Despite the rightward tendency of feet and stress, I opt for the leftward choice for [LEXSTR]. Strictly in terms of the denotative, this choice is an arbitrary one; however, it is necessary as long as we hold that the habitual prefix is itself specified as [LEXSTR]—which it must be in order to be footed by itself.

However, with [LEXSTR] aligning to the right, all stems would undergo initial gemination in the denotative. Obviously this will be true of unmarked stems, but also of [LEXSTR] ones: right-alignment is better satisfied when such stems are word-final. Meanwhile, any stem that is not specified as [LEXSTR] would then receive a *suffix* for the habitual. This hypothetical system is schematized in Figure (37).

(37) Hypothetical system with right-alignment of [LEXSTR]

		Stem	
		unspecified	[LEXSTR]
Affix	unspecified	initial gemination	initial gemination
	[LEXSTR]	suffix	heavy syllable prefix

I find it striking that such a system is logically possible, and wonder how intolerable it would be for learners and native speakers. It may represent an intermediate historical stage that followed the split of a single reduplicative morpheme into two morphological processes, one of which received more prominence, formalized with a [LEXSTR] specification. Given the odd distribution of affixes in such a grammar, it would be plausible for the system to settle on a more regular distribution, by aligning [LEXSTR] leftward, to guarantee an invariant and distinct shape for the habitual affix. In other words, not only does the leftward alignment of the feature better capture the actual facts, it is a probable outcome even of a system that originally used rightward alignment.

Moreover, the leftward draw of [LEXSTR] is consistent with a more mundane characterization: that lexical stress, by definition, is stress that does not follow the default. It is then fine that [LEXSTR] is leftward despite the rightward draw of feet and stress. What is odd about this particular pattern is that words with lexical stress actually receive the same stress pattern as those without—they only reduplicate differently.

8.5.3 *Two affixes or three?*

The collapse of the double-consonant and foot-suffix patterns into a single morphological entity is based on arguments that they have similar semantic effects, and very few verbs stems seem to be able to reduplicate both ways. In Section 8.3.1, however, I do admit the possibility that they are indeed separate morphemes. Doing so would predict that one stem could undergo either process, but with a minor technical complication: the allomorphic account attributes the position of the denotative affix to the presence of a specification of the stem. Thus, categorically, all [LEXSTR] stems must receive suffixes, while all others must not. How could this be resolved?

The answer is to posit an additional morpheme, an unassociated [LEXSTR] autosegment, that can attach to stems. Thus, we predict basic denotatives, which are composed of the STEM + DENOTATIVE. Such forms retain the allomorphic pattern as modeled in Section 8.3. However, adding the additional feature, to derive what we could call “extended denotatives”, allows even unmarked stems to bear a [LEXSTR] autosegment. Any unmarked stem (which would otherwise have a double-consonant denotative) that receives the floating [LEXSTR] autosegment in this manner thus ends up with a suffixed form for the extended denotative: some stems can therefore appear in either form.

(38) Denotatives and other derivatives

	<i>denotative</i>	<i>extended denotative</i>
<i>[LEXSTR] stem</i>	suffixed	suffix
<i>unmarked stem</i>	initial gemination	suffix

An interesting consequence of this approach is that any stem which itself is [LEXSTR] will have identical denotative and extended denotative forms: and thus if there is any clear difference in meaning between the denotative and extended denotative, it does not always have a clearly detectable phonological exponent. Even so, it allows for the intuition that consonant doubling and foot-suffixing sometimes can have distinct functions, as suggested by Goodenough & Sugita.

Furthermore, the use of the additional [LEXSTR] is consistent with an observation about the scant cases where a stem truly can go either way (i.e., it is not itself morphologically complex, it can stand freely with no initial geminate and no other suffix). Wherever a stem can truly undergo either process, the suffixing pattern—arrived at by adding the denotative affix *and* the additional floating autosegment to the stem—has a more derivative or metaphorical meaning than the double-consonant form, which results from concatenating only the stem and the denotative affix.

Another consequence of this story is that there is no need to stipulate the prevention of the [LEXSTR] extender from associating to an unreduplicated stem. In other words, we do not need to stipulate that the floating [LEXSTR] autosegment can only attach to morphologically complex denotatives. Rather, it could freely associate to unsuffixed stems, but in any such case, would be invisible: a plain stem and a stem associated to the floating [LEXSTR] would look identical.

8.5.4 *The non-redundancy of constraints*

A last issue is the apparent duplication of function among ALLFEETRIGHT, ALL- σ -RIGHT, and FREE-VOWEL. Each seems involved in a common plot to limit structure—especially vowel structure—in reduplicated forms. It is necessary, however, to keep them as separate constraints: in fact, only ALLFEETRIGHT can be removed without empirical consequence, but at the expense of formal and explanatory elegance.

It is clear that FREE-VOWEL cannot be removed from the hierarchy. Doing so would necessitate attributing final-vowel lenition to ALL- σ -RIGHT, which should only emerge in reduplicative contexts. ALL- σ -RIGHT is used to avoid denotatives like **fi-fires* and habituals like **safa-saf*. If it were allowed to apply in unreduplicated forms, to handle the work of FREE-VOWEL, we would expect suffixed forms like *furo* + *n* to appear as **fun* or **furin*. To prevent ALL- σ -RIGHT from running so rampant in the language, it is necessary to keep it ranked below MAX-IO. However, FREE-VOWEL would have to be ranked above MAX-IO, given the existence of forms like *fuur* from underlying *furo*. Moreover, ALLFEETRIGHT cannot replace the work of FREE-VOWEL, since only the latter distinguishes *fuur* from **furo*.

ALL- σ -RIGHT must also not be removed from the system, since it does work that neither ALLFEETRIGHT nor FREE-VOWEL can accomplish: only ALL- σ -RIGHT can prevent

the copying of a second stem vowel in habituais like *sas-saf* or *faf-fatan*.⁶ ALLFEETRIGHT and FREE-VOWEL consider these no different from **safa-saf* or **fana-fatan*.

Last, ALLFEETRIGHT ought to remain in the system, as removing it would offer a weird characterization of Chuukese footing. I will refer to the hypothetical Chuukic system that lacks ALLFEETRIGHT as the Chuukic Alternative; additional arguments against it are provided in § 9.3.

It is true that the Chuukic Alternative can handle much of Chuukese foot structure without ALLFEETRIGHT: right-to-left iteration of feet would still be guaranteed in a system that anchored final feet and forbade stress lapses. However, ALLFEETRIGHT, in its rank over FOOTBINARITY, helps maintain the existence of monomoraic final feet in multi-foot denotative forms. As a result, it ensures denotatives like *furo-fur* to appear instead of **furo-fuur*. In a system without ALLFEETRIGHT, the latter can only be avoided with the rank of WEIGHT-IDENT-BR above FOOTBINARITY, as I show in Tableau (38).

(38)	furo + DENOTATIVE	FREE VOWEL	MAX IO	ALL-σ- RIGHT	WEIGHT- ID-BR	FOOT BINARITY
a.	<i>furo</i> -(fur)			uou		*
b.	(<i>furo</i>)-(fuur)			uou	*!	
c.	(<i>furo</i>)-(furo)	*!		uouo		

This step is in tune with the apparent low rank of FOOTBINARITY, and does not prove contradictory for the prefixing pattern. Prefixed forms like *sas-saf* satisfy WEIGHT-IDENT as long as we consider them as the “insertive” representation, with an inserted moraic consonant in the prefix. However, the removal ALLFEETRIGHT loses out on a decent characterization of footing in long monomorphemic forms. That is, by attributing the monomoraic final foot of forms *furo-fur* to base-reduplicant quantity-identity, we have lost the uniform motivation for monomoraic final feet in unreduplicated forms.

So though it may be formally possible for ALLFEETRIGHT to be removed from the Chuukic system, it remains to be seen whether this is also true of the Pohnpeic languages, in which it plays a similar role. Regardless, it is not an intuitively sound move.

Even so, several effects seem to go hand-in-hand with respect to the ends of words in the Chuukic languages, whether one subscribes to the ALLFEETRIGHT model or the Chuukic Alternative for motivating final monomoraic feet. I continue the discussion in the following chapter, where I return to the issue of vowel devoicing in Woleaian—that language’s manifestation of final-vowel lenition, and a pattern that coincides with an intolerance of bimoraic feet. I discuss these phenomena in the following chapter, in which I argue that the coincidence of monomoraic feet and final-vowel deletion is a clear example of phonological Confluence.

⁶ ALL-σ-RIGHT’s work could be replaced by Compression usage of ALIGN-STEM-LEFT, which limit the segments in the prefix, but I hesitate at its morpheme-specific character. Still, the work of ALL-σ-RIGHT would not be subsumed by ALLFEETRIGHT and FREE-VOWEL, and the system would retain a three-pronged attack against vowel structure.

9. Confluence in Chuukic and Chuukic-Pohnpeic

9.1 *Chuukic languages*

The previous two chapters are devoted to analyses of the reduplicative systems of the Chuukic languages: the western Chuukic system on one hand, represented by Woleaian, and the eastern system, represented by Puluwat and Chuukese. In this chapter, I return to some of the properties that make these languages distinct from each other. I pay most attention to the difference in how these languages reflect the pan-Micronesian tendency for right-side weakening, or vowel lenition: the eastern Chuukic languages obey a process of synchronic deletion, while Woleaian simply devoices the equivalent vowels.

(1)	Chuukese, Puluwat	Woleaian
	Underlying surface	Underlying surface
	<i>sɔto</i> sɔt	<i>fati</i> fati
	<i>sɔto-RED</i> sɔto-sɔt	<i>fati-RED</i> fati-feti

I discuss several issues in this chapter. In particular, I investigate whether it is best to attribute eastern Chuukic deletion and western Chuukic devoicing to the same formal source. I also discuss the relationship between the tolerance of wholesale deletion and the place of Foot binarity. This relationship supports the Confluence hypothesis, since I show that two independent formalisms are nonetheless closely connected. I also pursue support for Confluence in a comparison of how Chuukic and Pohnpeic languages realize their habitual prefix.

9.2 *A truly universal constraint?*

To this point, the lenition process throughout the Micronesian family has been attributed to the formal constraint, FREE-VOWEL (Prince & Smolensky 1993); in fact, I have left the lenition facts untreated in the discussion of Woleaian. FREE-VOWEL is a constraint that, in its formal version, seems to do little more than restate the empirical facts: stem-final short vowels are not parsed if word final, and stem-final long vowels are not long if word-final. Nevertheless, I have characterized the requirement in terms of voicing, as the formalism in (2) shows.

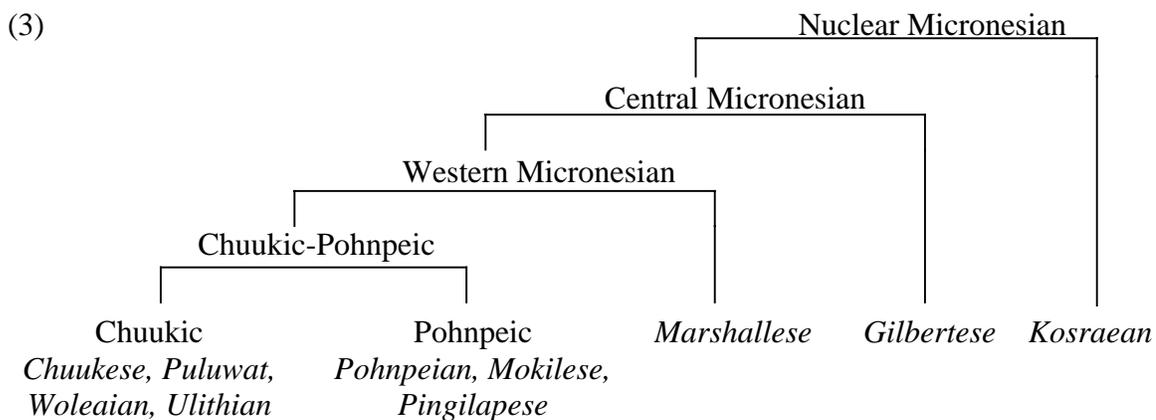
- (2) FREE-VOWEL The vowel following the primary stress is not voiced.

Such a formalization is meant to capture the facts for those languages that delete final short vowels as well as for Woleaian, which devoices all final short vowels. The analysis in Chapter 7 considers final devoiced vowels of Woleaian as moraic¹, and as a result they would violate FREE-VOWEL if it were formalized in terms of deletion, since

¹ However, it need not be the case; if Woleaian final vowels were non-moraic, then the language have the same foot structure as the eastern Chuukic languages. The difference would follow from the position of a constraint like VOWEL→MORA, violable in Woleaian. FREE-VOWEL then becomes an issue of *moraic* post-tonic vowels rather than voiced ones, as is suggested in Section 9.2.

they are not deleted. If we are to say that Woleaian devoicing is a reflex of the same phenomenon, it is preferable to attribute it to the same formal device, for the simplicity of the model; nevertheless, I will also entertain the alternative. This alternative, which ultimately I reject, is that the Eastern Chuukic languages (as well as all the Pohnpeic languages) respect a constraint that explicitly requires deletion, while Woleaian alone has ended up respecting some other constraint that explicitly requires devoicing. Ultimately I will attribute Woleaian devoicing and Chuukese deletion as two means of satisfying the same formal constraint.

The manifestation of Woleaian lenition will point us towards the actual formalization of the pan-Micronesian constraint. Instead of directly requiring deletion, I have characterized the observance of FREE-VOWEL as a required devoicing of word-final segments. The geographic distribution of its manifestation suggests that the use of deletion in stem-final lenition is itself an areal phenomenon, since traces of it are found in a contiguous geographical area that nonetheless transcends the accepted familial groupings. The fact that deletion is fossilized in Kosraean, synchronic in eastern Chuukic, Marshallese, and all Pohnpeic, but absent in Woleaian (a Chuukic language) and Kiribati (a later divergence than Kosraean) suggests that the innovation of deletion occurred later than the basic branching of the language family, and actually occurred in languages that were to some extent already divergent and mutually unintelligible.



Nevertheless, despite the lack of synchronic deletion in Woleaian and Kiribati, both have right-side weakening in the form of devoicing. Rehg (1991) uses this as support for the conclusion that proto-Micronesian had either final vowel devoicing or the conditions that made it likely, and that this made the later instantiation of deletion all the more likely in a number of languages. In short, the story I propose is that all Micronesian languages require stem-final vowels to be devoiced—and that some, further, forbid devoiced vowels.

There are reasonable grounds for positing this as a constraint-driven process—even regardless of whether formally it is a matter of deletion or devoicing (although the devoicing version will seem more sensible). Given the pan-Micronesian tendency for primary stress to occur in the final foot, the weakened vowel is always the

one that follows the vowel that carries primary stress. This cannot be an accident. Primary stress helps demarcate word boundaries and phrase boundaries; devoicing the vowel that follows will increase the contrast between the stressed vowel and the one that follows. The constraint FREE-VOWEL could then plausibly be phrased in terms only of primary stress and voicing, as in (2). Such a formalization is sufficient for Woleaian, but hints of opacity for the languages that delete: instead, the formalization needs to refer to more than one level of representation:

- (4) FREE-VOWEL (opaque) The vowel whose Input form follows the Input correspondent of the primary stress must not be voiced.

All other constraints aside, this last version is satisfied under the following conditions. An underlying stem *fane* is satisfied through devoicing, as in *fáne*, or deletion, as in *fán*. Likewise, an underlying stem *fanee* is satisfied by *fané* or by *fané*.

Let us unpack this constraint into smaller units. First, suppose the devoicing process is driven by an OCP-like avoidance of similar adjacent elements: in this case, voiced vowels. We can formalize this as CLASH-VOICE, as in (5). This constraint must be limited to the domain of the head-foot, in order to prevent wholesale devoicing of values throughout polymoraic words.

- (5) CLASH-VOICE_{HEAD}: Sequences of voiced vowels within the head-foot are forbidden.

This constraint will rule out any final foot that contains two voiced vowels; thus, it prefers (*fáne*) and (*fán*) to (*fáne*). However, it also allows *fa(né)*, and critically, all three preferred forms are possible from either /fane/ or /fanee/. It cannot prevent /fane/ → *fa(né)*, nor can it prevent /fanee/ → (*fán*).

In other words, if we are to reduce FREE-VOWEL to CLASH-VOICE, an additional mechanism is needed to produce the proper results. I formalize this as NON-FINALITY in (6); NON-FINALITY is violated wherever the final moraic element of the input and the primary-stress-bearing element of the output are in correspondence.

- (6) NON-FINALITY: The output segment bearing primary stress must not correspond to the rightmost element of the input.

NON-FINALITY rules out the output *fa(né)* only if the input is /fane/. If the input has a final long vowel, as in /fanee/, the output *fa(né)* satisfies NON-FINALITY. I show this in the following tableaux. For now we can presume some lower-ranking constraint or constraints (marked OTHER) are violated by the forms (*fáne*) and (*fán*) but not by *fa(né)*. With NON-FINALITY ranked higher than OTHER, *fa(né)* cannot be an output of /fane/, as Tableau (7) shows.

(7)	fane	CLASH-VOICE	NON-FINALITY	OTHER
a.	(fáne)	*!		
b.	f^{h} (fáne)			*
c.	f^{h} (fán)			*
d.	fa(né)		*!	

However, for the underlying representation /fanee/, the form *fa(né)* satisfies NON-FINALITY, and these other constraints can emerge to rule out *(fáne)* and *(fán)*. I show this in Tableau (8). In the following section, I pursue the nature of the other constraints.

(8)	fanee	CLASH-VOICE	NON-FINALITY	OTHER
a.	(fáne)	*!		
b.	(fáne)			*!
c.	(fán)			*!
d.	f^{h} fa(né)			

Despite the apparent circularity of the original formalism, FREE-VOWEL seems to be a reasonable generalization, an amalgam of CLASH-VOICE and NON-FINALITY. In addition, I have shown that the same formal constraint can be satisfied by devoicing, as in Woleaian, or deletion, as elsewhere. In the remainder of this chapter, I retain the label FREE-VOWEL to derive the combined effects of CLASH-VOICE and NON-FINALITY. In the following section I tackle several questions: namely, what motivates the particular strategy for satisfying FREE-VOWEL, and what if, as I have already suggested, the devoicing and deletion patterns in fact are not attributable to the same formal principle?

9.3 Satisfying FREE-VOWEL: strategies and models

Given the claim that all Chuukic languages satisfy FREE-VOWEL, some additional tinkering will be necessary to predict devoicing in Woleaian and Gilbertese and deletion in the other languages. A basic approach would be to place FREE-VOWEL above MAX-IO in one case, but below it in the other. This cannot be sufficient: if we limit ourselves only to these two constraints, the system will always result in the devoiced candidate as optimal, since it alone satisfies both MAX-IO and FREE-VOWEL.

(9)	fane	FREE VOWEL	MAX-IO
a.	fane	*!	
b.	f^{h} fáne		
c.	fan		*!

Thus, the tolerance of vowel devoicing in Woleaian needs to be attributed to the low rank of some other constraint, which itself is ranked high enough in the other

Chuukic languages to prevent devoicing as a means of satisfying FREE-VOWEL. A simple enough balance, then, is VOICEVOWEL, as defined in (10), which has the simple job of watching for unvoiced vowels.

(10) VOICEVOWEL All vowels are [+voi].

VOICEVOWEL is a simple Markedness constraint, grounded in the preferred co-occurrence of [-cons] with [+voi]. It actually is enough to include VOICEVOWEL in the system: devoicing and deletion patterns are both formalizable when we include it. I show this directly below, but warn that a better explanation is found with the further addition of constraints, to which I return shortly.

I should also clarify that the motivation for requiring voiced vowels should not instead be formalized as faithfulness to underlying voicing of vowels. Were that the case, and given the demands of Richness of the Base, the system would not be able to prevent the generation of non-final voiceless vowels in languages that allow final devoicing. In contrast, formalized as an output Markedness constraint, VOICEVOWEL requires *all* vowels to be voiced, regardless of their underlying voicing specification, and is overridden only in a restricted circumstance—where vowels are post-tonic.

9.3.1 VOICEVOWEL: a first pass

VOICEVOWEL is clearly undominated in the Eastern Chuukic languages, or at least it outranks MAX-IO. This is evident in unreduplicated forms and in suffixed denotatives, as I illustrate in the following tableaux. Ranked over MAX-IO, VOICEVOWEL will outlaw devoicing as a means of satisfying FREE-VOWEL (itself highly ranked).

(10)	soto CHUUKESE	FREE VOWEL	VOICE VOWEL	MAX-IO
a.	soto	*!		
b.	soto̥		*!	
c.	[↗] sot			*

In such a high rank, VOICEVOWEL will also apply to suffixed denotatives, since MAX-IO (among other constraints) is ranked above MAX-BR. Thus, in the Eastern Chuukic languages, FREE-VOWEL is satisfied with deletion in both unsuffixed forms and in suffixed denotatives.

(11)	soto, denotative CHUUKESE	FREE VOWEL	VOICE VOWEL	MAX-IO	MAX-BR
a.	soto-soto	*!			
b.	soto-soto̥		*!		
c.	[↗] soto-sot				*

The devoicing pattern is accomplished with some adjustment of constraint rank: obviously, VOICEVOWEL must be situated below MAX-IO in Woleaian, to produce voiceless vowels in unsuffixed forms, as shown in Tableau (12). Given the higher rank of MAX-IO, it is optimal to preserve the final vowel, so long as it is not voiced.

(12)	fati WOLEAIAN	FREE VOWEL	MAX-IO	VOICE VOWEL
a.	fati	*!		
b.	☞ fati̥			*
c.	fat		*!	

This position of VOICEVOWEL cannot be entirely accurate, however, unless it also is placed below MAX-BR, in order for devoicing to occur in reduplicated suffixes. Tableau (13) shows how a rank of VOICEVOWEL below MAX-BR predicts devoicing in suffixed reduplicated forms.

(13)	fati, denotative WOLEAIAN	FREE VOWEL	MAX-IO	MAX-BR	VOICE VOWEL
a.	fati-feti	*!			
b.	☞ fati-feti̥				*
c.	fati-fet			*!	
d.	fati̥-feti̥				**!

Still, a system could arise in which deletion would occur in reduplicated forms, but devoicing otherwise. Such an “emergence of the unmarked” kind of relationship is predicted by the ranking of VOICEVOWEL between MAX-IO and MAX-BR, in which marked unvoiced vowels would be avoided solely in the context of reduplication. The underived form devoices its final vowel, as Tableau (14) shows, while the final vowel of the suffixed form is deleted, as seen in Tableau (15).

(14)	fati EMERGENT DELETION	FREE VOWEL	MAX-IO	VOICE VOWEL	MAX-BR
a.	fati	*!			
b.	☞ fati̥			*	
c.	fat		*!		

(15)	fati + denotative EMERGENT DELETION	FREE VOWEL	MAX-IO	VOICE VOWEL	MAX-BR
a.	fati-feti	*!			
b.	fati-feti̥			*!	
c.	☞ fati-fet				*!
d.	fati̥-feti̥			**!	

I see no reason to preclude this as a possible natural language, but (despite the appearance of both patterns in the Micronesian family) I see it as an odd intermediary. Why, indeed, are there no languages in which FREE-VOWEL is itself emergent, obeyed only in reduplicated forms, by either means? Such a system is also easily arrived at typologically, simply by the rank of FAITH-IO >> FREE-VOWEL >> FAITH-BR, as Tableaux (16) and (17) show.

(16)	fati EMERGENT FREE-VOWEL	FAITH-IO	FREE VOWEL	FAITH- BR
a.	fati		*	
b.	fati_0	*!		
c.	fat	*!		

(17)	fati + denotative EMERGENT FREE-VOWEL	FAITH-IO	FREE VOWEL	FAITH- BR
a.	fati-feti		*!	
b.	fati-feti_0			*
c.	fati-fet			*

I object to this because neither FREE-VOWEL nor the means of satisfying it are ever effects limited to particular morphological domains in Micronesian languages. Recall that FREE-VOWEL, in its most grounded amalgam of (5) and (6), is simply a Markedness constraint that is closely tied to the (rightward) assignment of primary stress—a process which occurs independently of the character of the stress-bearing unit as stem or affix material. In other words, because FREE-VOWEL-observing languages assign stress *independently* of morphological structure in the form, it is understandable if they also satisfy FREE-VOWEL independently of the morphological category.

It thus does not seem right to characterize the contrast between devoicing and deletion as a trade-off between VOICEVOWEL and Faithfulness or category-specific Correspondence. The alternative I propose is that Woleaian favours devoicing not out of respect for faithfulness, but in order to avoid some other structure that is marked in a way unlike devoiced vowels.

9.3.2 A second pass: Voicelessness or weightlessness

Note that along with Micronesian final-vowel deletion go claims of final-consonant extrametricality. Wherever synchronic deletion occurs, the resulting final consonant is licit—despite tight restrictions on moraic consonants—suggesting it is non-moraic and thus extrametrical. Woleaian, with no synchronic deletion, requires no such tolerance of extrametricality. In fact, I will claim that it forbids it, and that the devoicing of vowels is applied simply to avoid consonant extrametricality. The real trade-off is then between VOICEVOWEL and WEIGHT-BY-POSITION (Hayes 1989) defined in (18) below. WEIGHT-BY-POSITION is the constraint that will be violated by any form that includes extrametrical consonants, such as those in deletion-type Micronesian languages.

- (18) **WEIGHT-BY-POSITION** A consonant associated to a coda position is also associated to a mora.

Woleaian has full respect for **WEIGHT-BY-POSITION**, but since it also observes **FREE-VOWEL**, its only option is to devoice final vowels. Deleting a final vowel would create an extrametrical consonant, in violation of **WEIGHT-BY-POSITION**, or a moraic final consonant, which would satisfy **WEIGHT-BY-POSITION**, but which would violate **CODACONDITION**. I summarize this in Tableau (19): note that an interesting consequence is that **VOICEVOWEL** may remain ranked as high as or above **MAX-IO** in Woleaian, quite unlike the model in Section 9.3.1 that lacks **WEIGHT-BY-POSITION**.

(19)	fati WOLEAIAN	FREE VOWEL	CODA COND	WGHT BY-POS	VOICE VOWEL	MAX-IO
a.	fati	*!				
b.	fati_\circ				*	
c.	fat			*!		*
d.	fat μ		*!			

In fact, **VOICEVOWEL** may also remain ranked above **MAX-BR**, and because of the undominated rank of **WEIGHT-BY-POSITION**, devoicing still arises in suffixed reduplicatives. I show this in Tableau (20).

(20)	fati, denotative WOLEAIAN	FREE VOWEL	CODA COND	WGHT BY-POS	VOICE VOWEL	MAX-IO	MAX-BR
a.	fati- feti	*!					
b.	fati-feti_\circ				*		
c.	fati- fet			*!			*
d.	fati_\circ - feti				***!		

The contrasting property of the eastern Trukic languages like Chuukese and Puluwat is captured with the simple placement of **VOICEVOWEL** above **WEIGHT-BY-POSITION**. With such a ranking, vowel-devoicing is not a suitable way of satisfying **FREE-VOWEL**; as a result, the stem-final vowel is deleted and a consonant is stranded in an extrametrical position, as Tableau (21) shows.

(21)	soto CHUUKESE	FREE VOWEL	VOICE VOWEL	WGHT BY-POS	MAX-IO
a.	soto	*!			
b.	soto \circ		*!		
c.	sot			*	*

It is the rank of VOICEVOWEL over WEIGHT-BY-POSITION, not MAX-BR, that has deletion occurring in suffixed denotatives. Again, vowel-devoicing is avoided, as Tableau (22) illustrates.

(22)	sɔto, denotative CHUUKESE	FREE VOWEL	VOICE VOWEL	WGHT BY-POS	MAX-IO	MAX-BR
a.	sɔto-sɔto	*!				
b.	sɔto-sɔto		*!			
c.	 sɔto-sɔt			*		*

The choice between devoicing and deletion as a means of satisfying FREE-VOWEL is therefore characterized as a conflict between consonant extrametricality and vowel-devoicing, both of which are categorical patterns that occur independently of the morphological form of the output, and thus independently of the distinction between MAX-IO and MAX-BR.

9.3.3 *The same FREE-VOWEL*

In Section 9.1 I allude to the possibility that Woleaian and the eastern Chuukic languages do not actually satisfy the same lenitive constraint. The alternative situation is as follows: FREE-VOWEL, as formalized for Chuukese and Puluwat, directly requires deletion, while some other formalism, say DEVOICE-FINAL, is active in Woleaian.

(23) DEVOICE-FINAL Final vowels are devoiced.

Understandably this approach might initially offer a simpler version of the east-west contrast in Chuukic languages: somewhere along the way in one of the branches, one constraint was reanalyzed as the other, and the rest of the system follows. Even so, this requires the rearrangement of several more constraints in the account, to such an extent that the reanalysis approach ultimately offers nothing better than what develops above in Section 9.3.2.

At the heart of the matter is that even if we are to attribute Woleaian devoicing to DEVOICE-FINAL and not to FREE-VOWEL, we still must not deny the existence of the constraint VOICEVOWEL, which makes a conflicting demand. If we return to the Woleaian form *fati*, the voiced candidate satisfies VOICEVOWEL, but violates DEVOICE-FINAL. The rank of DEVOICE-FINAL over VOICEVOWEL is not in doubt.

Nevertheless, we still must deal with a deletion candidate **fat*, which, like the optimal *fati*, satisfies DEVOICE-FINAL: since deletion results in there being *no* final vowel, the devoicing requirement is vacuously met. To avoid such a result, at least one of MAX-IO or WEIGHT-BY-POSITION must outrank VOICEVOWEL, since the deletive candidate **fat* violates both, as summarized in Tableau (24).

(24)	fati WOLEAIAN	DEVOICE FINAL	CODA COND	WGHT- BY-POS	MAX-IO	VOICE VOWEL
a.	fati	*!				
b.	fati_{f}					*
c.	fat			*!	*	
d.	fat μ		*!			

If we then move to a suffixed denotative, a parallel situation is evident: at least one of WEIGHT-BY-POSITION or MAX-BR must outrank VOICEVOWEL, to ensure that the devoiced form *fati-feti* is chosen over the deletive form **fati-fet*. I summarize this in Tableau (25).

(25)	fati, denotative WOLEAIAN	DEVOICE FINAL	CODA COND	WGHT BY-POS	MAX IO	MAX BR	VOICE VOWEL
a.	fati-feti	*!					
b.	$\text{fati-feti}_{\text{f}}$						*
c.	fati-fet			*!		*	

To capture the Woleaian devoicing pattern using DEVOICE-FINAL, then, we are left with the following choice: either the rank of WEIGHT-BY-POSITION over VOICEVOWEL is what motivates devoicing, or both MAX-IO and MAX-BR outrank VOICEVOWEL. Regardless, this is no more informative than the final analysis of § 9.3.2.

If WEIGHT-BY-POSITION is not the constraint that motivates devoicing in Woleaian, then VOICEVOWEL must lie below both MAX-IO and MAX-BR in Woleaian and above both in Chuukese, despite the independence of right-side weakening from morphological category. This is the same undesirable story as in Section 9.3.1; reconstituting FREE-VOWEL as DEVOICE-FINAL for Woleaian cannot avoid this.

If WEIGHT-BY-POSITION *is* the important constraint for Woleaian, then VOICEVOWEL simply lies below WEIGHT-BY-POSITION in Woleaian, but not in Chuukese. In this case, the model is equivalent to the conclusion of Section 9.3.2: Woleaian resorts to the marked structure of devoiced vowels to avoid the other marked structure of extrametrical consonants. As a result, Woleaian's means of satisfying DEVOICE-FINAL here are exactly the same as its means of satisfying FREE-VOWEL in Section 9.3.2: devoicing is preferred over stranding a non-moraic consonant. Again, positing a unique lenition constraint for Woleaian does not simplify the contrast among these languages.

An additional problem for a DEVOICE-FINAL approach to Woleaian lenition is the language's treatment of stem-final long vowels, which shorten, just as they would in deletive patterns. It is actually a prediction of the FREE-VOWEL approach that this will happen: since the shortening of final vowels will not result in a violation of WEIGHT-BY-POSITION, it is possible for this to occur even in a devoicing system like Woleaian's. In other words, VOICE-VOWELS still has a restricted effect here, as I show in Tableau (26) for the reduplicated form *fii-fi*.

(26)	fii, denotative WOLEAIAN	FREE VOWEL	CODA COND	WGHT BY-POS	VOICE VOWEL	MAX IO	MAX BR
a.	fii- fii	*!					
b.	fii- fij				*!		
c.	 fii- fi						

I therefore stand by the position that the same FREE-VOWEL is active in all Chuukic languages, since its interaction with CODACONDITION, WEIGHT-BY-POSITION, and VOICEVOWEL can motivate both kinds of word-final lenition. The appeal to DEVOICE-FINAL must negotiate the same balance with these other constraints.

The present discussion has presented devoicing and deletion as two ways of satisfying FREE-VOWEL: devoicing follows from the rank of WEIGHT-BY-POSITION over VOICEVOWEL, while deletion follows from the opposite rank. This contrast, however, is not the only one between Woleaian and Chuukese/Puluwat. In the following section, I investigate an additional distinction in the phonological systems.

9.4 *The other contrastive property*

Two independently derived formal systems have been proposed for the Eastern and Western Chuukic languages, and yet they share a great deal of formal structure in the guise of constraint rankings. In addition, two distinct forms of right-side weakening have been motivated by the same formal principle, which is observed by a choice of two marked alternatives: devoiced vowels or extrametrical consonants.

A second contrast exists in the family, however, and it is one that may seem random, but is probably no accident. Languages that allow final-vowel deletion also allow monomoraic feet. In this section I will show that this second contrast is closely related to the flavour of lenition, but requires a second change of constraint rank to be adequately modeled. I will show that this is true regardless of whether one uses ALLFEETRIGHT as the size restrictor in Chuukese and Puluwat.

The foot pattern and weakening pattern show a curious confluence: unary feet are allowable if and only if final-vowel deletion also applies. Two other possible systems are notably absent: a final-devoicing pattern that allows unary feet, and a deletion pattern that forbids them. The chart in (27) summarizes this.

(27) Gaps in Chuukic typology

	<i>Unary feet allowed</i>	<i>unary feet forbidden</i>
<i>deletion</i>	Chuukese, Puluwat	–
<i>devoicing</i>	–	Woleaian

I claim that the empty cells in Table (27) are more likely than not to be empty—that is, that they represent less likely languages, even though in the Boggle model of Optimality-Theoretic ranking typology discussed in §1.4.1, they are equally

likely as the filled cells to be generated. Before pursuing this claim, I first describe the differences in ranking that must be made in order to capture adequately the footing contrast.

9.4.1 Unary Feet in Chuukese

The footing contrast is easily seen in final feet, and especially in suffixed denotatives. For example, the Chuukese denotative of stems like *soto* has a monomoraic suffix, as in *soto-sɔ̃t*. There are actually two ways of forcing this result: one is to rank ALLFEETR_{RIGHT} over FOOTBINARITY, while the other—the ‘Chuukic Alternative’ of Section 8.5.4—is to call upon ALL-σ-RIGHT and WEIGHT-IDENT-BR to accomplish the work of ALLFEETR_{RIGHT}. I adopt the ALLFEETR_{RIGHT} approach below before showing why the Chuukic Alternative is untenable.

As argued in Section 9.3.2, Chuukese ranks FREE-VOWEL and VOICEVOWEL over WEIGHT-BY-POSITION. This ensures the output will have a deleted final vowel, but two candidates are left: the optimal *soto-sɔ̃t*, and a competitor **soto-sɔ̃t*, which excels in its satisfaction of FOOTBIN. The optimum emerges, however, as long as ALLFEETR_{RIGHT} outranks FOOTBIN. I illustrate this in Tableau (28).

(28)	soto + DENO CHUUKES	FREE VOWEL	VOICE VOWEL	WEIGHT BY-POS	ALLFEET RIGHT	FOOT BIN
a.	soto-sɔ̃t	*!			**	
b.	soto-sɔ̃t̥		*!		**	
c.	soto-sɔ̃t			*	**!	
d.	☞ soto-sɔ̃t			*	*	*

In contrast, Woleaian ranks WEIGHT-BY-POSITION over VOICEVOWEL, which nets vowel devoicing instead of extrametricality. Thus, deletive candidates for the denotative of *fati*, such as **fati-fet* and **fati-feet*, are thrown out. In this case, two other candidates remain viable: the optimal *fati-feti*, and a suboptimal **fati-ti*. This second form is superior by ALLFEETR_{RIGHT}, but not by FOOTBIN, which motivates the opposite ranking of these two than what is attested in Chuukese. With FOOTBIN ranked higher, the optimal form emerges with a bimoraic suffix, as shown in Tableau (29).

(29)	fati + DENO WOLEAIAN	FREE VOWEL	WEIGHT BY-POS	VOICE VOWEL	FOOT BIN	ALLFEET RIGHT
a.	fati-fati	*!				**
b.	fati-fat		*!		*	*
c.	fati-faat		*!			**
d.	fati-ti			*	*!	*
e.	☞ fati-fati			*		**

Briefly, the generalization is this: Chuukese ranks VOICEVOWEL over WEIGHT-BY-POSITION and ALLFEETRIGHT over FOOTBINARITY. Woleaian has the opposite rank for both pairs: WEIGHT-BY-POSITION over VOICEVOWEL and FOOTBINARITY over ALLFEETRIGHT. Although one could imagine a cross-pollination of these patterns, I argue that the two rankings are correlated. I return to this issue in 9.5, but show first below why the Chuukic Alternative (introduced in 8.5.4) is a less acceptable way of modeling the final monomoraic feet of Chuukese.

9.4.2 The Chuukic Alternative

The Chuukic Alternative of Section 8.5.4 entertains replacing ALLFEETRIGHT's work of size-restriction with the independently motivated constraints ALL- σ -RIGHT and WEIGHT-IDENT-BR. In such a model, there is only a single change of ranking needed to characterize the contrast between Woleaian and Chuukese final feet: only the relationship between VOICEVOWEL and WEIGHT-BY-POSITION is important.

The Chuukic alternative requires a rank of WEIGHT-IDENT-BR over FOOTBINARITY in Chuukese and Puluwat. This relationship is responsible for maintaining the single-mora quantity of the suffix: since **sɔto-sɔt* violates WEIGHT-IDENT, the preference is for *sɔto-sɔt* to emerge instead, at the expense of FOOTBINARITY, as Tableau (30) shows.

(30)	sɔto + DENO ALT-CHUUKESSE	FREE VOWEL	VOICE VOWEL	WEIGHT BY-POS	WEIGHT IDENT-BR	FOOT BIN	MAX BR
a.	sɔto-sɔto	*!					
b.	sɔto-sɔtɔ		*!				
c.	sɔto-sɔt			*	*!		o
d.	☞ sɔto-sɔt			*		*	o

Woleaian, as it happens, can have the same rank of WEIGHT-IDENT-BR over FOOTBINARITY, with no dire consequences. The only necessary difference in Woleaian is that WEIGHT-BY-POSITION outrank VOICEVOWEL. Since the main competitor for Woleaian *fati-fatɨ* is **fati-tɨ* and they both satisfy WEIGHT-IDENT-BR, FOOTBINARITY can sort them out, even if it is ranked lower, as Tableau (31) shows.

(31)	fati + DENO ALT-WOLEAIAN	FREE VOWEL	WGHT BY-POS	VOICE VOWEL	WEIGHT IDENT-BR	FOOT BIN	MAX BR
a.	fati-fatɨ	*!					
b.	fati-fat		*!			*	i
c.	fati-faat		*!				i
d.	fati-tɨ			*		*!	fa
e.	☞ fati-fatɨ			*			

So, the position of WEIGHT-IDENT-BR with respect to FOOTBINARITY in Woleaian is not contradictory with its position in Chuukese. In other words, the Chuukic Alternative allows the following result: changing the rank only of WEIGHT-BY-POSITION and VOICEVOWEL predicts both pattern changes. If VOICEVOWEL is higher than WEIGHT-BY-POSITION, as in Chuukese, the system forbids unvoiced vowels *and* allows monomoraic feet. Conversely, if WEIGHT-BY-POSITION is higher, the system forbids consonant extrametricality *and* forbids monomoraic feet.

Sadly for the Chuukic alternative, I do not find it an acceptable characterization of footing in Chuukese, since it portrays the appearance of final monomoraic feet as a conflict between FOOTBINARITY and reduplicative correspondence. It says nothing about final monomoraic feet in unreduplicated forms, whose appearance is accidental unless one invokes the conflict between FOOTBINARITY and ALLFEETRIGHT. For it is only with ALLFEETRIGHT that the size-restriction of the suffix is characterized as a quantitative limitation regardless of morphological category. If its work is carried out by ALL- σ -RIGHT and WEIGHT-IDENT-BR, the *consistent* nature of the Chuukese suffix (monomoraic) and Woleaian suffix (bimoraic) is coincidental.

Regardless, it remains the case that the manner of final-vowel lenition is related to the quantity of the final foot, no matter how the latter pattern is formalized. Then if we reject the Chuukic Alternative, the co-occurrence of monomoraic feet and extrametrical consonants is also coincidental—however, it is an easier coincidence to explain. In fact, I propose that a single innovation along one parameter precipitated the other contrasting pattern, and moreover, not only is this true of the likely course of divergence, it is plausible regardless of the direction of change.

9.5 *A conspiracy? FOOTBIN was pushed!*

The gaps in Table (27) suggest an Optimality-Theoretic conspiracy: two changes of ranking are required to model what superficially and descriptively, looks like a single pattern innovation. When I mention the idea of innovation, it could be that Chuukese and Puluwat are phonologically conservative, and that Woleaian has been divergent. If this is the case, it is reasonable to see that the loss of a deletion pattern begat a loss of tolerance of unary feet. Alternatively, Woleaian may represent the more conservative form, which it probably does, as Rehg (1991) argues, given the areal and non-genetic spread of deletion. If this were the case, the innovation of deletion in eastern Chuukic precipitated a tolerance of unary feet. In this section I argue that no single innovation could reasonably settle on a system represented by the empty cells in Table (27)—even though those cells differ from real languages by a single parameter, a single innovation. Consequently, the gaps in Table (27) represent typologically possible but conceptually unexpected systems.

I will consider the both devoicing and deletion as possible innovative patterns, and regardless of the direction of innovation, I will show that the connection between lenition and foot structure is not an accidental one. Thus, it is necessary to show that an innovation of devoicing could precipitate an accompanying change in footing, and that an innovation of deletion could as well.

9.5.1 Contingency: innovation in Woleaian

First, let us treat the hypothetical case in which Chuukese and Puluwat represent a more historically faithful reflex of a proto-Chuukic language, of which they and Woleaian are daughter languages. This means that proto-Chuukic was deletive and tolerated final monomoraic feet. How could Woleaian have innovated out of this situation?

Here is a likely course: as Chuukese synchronically shows, underlying representations of stems require an inclusion of the stem-final vowel that may delete. We know this is true because the exact identity of the vowel in preserving contexts (such as suffixed forms) is unpredictable. So a speaker who says or hears “sɔt” or “sɔto-sɔt” knows, unconsciously at least, that she is using the stem *sɔto*. Every instance of that word uttered, even if unsuffixed, could prime the underlying form to such an extent that the speaker believes that the vowel is actually there (even if it is not)—and is just so quiet that it is not voiced. This is tantamount to a drop in the rank of VOICEVOWEL. I illustrate this process in Figure (32).

(32) Likely hypothetical path for innovating devoicing

Source grammar	
↓	
“sɔto-sɔt”	<i>Source grammar has synchronic final deletion</i>
↓	
[(sɔto)-(sɔtɔ)]	<i>Learner is primed to hear final vowel</i>
↓	
Acquired grammar	<i>Learner posits /sɔto-RED/ and creates grammar that devoices final vowels and forbids degenerate feet: FOOTBINARITY » ALLFEETRIGHT WEIGHT-BY-POSITION » VOICEVOWEL</i>

Any speaker who has learned this devoicing pattern then hears stress occurring on the penultimate mora instead of the final one. Now, in the absence of evidence to the contrary, FOOTBINARITY remains obeyed, at the expense of ALLFEETRIGHT. Consequently, the perception of the final voiced vowel by the learner provides evidence for two separate constraint rerankings.

In fact, it would be bizarre for a learner to acquire one ranking without the other: the learner of the innovative pattern would need to hear stress in the wrong places. The unlikely situation is that FOOTBINARITY does not respond to the innovation of devoicing, and remains ranked below ALLFEETRIGHT. In such a case, the innovation would cause *fati* to reduplicate as (*fâti*)(*tí*), showing, implausibly, a loss of the stressed syllable of (*fâti*)(*fÁtí*), and a placement of stress on a devoiced vowel. This could only come about if the learner settles on (*fâti*)(*tí*) as the default perceived form, yet its appearance either as a

true articulatory variant in the set of ambient forms, or as a perceptual variant, is going to be blocked by the pressure of Cognitive counterbalance.

Moreover, unreduplicated long stems like *metariüwa* ‘Scorpio star’ would show an odd stress shift: prior to the innovation, these would be *(mèta)(rúw)*, and the solitary devoicing innovation would produce *me(tàru)(wá)*—in which both formerly stressed elements are now unstressed. Realistically, given the salience of stressed elements and the role of Cognitive Counterbalance, the learner is likely to maintain them in their conservative position.

I propose that such changes in stress position are unlikely and intolerable, and thus that the introduction of devoicing into Woleaian (if that is indeed how the language developed the pattern) simply created bimoraic final feet, encouraging an accompanying adjustment in the rank of FOOTBINARITY. Then no conspiracy is afoot; instead the rank of one pair of constraints is grounded in the rank of another pair.

9.5.2 *Innovation in Chuukese*

The previous story, however, is but one of two opposing contingencies. The other possible scenario is that Woleaian’s devoicing is more representative of proto-Chuukic, and that Chuukese innovated the deletion pattern. Indeed, this is a better reflection of probable reality, because evidence of stem-final deletion is restricted to a geographic area (the central and eastern Caroline Islands plus the Marshalls) that does not correspond to any subgrouping of the Micronesian family, as Figure (3) above shows. It includes all the Pohnpeic languages but only some of the Chuukic ones; it also includes Kosraean, but not Gilbertese, which is a later divergence. In fact, the languages that do not show any evidence of ever having had a deletion pattern, Woleaian and Gilbertese, are spoken at the geographic peripheries: Woleaian, far to the west near Yap, and Gilbertese, far to the east, encroaching on Polynesia.

If Chuukese does represent the innovator, then, the change has been from a system that devoiced final vowels to one that deletes them. Such a pattern change is not a difficult one to imagine, and requires less explanation than the opposite direction of change. This time, a learner encounters forms with final devoicing, whose final vowels are difficult to perceive, might not be heard at all, and are thought to be deleted. She thus ends up generalizing a system with synchronic deletion, and allows extrametrical consonants instead of devoiced vowels.

Such a change in lenition will actually present evidence for the violability of FOOTBINARITY: for if this speaker hears *(fàti)(fátì)* as *(fàti)(fát)*, and *(mèta)(rúwə)* as *(mèta)(rúw)*, she will have learned a system that allows monomoraic feet. To do so, she must encode a rank of FOOTBINARITY below ALLFEETRIGHT. I illustrate this learning sequence in Figure (33).

(33) Likely path for innovating deletion

Source grammar	
↓	
“fàti-fát ~ fàti-fátì”	<i>Phonetic pressure may induce deletion over devoicing. Variants with different stressed vowels are unlikely given cognitive counterbalance: thus no [fa(tífat)]</i>
↓	
[(fàti)(fát)]	<i>Voiceless vowels may go undetected, but percepts with different stressed vowels are unlikely given cognitive counterbalance: thus no [fa(tífat)]</i>
↓	
Acquired grammar	<i>Learner posits /fati-RED/ and creates grammar that deletes final vowels and allows degenerate feet: ALLFEETRIGHT » FOOTBINARITY VOICEVOWEL » WEIGHT-BY-POSITION</i>

There is no evidence to suggest the unlikely alternative of maintaining FOOTBINARITY highly. For the learner to acquire a system that respects FOOT-BINARITY while deleting final vowels, it would take evidence in forms like *fa(tí-fet)* and *me(táriiw)*, in which stress placement is categorically altered. Such forms are not likely to be possible articulatory variants or misperceptions, given the activity of Cognitive Counterbalance.

In this case, then, there is also no conspiracy of ranking. Instead, the rank of FOOTBINARITY below ALLFEETRIGHT is grounded in the rank of VOICE-VOWELS over WEIGHT-BY-POSITION. We can now say that the gaps in Table (27) are not accidental, regardless of whether Chuukese deletion or Woleaian devoicing is a more faithful representative of lenition in Proto-Chuukic.

9.6 Interim conclusion and residual issues

In the previous subsection I present one possible consequence of a failure for innovative devoicing to precipitate tolerance of monomoraic feet: stress ends up on the wrong elements. At least for reduplicated forms, there is an alternative route that I have not accounted for: couldn't *fati*, in the innovative Chuukese, reduplicate as *(fati)(faat)*, which respects FREE-VOWEL, but in which a concomitant violation of FOOTBINARITY need not be observed?

There is, in fact, a gaggle of exceptional reduplicative Chuukese forms that present exactly such a picture, such as *kiis* (from *kisi*) → *(kisi)(kiis)* ‘be small’. It is telling that they are exceptional, for far and away we should expect a monomoraic suffix. Their exceptionality is difficult to explain—it may be a frequency effect, but it is hard to know. Nevertheless, it is not hard to explain the fact that these *are* exceptional rather than the rule. The placement of stress is no doubt relevant: here we expect *(kisi)(kiís)*, while a monomoraic suffixed form would stress a different base element, as in **(kìsi)(kís)*. Perhaps the desire not to shift stress in this manner helps maintain the

regularity of the system towards permitting monomoraic feet—but the very oddness of the stress shift otherwise provides the salience for exceptional forms to persist.

Furthermore, a source of exceptionality is not too difficult to find. One possibility is that, indeed, the innovation of stem-final deletion did not have an *immediate* effect on binarity, and that an intermediate stage in which FOOTBINARITY had an emergent effect in suffixed forms did occur. Then forms like *kisi-kiis* are fossilized relics of that period.

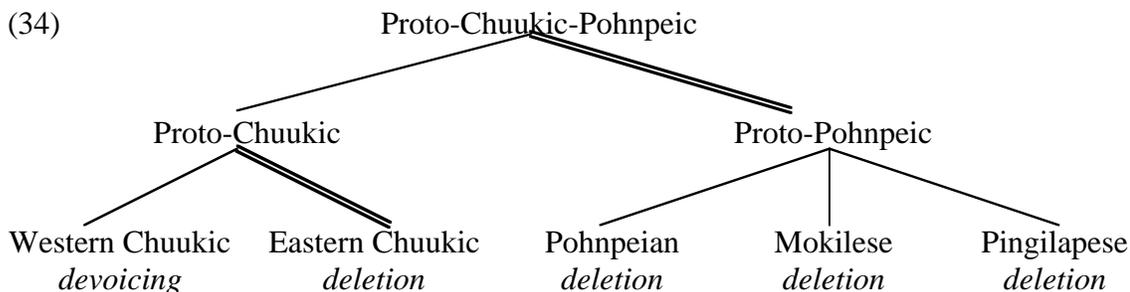
Another possibility is that *kisi-kiis* is analogous to other minimality effects. Recall that Chuukese has a bimoraic minimum in monopodal nouns; that is, unary feet are allowed only in verbs, or in multi-foot nouns. If these are related, then the claim is that the suffix in *kisi-kiis* is marked in the same way as free-standing nouns to be subject to the minimality effect.

Thus, such forms are, for a number of reasons, not implausible as exceptions, so we retain the notion that tolerance of monomoraic feet in Chuukese is a direct precipitate of the emergence of a synchronic deletion form of right-side lenition. The story for the Chuukic languages is therefore complete: there is a strong connection between devoicing and binarity, and between deletion and the relaxation of binarity.

We are now in a position to test the claims of Confluence at a higher language-familial level, as we have covered the Pohnpeic subgroup in Chapters 4, 5 and 6, and the Chuukic group in Chapters 7 and 8, as well as here. In the remainder of this chapter I discuss Confluence in terms of both subgroups.

9.7 Deletion, feet, and Chuukic-Pohnpeic

In fact, Pohnpeian, Mokilese, and Pingilapese exactly reflect the Chuukese confluence of deletion and unary feet. Woleaian has devoicing, which means deletion could not have been innovated in any language from which it is descended. Thus, it must have occurred independently at least twice. That is, if Proto-Chuukic-Pohnpeic had the final devoicing pattern reflected in Woleaian, then the innovation of deletion in Figure (33) has taken place throughout the Pohnpeic group as well: at least once in Eastern Chuukic and at least once in Pohnpeic. I illustrate this in Figure (34). The branches of the tree in which devoicing became deletion are indicated by a double line.



From this we can draw two conclusions, the first of which is that the rank of VOICEVOWEL over WEIGHT-BY-POSITION is a likely one to emerge. This is formally equivalent to the claim by Rehg (1991) that final devoicing makes the innovation of final deletion likely to occur independently in different languages.

The second conclusion corroborates the Confluence of foot structure and lenition discussed in Section 9.5. That is, not only do the Pohnpeic languages have the same synchronic deletion seen in the Eastern Chuukic languages, they also allow monomoraic feet, as their denotative suffixes indicate. Thus, wherever a devoicing pattern has arisen independently, a tolerance of monomoraic final feet has followed.

9.8 *Bimoraic prefixes*

Pohnpeic languages, however, are unlike the Chuukic family in their means of creating bimoraic prefixes. As Section 6.2 summarizes, the Pohnpeic languages share a tendency for heavy monosyllables wherever there is a potential sequence of homorganic consonants, as in Mokilese *kak-kak*, Pohnpeian *din-dilip*, and Pingilapese *dii-diraip*. But where the potential sequence is not homorganic, vowel excrescence intervenes, resulting in a disyllabic prefix, as in Mokilese *neki-nekid*, Pohnpeian *sipi-siped*, and Pingilapese *pili-pile*.

In contrast, all Chuukic languages have a consistently monosyllabic prefix, regardless of any potential homorganicity. Instead of copying the second consonant of the base, Chuukic prefixes are always CVC, in which the two consonants are identical. Thus, in Chuukese CVC stems with identical consonants, we naturally see identical CVC suffixes, as in *kak-kak* ‘ringing’ and *nan-nan* ‘chattering’, parallel to Mokilese *kak-kak*. However, in homorganic but non-identical cases, Chuukese retains the identical CVC shape, as in *sæs-sær* ‘moving’ and *tət-tən* ‘being in a line’. Each Pohnpeic language would handle such cases by using a heavy monosyllable, but never by using the Chuukic strategy. Moreover, Chuukic applies the same strategy in cases of potential non-homorganic sequences, as in *fif-fini* ‘choosing’ and *ses-sepi* ‘using a bowl’, where all Pohnpeic languages would appeal to vowel insertion and faithfully copy the second consonant. I summarize these contrasts in Table (35).

(35) Prefix subpatterns

	Identical CC	homorganic CC	non-homorganic CC
Chuukese	nan -nan <i>chattering</i>	tət -tən <i>in line</i>	fif -fini <i>choosing</i>
Mokilese	kak -kak <i>bouncing</i>	kaŋ -kaŋ <i>eating</i>	neki -nekid <i>saving</i>
Pohnpeian	mem -mem <i>being sweet</i>	din -dilip <i>mending thatch</i>	sipi -siped <i>shaking out</i>
Pingilapese	paa -pap <i>swimming</i>	dii -diraip <i>driving</i>	pili -pile <i>saying</i>

The basic contrast is as follows: the prefix is monosyllabic in all cases in Chuukic, but monosyllabic only in some cases in Pohnpeic. What Chuukic adds to the discussion is another test of Confluence: first, recall that the Pohnpeic disyllabic prefix, a product of vowel insertion, is a means of separating potential consonant sequences.

I offer a further generalization in Table (36), which shows a distribution of languages by the syllable-count of their prefixes, based on the potential homorganicity of consonant sequences under reduplication. Here we see that Chuukic languages have monosyllabic prefixes regardless of the homorganicity of the potential sequence, while Pohnpeic languages have monosyllabic prefixes only for homorganic situations.

(36) Missing languages within Chuukic-Pohnpeic

		potential non-homorganic sequences, e.g. <i>tep</i>	
		monosyllabic prefix	disyllabic prefix
potential homorganic sequences e.g. <i>kak</i>	monosyllabic prefix	Chuukic <i><u>tet</u>-tep</i> <i><u>kak</u>-kak</i>	Pohnpeic <i><u>tepi</u>-tep</i> <i><u>ka</u>-kak</i>
	disyllabic prefix	∅ <i><u>tet</u>-tep</i> <i><u>kaki</u>-kak</i>	∅ <i><u>tepi</u>-tep</i> <i><u>kaki</u>-kak</i>

Table (36) shows some gaps in possible languages: no language restricts the disyllabic strategy to potential homorganic sequences, and no language uses the disyllabic strategy across the board. Chapter 6 already offers an account for this generality within the Pohnpeic group. The account extends naturally to the Chuukic languages: in other words, the gaps in Table (36) are already explained.

In addition, there is another parameter by which the Chuukic languages stand apart: not only the consistent monosyllabicity of their prefix, but also the leftward gemination that occurs under prefixation. In other words, while the syllable-count of the prefix in Pohnpeic languages reflects a distinction between potential non-homorganic and homorganic sequences, there is no such distinction made among Chuukic monosyllables: the Chuukic suffix *never* reflects the second base consonant, while the Pohnpeic suffix *always* does. I illustrate this coincidence in Table (37).

(37) Coincidence of syllabicity and sequence avoidance

	<i>Potential homorganic sequences</i>	<i>Potential non-homorganic sequences</i>
<i>Copy C₁VC₂</i> (allow disyllabic prefix)	Pohnpeic	Pohnpeic
<i>Copy C₁VC₁</i> (require monosyllabic prefix)	Chuukic	Chuukic

There is a contrast to be made between these languages and other empirically possible ones. A hypothetical Language A could copy C_1VC_2 in homorganic cases but C_1VC_1 in non-homorganic ones: this yields *ton-tono* in the homorganic case but left-geminating *ses-fiti* in the non-homorganic case. Conversely, hypothetical Language B could copy C_1VC_1 in homorganic cases but C_1VC_2 in the non-homorganic cases, yielding *tot-tono* and *sepi-sepi*. Both situations are summarized in Table (38).

(38) Hypothetical but unattested languages

	Potential homorganic sequences	Potential non-homorganic sequences
Copy C ₁ VC ₂ (allow disyllabic prefix)	Language A <i>ton-tono</i>	Language B <i>sepi-sepi</i>
Copy C ₁ VC ₁ (require monosyllabic prefix)	Language B <i>tot-tono</i>	Language A <i>ses-sepi</i>

The Confluence model predicts these systems to be unlikely historical developments. Although these hypothetical languages might be computationally and formally possible, the question to be asked is why we see the collocations in Table (37) rather than the ones in Table (38). To do so requires some conjecture as to the manner of divergence that characterized the split between Chuukic and Pohnpeic. I will follow Goodenough & Sugita (1980) in positing a prefixing pattern that reflects the first and second consonant of the base of proto-Chuukic-Pohnpeic. The if we look at the hypothetical proto-stems *tono* and *sepe*, they are prefixed as *ton-tono* (or *toni-tono*) and *sepi-sepe*.

Knowing what we know about Micronesian foot and moraic structure, and putting aside the manifestation of FREE-VOWEL, these forms would be stressed as (*tòni*)(*tóno*) and (*sèpi*)(*sépe*). Moreover, we could imagine that the unstressed vowels are reduced to devoiced variants, yielding (*tòni̥*)(*tóno*) and (*sèpi̥*)(*sépe*). In addition, the rightward pressure of structure (formalized by ALL-σ-RIGHT and ALLFEETRIGHT) would induce variants like (*tòn*)(*tóno*) and (*sèp*)(*sépe*), where the unstressed vowels are syncope.

Thus, it is the step between production of these variants and perception of them by learners that gives rise to the split between Chuukic and Pohnpeic. A first point to make is that the frequency of variation between (*tòni*)(*tóno*), (*tòni̥*)(*tóno*), and (*tòn*)(*tóno*) is, initially to us, unpredictable, as is the variation between (*sèpi*)(*sépe*), (*sèpi̥*)(*sépe*), and (*sèp*)(*sépe*).

Nevertheless, the claim is that of the fully syncope variants, the homorganic (*tòn*)(*tóno*) will be at least as frequent as the non-homorganic (*sep-sepe*). Note that both forms have a medial moraic consonant; the homorganic one satisfies the formal CODACONDITION. We have not yet associated CODACONDITION to any substantive grounding, but I will submit that place-linked moraic timing slots are preferred because the long closure of moraic consonants is articulatorily easier if there are no internal changes of place specification. For example, in the sequence *nt*, the long closure (and thus maintenance of moraic timing) is less effortful to hold than the sequence *ps*. It follows that syncope is either equally likely in homorganic and non-homorganic sequences or more likely in homorganic sequences. It would be odd for syncope to be frequent only in non-homorganic sequences.

As a result, Pohnpeic fulfills one scenario, in which syncope is a more likely variant only in homorganic sequences. The next step after the instantiation of this variation is reanalysis on the part of the learner, which occurs in the choice of the most frequent variant as the default form for her grammar to account for. Should the learner

maintain *sepi-sep* as the preferred output for non-homorganic sequences, she ends up with a system that requires faithfulness to the second consonant. Thus, even if *tot-tono* were ever an ambient or perceptual variant, the acknowledgement of C_2 faithfulness in the system encourages *ton-tono* as a likelier default for homorganic cases. Thus, if Language B were to appear, it would ultimately resolve towards Pohnpeic anyway. I illustrate this in Figure (39).

(39) Likely path for innovating Pohnpeic strategy

Source grammar	
↓	
“tono-tono ~ ton-tono”	“sepi-sepi”
↓	
[ton-tono ~ tot-tono]	[sepi-sepi]
↓	
Acquired grammar	
	<i>Phonetic pressure may induce monosyllabism, but less so for /sepi-sepi/ than for /tono-tono/</i>
	<i>Voiceless vowels may be undetected; coda consonants may be misperceived</i>
	<i>Choice of [sepi-sepi] as default creates a grammar that requires C_1VC_2: Lg B resolves to Pohnpeic</i> <i>CODACOND, MAX-BR » DEP-BR</i>

Chuukic exemplifies the other scenario, in which syncopated variants at the innovating point were as frequent for both homorganic and non-homorganic forms. An additional step is necessary, however. Not only does the learner choose the highly frequent syncopated variants as default, she also perceives full geminates rather than specified moraic consonants. The choice of geminate percepts as the preferred default forms will have the learner create a grammar that requires reduplication of C_1VC_1 ; consequently, a move towards Language A will instead resolve to the Chuukic pattern. I illustrate this in Figure (40).

(40) Likely path for innovating Chuukic strategy

Source grammar	
↓	
“tono-tono ~ ton-tono”	“sepi-sepi ~ sep-sepi ~ ses-sepi”
↓	
[ton-tono ~ tot-tono]	[ses-sepi ~ sep-sepi]
↓	
Acquired grammar	
	<i>Phonetic pressure may induce monosyllabism</i>
	<i>Coda consonants may be misperceived</i>
	<i>Choice of [ses-sepi] as default creates a grammar that requires C_1VC_1: Lg A resolves to Chuukic</i> <i>CODACOND, ALL-σ-RIGHT, DEP-BR » MAX-BR</i>

I include variant *ses-sepi* as an ambient variant for the caregiver, given the substantive account of CODACONDITION just outlined, which suggests it would seem that this is a reasonable competitor. Its presence in the set of ambient forms would only increase its chances of being chosen as the learner's default form.

The result of the distinction between (39) and (40) is that we now have two different constraint rankings, a Chuukic one and a Pohnpeic one. The contrast between the two groups is more than a single constraint ranking, but the acknowledgement of the steps in transmission offer an account of why we see exactly these distinctions and not any others.

Let us return to our hypothetical non-languages. Language A was to allow C_1VC_2 prefixes in homorganic but non-identical situations, as in *ton-tono*, but C_1VC_1 in non-homorganic sequences, as in *ses-sepe*. We do not expect this language to come about because as soon as the learner has enough evidence to suggest *ses-sepe* is the default form, she ends up with a grammar that values identical geminates over base-maximization. The same system will thus predict *tot-tono* over *ton-tono*.

Meanwhile, Language B is the converse; it uses C_1VC_1 in homorganic cases, as in *tot-tono*, but C_1VC_2 prefixes in non-homorganic sequences, as in *sepe-sepe*. This language is less unexpected, and in fact, Mokilese has a few forms that mirror *tot-tono*, as in *did-dilip* (rather than *dil-dilip*). Moreover, in 6.2 I argue that the pre-consonantal moraic position can be (and has been) reinterpreted alternately as vowel, sonorant, or obstruent in Pingilapese, Pohnpeian, and Mokilese. Even so, there will not be evidence from *sepe-sepe* to suggest to the learner that leftward gemination is a default strategy. Moreover, the sonority of the moraic *n* in *ton-tono* increases its loudness and decreases its chances of being heard as *tot-tono*.

Therefore we have an account of the gaps in Table (38), and we have done so without restricting the ranking permutability of Optimality Theory. Instead, the Confluence model has given us an explanation for the attested manner of divergence using extra-grammatical explanation. In the next several chapters, I investigate individual phenomena of Micronesian languages that lie outside the Chuukic-Pohnpeic subgroup. Each offers additional support for the Confluence hypothesis.

10. On the Marshallese instantiation of initial gemination

10.1 *Marshallese*

Marshallese is a Micronesian language spoken in the Marshall Islands of the western equatorial Pacific Ocean. This chain of islands is northeast of the Caroline Islands, which are home to the Chuukic and Pohnpeic continua. Together, the languages of those continua and Marshallese form a Micronesian subgroup that excludes only Kosraean and Gilbertese. In this chapter, I discuss the Marshallese reduplicative paradigm, with special reference to the way it differs from the Chuukic-Pohnpeic subgroup. I argue that the instantiation of Marshallese's rendering of word-initial geminates represents additional evidence for the hypothesis of Confluence in phonology set out in Chapter 1.

Marshallese comprises two major dialects known as Ralik and Ratak, which correspond to two chains of the Marshall Islands. Bender (1969) and Abo et al (1976) discuss several features that distinguish the dialects, some of which are lexical. However, a strong phonological distinction is seen in how the dialects render the modern reflex of initial gemination—equivalent structures are allowed in Chuukic languages, while Pohnpeic languages require nasalization of the first member of the geminate.

Both Marshallese dialects avoid word-initial geminates, but use different strategies for doing so. The Ralik dialect preserves stem-initial geminates, but renders them non-initial with prothetic vowels. Complicatingly, this vowel is itself preceded by an epenthetic glide, as in *yebbel* 'lights on'. The Ratak avoids such avoids such *yVCC* structures and instead has sequences of identical onset consonants separated by a vowel, as in *bebel* 'lights on'. While I will refer to the dialects by name, I will also characterize Ratak as the *CV-* dialect and Ralik as the *yeC-* dialect for clarity.

In the following section, I address some preliminary issues of Marshallese phonology. I then provide a formal account of the realization of initial gemination in both dialects, with explicit reference to its role in the reduplicative paradigm. I conclude with a discussion of Confluence in the phonology of the two Marshallese dialects.

10.2 *Marshallese phonology*

In this section, I formalize some basic assumptions about the prosodic representation of Marshallese words. There are several aspects of Marshallese phonology that seem superficially unique among Micronesian languages, but a deeper look will show that its structure is not terribly different from that of Pohnpeian. Aside from issues of segment inventory, the major distinction of Marshallese is its lack of long vowels. What historically were long vowels are realized as two short vowels separated with a glide, as in *jahal* 'observe' (c.f. Pohnpeian *taala* 'watch intently') and *pewek* 'sweep' (c.f. Mokilese *pook* 'sweep'). Some other cognates are also visible: Marshallese *biyin* 'smell of', *wahan* 'my canoe', *dahan* 'blood of' have correspondent forms in Mokilese *poon*, *waan*, and *insaan*. Thus, instead of allowing *CVC*, *CVVC*, and *CVCVC* stems, Marshallese collapses *CVVC* with *CVCVC* stems. We will see in Section 10.4 that this has an interesting interaction with other phenomena in the reduplicative suffixing pattern.

A second issue is the moraicity of consonants. A first glance at Marshallese transcriptions suggests a fairly free distribution of consonants in both medial and final coda positions, as in *beq-beq* ‘sand’ and *kad-kad* ‘throw’. However, Bender (1969: 60) describes a pattern of vowel excrescence that separates medial non-homorganic CC sequences; adjacent consonants are tolerated if they are identical (i.e., geminates, as in *jimettan*, *haddiy* etc.) or ‘closely related ones’ (i.e., homorganic, as in *winteh*, *tiyjem^hah*). This is suggestive of a restriction on place specification of medial coda consonants.

Since the same restriction does not apply to final consonants, I propose that Marshallese requires medial codas to be moraic, and that all moraic consonants must be placed-sharing. These requirements are formalized as WEIGHT-BY-POSITION and CODACONDITION in (1). Note that these constraints are formally identical to principles of the same names in other chapters.

- (1) WEIGHT-BY-POSITION Coda Consonants are moraic.
 CODACONDITION Moraic consonants with unique [+place] are forbidden.

The ranking of CODACONDITION over WEIGHT-BY-POSITION will ensure first that a form like *beq-beq* cannot have either of its coda consonants moraic. The optimal form is one in which the medial coda is avoided through epenthesis, but the final coda remains non-moraic. I summarize this in Tableau (2).

(2)	beqbeq	CODA CONDITION	WEIGHT-BY- POSITION
a.	μμ μμ (beq)(beq)	qq!	
b.	μ μ (beq)(beq)		qq!
c.	☞ μ μ μ (beqi)(beq)		q

A last candidate, **beqi-beqi*, will be avoided on account of having a final vowel, counter to the formalization of FREE-VOWEL from previous chapters, which I consider Marshallese to observe. In the remainder of this chapter I will not express medial excrescent vowels; however, I will consider non-final CVC sequences like the first in *beq-beq* to be bimoraic on account of the interaction illustrated above. More crucially, final consonants will always be considered non-moraic.

10.3 Marshallese reduplication

Bender (1969) introduces two reduplicative patterns for Marshallese: a syllable suffix, and a second pattern of initial gemination which he describes as an extension for suffixed forms, deriving distributive forms. I provide examples of suffixed forms in

Tables (3) and (4); note that the suffixed form tends to have an intransitive meaning. In Table (3), the pattern is transparent: CVC forms reduplicate fully, as in *beq-beq* ‘sandy’, while CVCVC forms reduplicate the final CVC, as in *tebal-bal* ‘crawl’. Note that the vowel *e* is a lower mid vowel.

(3) Marshallese suffixed forms

<i>Stem</i>	<i>gloss</i>	<i>suffixed</i>	<i>gloss</i>
beq	<i>sand</i>	beq-beq	<i>be sandy</i>
bil	<i>launching</i>	bil-bil	<i>sail model canoes</i>
kad	<i>throw (tr)</i>	kad-kad	<i>throw (intr)</i>
mey	<i>chew (tr)</i>	mey-mey	<i>chew (intr)</i>
til	<i>torch</i>	til-til	<i>burn</i>
yil	<i>blisters</i>	yil-yil	<i>blisters (dist)</i>
biteŋ	<i>mattress</i>	biteŋ-teŋ	<i>sleep on mattress</i>
deyel	<i>fan, use a fan (tr)</i>	deyel-yel	<i>fan, use a fan (intr)</i>
jehet	<i>wear a shirt (tr)</i>	jehet-het	<i>wear a shirt (intr)</i>
kahar	<i>drive a car (tr)</i>	kahar-har	<i>drive a car (intr)</i>
kiwij	<i>smell of cats (tr)</i>	kiwij-wij	<i>smell of cats (intr)</i>
m ^w eney	<i>that house</i>	m ^w eney-ney	<i>that house</i>
tebal	<i>crawl (tr)</i>	tebal-bal	<i>crawl (intr)</i>

(4) Marshallese suffixed forms, with thematic consonants

<i>Stem</i>	<i>Gloss</i>	<i>UR</i>	<i>Suffixed</i>	<i>Gloss</i>
bewej	<i>assemble (tr)</i>	bewe	bew-bew	<i>assemble (intr)</i>
daney	<i>watery, slimy (tr)</i>	dane	dan-dan	<i>watery, slimy (intr)</i>
dapij	<i>hold up, grip (tr)</i>	dapi	dap-dəp	<i>hold up, grip (intr)</i>
jibey	<i>seize (tr)</i>	jəbe	jəb-jəb	<i>seize (intr)</i>
jaleŋ	<i>roll up (tr)</i>	jale	jal-jəl	<i>roll up (intr)</i>
ŋarij	<i>bite the dust (tr)</i>	ŋari	ŋar-ŋar	<i>bite the dust (intr)</i>
ŋatey	<i>unable to stomach (tr)</i>	ŋate	ŋat-ŋat	<i>unable to stomach (intr)</i>
pewek	<i>sweep (tr)</i>	pewe	pew-pew	<i>sweep (intr)</i>
yidey	<i>to sting (tr)</i>	yide	yid-yid	<i>to sting (intr)</i>
bahatey	<i>smoke (tr)</i>	bahate	bahat-hat	<i>smoke, steam</i>
jekadey	<i>scattered (tr)</i>	jekade	jekad-kad	<i>scattered (intr)</i>
kaleher	<i>wounded (tr)</i>	kalehe	kaleh-leh	<i>wounded (intr)</i>
paleŋeŋ	<i>married (tr)</i>	paleŋe	paleŋ-leŋ	<i>married (intr)</i>
pirekey	<i>braid (tr)</i>	pireke	pirek-rek	<i>braid (intr)</i>

The forms in Table (4) require some clarification. When unreduplicated, each stem has other suffixal material that is absent from the reduplicated forms. For example, the sequence *ey* of *daney* ‘watery’ and *bahatey* ‘smoke’ is absent from the reduplicated forms *dan-dan* and *bahat-hat*. I leave it an open question for now whether the last

vowel, as in *daney*, is part of the stem, but suggest in Section 10.4 that it is. Regardless, the final consonant of the unreduplicated forms in Table (4) are drawn from a restricted set, either *y*, *j*, or *k*, with one instance of *r*, as in *kaleher*. There is a parallel to these final consonants in the Chuukic and Pohnpeic languages, in which denotative suffixes do not reflect the thematic consonants of unreduplicated forms. With this in mind, I also provide the likely underlying representation of each root, from which the reduplicated forms are derived.

The second pattern is one that combines the suffixing pattern with gemination of the initial consonant, as in *mmayal-yal* ‘smell of iron’ and *ppal-pal* ‘flutter’. Note that these geminates are only transcribed as such, essentially to provide a uniform orthographic convention across the Ratak and Ralik dialects. In fact, the geminates are separated by inserted vowels in Ratak, as in *me-mayal-yal*, and preceded by inserted vowels in Ralik, as in *yem-mayal-yal*. Thus, in Table (5) I provide transcriptions that accurately reflect both patterns.

(5)	Marshallese distributives				
	<i>Stem</i>	<i>Gloss</i>	<i>Ratak</i>	<i>Ralik</i>	<i>Gloss</i>
	kaj	<i>bump</i>	kekajkaj	yekajkaj	<i>bumpy</i>
	bahyid	<i>smoking pipe</i>	bebahyidyid	yebbahyidyid	<i>smell of smoke</i>
	berew	<i>throat, heart</i>	beberewrew	yebberewrew	<i>fickle</i>
	biriy	<i>uvula</i>	bibriyriy	yibbiryriy	<i>desire food</i>
	biqen	<i>chunk</i>	bibiqenqen	yibbiqenqen	<i>chunk (distr)</i>
	jewek	<i>shy</i>	jejewekwek	yejjewekwek	<i>always ashamed</i>
	mayal	<i>axe</i>	memayalyal	yemmayalyal	<i>smell of iron</i>
	pal	<i>flutter, wave (tr)</i>	pepalpal	yeppalpal	<i>flutter (intr)</i>
	ijen	<i>to catch</i>	jejenjen	yejjjenjen	<i>pick off one by one</i>
		<i>sleeping birds</i>			

It would be a morphological oddity that a particular reduplicative affix would require an exponent at both edges of the stem. However, it appears that derived gemination can occur without suffixation, as the forms in Table (6) show. These forms show the same distinction as those in Table (5); namely, that Ratak derives a CV- element while Ralik derives a yVC- element.

I therefore claim that there are two reduplicative morphemes in Marshallese: one that results in initial gemination and another that uses suffixation. The distributive forms in Table (5) receive their interpretation by virtue of carrying both morphemes. Some empirical evidence can be found in the stem *kaj* ‘bump’, which has all three possible derived forms: *kaj-kaj* ‘be shaken’, *kkaj* ‘bumpy’, and distributive *kkaj-kaj*. Marshallese can thus be characterized as allowing right-side and left-side reduplication, like its cousins in the Chuukic-Pohnpeic group. However, Marshallese lacks a cognate (in both a semantic and phonological sense) of the Chuukic-Pohnpeic bimoraic habitual prefix. In the next section, I offer a formal account of the Marshallese patterns.

- (6) Non-suffixed forms with derived initial geminates.

<i>Stem</i>	<i>Gloss</i>	<i>Ratak</i>	<i>Ralik</i>	<i>Gloss</i>
bat	<i>slow</i>	bebat	yebbat	<i>late</i>
bəl	<i>bloom</i>	bəbəl	yəbbəl	<i>blossom, bloom</i>
bəwəl	<i>filled up</i>	bebewel	yebbewel	<i>swollen</i>
bek	<i>take, carry (tr)</i>	bəbək	yebbək	<i>take</i>
dapij	<i>tr</i>	dedap	yeddap	<i>cling to, stick to</i>
dəbdəb	<i>spear</i>	dədəb	yədəb	<i>husk</i>
dewer	<i>tr</i>	dedewer	yeddewer	<i>put down, leave</i>
diyil	<i>fishing method</i>	didiyil	yiddiyil	<i>variant</i>
jakey	<i>tr</i>	jejahak	yejjahak	<i>pass s.t. to s.o.</i>
jayal		jejajal	yejjayal	<i>observe</i>
jiped	<i>tr</i>	jijped	yijjiped	<i>run over</i>
kahal	<i>tr</i>	kekahal	yekkahal	<i>entice</i>
m ^w ət	<i>plunge, of canoe</i>	məm ^w ət	yəmm ^w ət	<i>pitch, of a boat</i>
rawaj	<i>tr</i>	rerawaj	yerrawaj	<i>goad</i>

10.4 A formal account

The suffixing pattern can easily be seen to work exactly as the denotative suffix of the Pohnpeic and Eastern Chuukic groups. Because of the non-moraic nature of final consonants, the suffixed element is monomoraic. We can attribute this limitation to an effect of foot structure. The constraint ALLFEETRIGHT pressures prosodic structure to the right, enough to motivate violations of FOOTBINARITY in the final foot.

- (7) ALLFEETRIGHT Align the right edge of every foot to the right edge of some word.
- FOOTBINARITY Feet are bimoraic.

The rank of ALLFEETRIGHT over FOOTBINARITY will keep the prefix to a single mora in length, as the following tableaux will show. For the suffixed form of *beq*, the final foot of the optimal form (*beq*)-(beq) is monomoraic, since its final consonant is extrametrical. Though this violates FOOTBINARITY, any attempt at satisfying the constraint, as in *(*beq*)-(beqe) or *(*beq*)-(beweq), will incur an additional violation of ALLFEETRIGHT, since the initial foot in such forms is two moras away from the right edge. Tableau (8) provides a summary.

(8)	beq + RED	ALLFEETRIGHT	FOOTBINARITY
a.	\mathcal{F} (beq)-(beq)	*	*
b.	(beq)-(beqe)	**!	
c.	(beq)-(beweq)	**!	

This constraint ranking applies similarly to longer stems like *biteŋ* ‘mattress’, but an additional formalization is necessary. To prevent full copy in such cases, it is necessary to acknowledge a formal requirement of base-reduplicant maximization, and rank it below ALLFEETRIGHT. I formalize MAX-BR in (9).

- (9) MAX-BR Every segment in the base has a correspondent in the reduplicant.

As long as ALLFEETRIGHT outranks MAX-BR, full copy is avoided, since a reduplicant with more than one moraic segment would necessarily incur more violations of ALLFEETRIGHT than what the optimal *biteŋ-teŋ* incurs. I illustrate this in Tableau (10).

(10)	biteŋ + RED	ALLFEETRIGHT	FOOTBINARITY	MAX-BR
a.	 bi(teŋ)-(teŋ)	*	*	bi
b.	bi(teŋ)-(biteŋ)	**!		
c.	(bite)(ŋi- bi)(teŋ)	***!	*	

10.4.1 Deleted stem vowels

Before moving on to the gemination pattern, I will treat the subset of forms in Table (4), which are notable by the thematic consonants that are not reflected in the reduplicated forms. For example, *daney* reduplicates as *dan-dan*, suggesting that the *y* is a transitive marker that is not included in the reduplicated form. However, the morphological affiliation of the vowel *e* is less obvious.

In other Micronesian languages with a similar phenomenon, the vowel that precedes the thematic consonant is clearly part of the stem. For example, in Mokilese the form *pilɔd* ‘pick something’ reduplicates as *pile-pil*. The argument is that *pilɔd* is composed of a stem *pilɔ* and thematic suffix *d*. When the stem is reduplicated, the thematic suffix is not part of the complex word, so *pilɔ* reduplicates without the *d* suffix—but the stem-final vowel remains in this form, fronting to *e* in *pile-pil*. The reduplicated form is subject to stem-final lenition, which prevents the final vowel from being realized in the suffix. Stem-final vowel lenition is attributed in Mokilese and elsewhere to the constraint FREE-VOWEL.

- (11) FREE-VOWEL The vowel following the primary stress is not voiced.

In most Micronesian languages, satisfaction of FREE-VOWEL is actually met by the deletion of final short vowels and shortening of final long vowels. Throughout the Chuukic and Pohnpeic languages, FREE-VOWEL applies categorically to the right edge of any word, derived or not. Further, most of these languages satisfy FREE-VOWEL by deletion of the post-tonic vowel rather than devoicing. Thus, if a stem is unsuffixed, its final vowel will be deleted, but any suffix preserves the stem-final vowel. For example,

in Pohnpeian *pika* ‘sand’ surfaces as *piik* when unsuffixed but *pikan* ‘sand of’ and *pika-pik* ‘sandy’; the stem-final *a* is preserved wherever it is followed by a suffix.

Marshallese pairs like *daney* and *dan-dan* offer an interesting contrast, for if the stem is underlyingly *dane*, it is odd that the final vowel deletes even when it is followed by a suffix. It is possible to portray this as the overapplication of FREE-VOWEL, as Tableau (12) illustrates.

(12)	dane + RED	FREE-VOWEL	MAX-BR
a.	☞ dan- dan		
b.	dane- dan		e!
c.	dane- dane	*!	

In general, this system will predict any CVCV to reduplicate as CVC-CVC, not separated by any vowel except an excrescent one. However, rather than leave the base-minimizing device to MAX-BR, I will propose that the deletion of stem-final *e* in *dan-dan* is indicative of a more global phenomenon of size restriction. In other words, the constraint ALL- σ -RIGHT is ranked high enough to motivate deletion of stem vowels, insofar as syllable and moraic structure will allow it.

(13) ALL- σ -RIGHT All Syllables are final.

Ranked over MAX-VOWEL-IO, ALL- σ -RIGHT will motivate deletion of vowels under some circumstances. It will not, however, truncate disyllables like *biteŋ* to monosyllables, since no internal vowel deletion could produce a well-formed monosyllable. Similarly, ALL- σ -RIGHT will not shorten longer forms like *biteŋ-teŋ* for the same reasons.

(14)	biteŋ + RED	ALLFEET RIGHT	FOOT BINARITY	*COMPLEX	ALL- σ RIGHT	MAX-V IO
a.	(bteŋ)-(teŋ)			**!	*	ee
b.	☞ bi(teŋ)-(teŋ)	*	*		**	iee
c.	bi(teŋ)-(biteŋ)	**!			***	ieie
d.	(bite)(ŋi- bi)(teŋ)	****!	*		****	ieie

As we will see in the following section, this approach will offer a similar account of the loss of stem vowels in a subset of Ratak initial antigeminates.

10.5 Reflexes of initial gemination

The Ratak and Ralik dialects differ in their instantiation of initial gemination. In Ratak, initial geminates are avoided by splitting the geminate with a vowel, as in *bebat* ‘late’. Ralik preserves the geminate in such forms, but precedes it with a glide-vowel sequence, as in *yebbat*. Moreover, medial gemination is allowed in both dialects, so the

Ratak CV- dialect will not follow simply from a global ban on moraic consonants. Instead, what is crucial is that the only geminates to be avoided—in either dialect—are word-initial.

Recall that in Woleaian and Chuukese, initial geminates are represented as moraic onsets. In other words, they differ from medial geminates by virtue of not associating to the coda position of a syllable. To formalize this distinction, I propose the constraint POSITION-BY-WEIGHT, which makes use of the moraic and coda positions.

(15) POSITION-BY-WEIGHT Moraic consonants are codas (i.e., syllable-final).

This constraint is the converse of WEIGHT-BY-POSITION, which is violated by any coda consonant that is not moraic. POSITION-BY-WEIGHT is violated by any moraic consonant that is not in a coda position. I propose that POSITION-BY-WEIGHT is inviolable in both Marshallese dialects, but its satisfaction is met at the expense of different constraints in each dialect.

(16)	RED + bat	POSITION-BY-WEIGHT
a.	bbat	*!
b.	bebat	
c.	yebbat	

We are now in a position to establish a means of distinguishing the two dialects. Note that the Ralik dialect form contains a geminate while the Ratak form does not. We can forbid this geminate in Ratak by appealing to NOCODA.

(17) NOCODA Moraic consonants are forbidden.

The inclusion of NOCODA prevents the geminate from appearing, as the following tableau shows. Note that this system still allows medial geminates, a point to which I return shortly. Note also that the final *t* of each candidate satisfies NOCODA, since it is non-moraic in each form; the non-moraicity of final consonants is discussed in Section 10.2.

(18)	RED + bat RATAK	POSITION-BY-WEIGHT	NOCODA
a.	bbat	*!	
b.	↵ bebat		
c.	yebbat		*!

Now the challenge is to account for the Ralik dialect; what, indeed, would be needed to force the integrity of the geminate? I propose that the internal insertion pattern exemplified by *bebat* is motivated by the Obligatory Contour Principle (Leben 1973,

Goldsmith 1976, Odden 1993, Suzuki 1997). In particular, I will claim that the Ralik dialect avoids sequences of identical consonants, and that this effect emerges only in the context of initial gemination. I provide a formal definition in (19) below; following Suzuki (1997), this constraint is an instantiation of the OCP over consonant-place features.

(19) OCP-C-PLACE Sequences of identical consonants are forbidden.

The effect of OCP-C-PLACE is to disprefer forms like the initial *beba-* sequence in *bebat*; even though the two *b*'s are separated by a vowel, there is no intervening consonantal place feature, so they violate OCP-C-PLACE. When the OCP outranks NOCODA, as is the case for the Ralik (*yeC-*) dialect, the proper geminate form is chosen over the non-geminated form, as Tableau (20) shows. The geminate in forms like *yebbat* (even if given a two-root representation) satisfies the OCP since it has a single place feature, whereas the two consonants in *bebat* each have their own.

(20)	RED + bat RALIK	POSITION-BY- WEIGHT	OCP C-PLACE	NOCODA
a.	bbat	*!		
b.	bebat		*!	
c.	☞ yebbat			*

The opposite rank, NOCODA over OCP-C-PLACE, will predict the Ratak pattern. The higher rank of NOCODA rules out the moraic association of the *b* in *yebbat*; thus, despite its violation of the OCP, *bebat* emerges instead. Tableau (21) illustrates.

(21)	RED + bat RATAK	POSITION-BY- WEIGHT	NOCODA	OCP C-PLACE
a.	bbat	*!		
b.	☞ bebat			*
c.	yebbat		*!	

10.5.1 More deleted stem vowels

A subset of Ratak forms requires additional explanation. Several forms lose their first stem vowel when prefixed. For example, with *jiped*, although we would expect *jijiped*, the form is cited as *jiped*. In fact, this occurs wherever the stem is CVCVC and the medial consonant is not a glide; thus, for *beṛew*, *biri*, and *bitik*, the result is *beṛewṛew*, *bibriyriy*, and *bibtiktik*. As I suggest in Section 10.4.1, this subpattern follows from the activity of ALL-σ-RIGHT, as Tableau (22) shows. Too much deletion of vowels results in poorly-structured forms like **jijpd*, but the deletion of the middle vowel is acceptable, yielding *jiped*.

(22)	RED + jiped RATAK	CODACONDITION	ALL- σ -RIGHT
a.	ji.ji.ped		**!
b.	jij.ped		*
c.	jijpd	*!	

Nevertheless, this subpattern may be completely misleading. Given what Bender says about medial consonant sequences, the form *jiped* will receive a medial excrescent vowel anyway, since *j* and *p* are not homorganic. Thus, *jijped* may be a more accurate representation. Its middle vowel is left out of transcriptions because it is indistinguishable from an excrescent vowel.

10.5.2 Alternative accounts

There are several advantages that the OCP approach has over alternative accounts, such as that provided by Hendricks (1999), using the Compression model of size restriction. The Compression model uses alignment of stems and affixes to force minimal elements to be copied at word edges. Thus, under Compression, the consonant-sized reduplicant in Marshallese is motivated not by a constraint RED=C, but the pressure of ALIGN-ROOT-LEFT, as defined in (23). Hendricks argues that the Marshallese dialect difference is a function of a conflict between Root-alignment and input-output dependence, formalized as DEP-IO.

- (23) DEP-IO Every segment in the output has a correspondent in the input.
- ALIGN-ROOT-LEFT The left edge of the root is aligned to the left edge of the word.

A crucial assumption in Hendrick's approach is that Ralik forms like *yebbat* produce a single violation ALIGN-ROOT-LEFT. In other words, the constraint requires that the leftmost segment in the root be the leftmost *morphological* segment in the form. Thus, the initial *ye-* is invisible to the constraint, and only the initial *b* stands between the root and the left edge. In contrast, the Ratak form violates ALIGN-ROOT-LEFT twice, even though one of the segments that intervenes between the left word edge and the initial stem consonant is epenthetic.

In the Ratak dialect, Hendricks proposes that DEP-IO outranks ALIGN-ROOT-LEFT. As a consequence, the non-geminate form *bebat* is preferred, because it has one fewer epenthetic segments than *yebbat*, as Tableau (24) shows.¹

¹ In Hendricks's account, initial geminates are avoided with *CC rather than POSITION-BY-WEIGHT.

(24)	RED + bat RATAK	POSITION-BY- WEIGHT	DEP-IO	ALIGN-ROOT- LEFT
a.	b _{RT} [bat]	*!		*
b.	^ɸ be _{RT} [bat]		e	**
c.	yeb _{RT} [bat]		ye!	*

The opposite rank for Ralik predicts the geminate form *yebbat* to appear, because the specific interpretation of ALIGN-ROOT-LEFT considers the root to be better aligned to the left in *yebbat* than it is in *bebat*, which has one fewer epenthetic segment. I show this in Tableau (25).

(25)	RED + bat RALIK	POSITION-BY- WEIGHT	ALIGN-ROOT- LEFT	DEP-IO
a.	b _{RT} [bat]	*!	*	
b.	be _{RT} [bat]		**!	e
c.	^ɸ yeb _{RT} [bat]		*	ye

While this may seem simple enough, the Compression approach is hindered by the problem that not all initial geminates are derived in Marshallese. I provide a list of examples in Table (26); none of these is derived from an ungeminated form. Crucially, this set of forms shows the same dialect difference as derived geminates: Ratak employs antigemination, while Ralik inserts *yV* before the geminate.

(26) Marshallese underived initial geminates

Ratak	Ralik	gloss
kekal	yekkal	<i>build</i>
kekan	yekkan	<i>food</i>
qeqahad	yeqqahad	<i>fade away</i>
qeqal ^w	yeqqal ^w	<i>coconut sennit</i>
bebeyer	yebbeyer	<i>give up</i>
bebel	yebbel	<i>lights on</i>
lELAJ	yellaj	<i>melodious voice</i>
m ^w em ^w ewel	yemm ^w ewel	<i>to be thanked</i>
n ^w en ^w ek	yenn ^w ek	<i>sharp pain</i>
n ^w en ^w ewej	yenn ^w ewej	<i>hide, conceal</i>
teteŋ	yetten	<i>sleep soundly</i>

The problem for the Compression approach is that it capitalizes on the position of the morphological entity of the root. Let us consider the form *kkal* ‘build’, with no corresponding ungeminated stem. The two dialects realize this stem in different ways: it is *kekal* in Ratak and *yekkal* in Ralik.

These forms will have a morphological structure unlike the derived forms in Tableaux (24) and (25). Notably, because the geminate is underlying, the root boundary

will precede the first member of the geminate rather than fall between them. In other words, where above we had an opposition of *be[bat* and *yeb[bat*, now we have an opposition of *[kekal* and *ye[kkal*.

In both *kekal* and *yekkal*, ALIGN-ROOT-LEFT is fully satisfied, because of its specific interpretation. The left edge of the root in both forms is also the leftmost morphological segment. As a result, the Compression analysis correctly predicts *kekal* in the Ratak dialect, as I show in Tableau (27).

(27)	kkal RATAK	POSITION-BY-WEIGHT	DEP-IO	ALIGN-ROOT-LEFT
a.	_{RT} [kkal	*!		
b.	_{RT} [kekal		e	
c.	ye _{RT} [kkal		ye!	

Critically, however, the opposite ranking predicts the same form for the Ralik dialect, only because each form fully satisfies ALIGN-ROOT-LEFT, in which case, DEP-IO can emerge and still incorrectly choose **kekal* over *yekkal* for Ralik. I summarize this effect in Tableau (28).

(28)	kkal RALIK	POSITION-BY-WEIGHT	ALIGN-ROOT-LEFT	DEP-IO
a.	_{RT} [kkal	*!		
b.	_{RT} [kekal			e
c.	ye _{RT} [kkal			ye!

A means of resolving this is proposed by Suh (1997), who argues that the distinction between the Ralik and Ratak patterns is a function of multiple correspondence. In other words, the input form *kkal* begins with a single segment linked to a mora to represent its length. The output candidate **kekal* is ruled out in Ralik because it violates INTEGRITY, defined in (29).

(29) INTEGRITY Every input segment has a single output correspondent.

In Ralik, INTEGRITY is ranked above DEP-IO, and as a result, the form *yekkal*, which satisfies INTEGRITY but violates DEP twice, is chosen over **kekal*, which has fewer DEP violations but violates INTEGRITY. I illustrate this in Tableau (30).

(30)	kkal RALIK	POSITION-BY-WEIGHT	INTEGRITY	ALIGN-ROOT-LEFT	DEP-IO
a.	_{RT} [kkal	*!			
b.	_{RT} [kekal		*		e
c.	ye _{RT} [kkal				ye!

The opposite rank holds for Ratak, and consequently, the opposite result obtains. With INTEGRITY ranked lower than DEP-IO, Ratak prefers *kekal*, which violates DEP once, to **yekkal*, which violates it twice. I summarize this in Tableau (31).

(31)	kkal RATAK	POSITION- BY-WEIGHT	DEP-IO	INTEGRITY	ALIGN-ROOT- LEFT
a.	_{RT} [kkal	*!			
b.	_{RT} [kekal		e	*	
c.	ye _{RT} [kkal		ye!		

Hendricks acknowledges that his account and Suh's are consistent, but that his ALIGN-ROOT approach handles only morphological (reduplicative) gemination, while Suh's INTEGRITY approach handles only phonological (lexically contrastive) gemination. A single constraint hierarchy can combine their accounts, but it is an observational curiosity that DEP-IO outranks both INTEGRITY and ALIGN-ROOT-LEFT in Ratak, but is outranked by each in Ralik.

In other words, the combined Hendricks-Suh model attributes a uniform surface pattern in each language to two formalisms. The Ralik maintenance of geminates through insertion of *yV-* is captured by two rankings: ALIGN-ROOT-LEFT » DEP-IO for derived forms and INTEGRITY » DEP-IO for underived ones. Conversely, the Ratak anti-gemination pattern is captured by the reversal of both rankings. It is a formal accident that the end result of resolving POSITION-BY-WEIGHT is internally uniform in each language.

The OCP approach avoids such a result because it treats both means of avoiding initial gemination as non-morphological effects, regardless of whether the potential geminates are derived or not. That is, the account portrays both dialects as treating underlying (underived) initial moraic consonants² the same as potentially derived ones. Thus, the avoidance of *b...b* sequences in Ralik has nothing to do with the position of the root, nor with multiple correspondence: it follows only from the rank of OCP over NOCODA. Likewise, the avoidance of geminates in Ratak has nothing to do with superfluous epenthesis, nor again with the position of the root: it follows only from the rank of NOCODA over OCP. Moreover, the OCP approach obviates the focused interpretation of ALIGN-ROOT-LEFT that the Compression approach requires.

10.6 Discussion: Marshallese and confluence

In the previous section, several aspects of Marshallese phonology emerge, each of which is germane to a discussion of phonological divergence within the Micronesian family. Notably, the rightward pressure of foot structure again appears, and as is the case for Pohnpeic and at least the Eastern Chuukic continuum, it is strong enough to allow monomoraic final feet. Two effects of moraic quantity, however, stand out in Marshallese: the lack of vowel length, and the avoidance of initial consonant gemination

² This effect is true regardless of whether the initial geminate is represented as an onset root linked to a mora or two roots that share a C-place node.

through several strategies. We now have the opportunity to draw on the findings of previous chapters, to show how the unique properties of Marshallese represent not random innovations, but relatively restricted mutations, as the Confluence hypothesis predicts.

It must first be pointed out that Marshallese is not unique in its respect for POSITION-BY-WEIGHT. Rather, the Chuukic subgroup is unique in its disrespect for the constraint, while Marshallese and the Pohnpeic languages respect it. Marshallese simply gives us additional means of discussing various ways of satisfying POSITION-BY-WEIGHT in the face of potential initial geminates. As the previous section argues, two strategies for avoiding such structures are the Ralik addition of an initial syllable, which provides a coda position for the otherwise offending geminate, and the Ratak use of anti-gemination, which avoids the moraic consonant of the geminate. The Pohnpeic subgroup shows a third strategy, nasalization of the geminate to an NC sequence, which allows the nasal to syllabify by itself and satisfy POSITION-BY-WEIGHT, as in Pohnpeian *mpek* ‘to look for lice’, *nda* ‘to say’, *ŋkɔl* ‘to make sennit’.

There are several possible historical sources of the Micronesian initial geminate and its variant alternatives. Bender (1971), Harrison (1973) and Goodenough (1980) agree that a syllable-reduplication pattern in an earlier stage – at least the precursor to Marshallese and Chuukic-Pohnpeic – was reduced through syncope to initial gemination, which then underwent several more innovations, notably nasalization in Pohnpeic and vowel insertion in Marshallese. I take no position on whether proto-gemination had syncope as its genesis, but do acknowledge that the Marshallese variants are cognate processes of Chuukic initial long consonants and Pohnpeic initial syllabic nasals.

What is interesting is that true initial geminates are widely avoided, through various means. Yet in Micronesian languages, length can signal a lexical contrast in the case of underlying initial geminates, or a grammatical contrast in the case of derived ones. In each language, the alternative to an initial geminate has segmental material with more sonority; this is certainly true of both Marshallese dialects, as well as the nasal-initial Pohnpeic forms. There thus seems to be a general strategy to preserve not simply some reflex of the historical geminate, but its quantity as well.

An additional concern is the nature of the sentential context of forms with initial geminates. Marshallese, like other Micronesian languages, allows all kinds of word-final codas. At least some of the time, initial geminates would be post-consonantal, which would increase the articulatory and perceptual pressure for the variant forms.

I argue that the tendency for languages to rank POSITION-BY-WEIGHT highly is an example of Confluence, as is the preservation of quantity inherent in each strategy of avoiding initial geminates. In the remainder of this section, I offer some conjecture as to how variant forms could have come to be preferred over true initial geminates.

It may be that speakers at some stage, consciously or not, produced variants of initial geminates that correspond to their modern reflexes: syllabic nasals, or epenthesized forms. Each of these variants could be motivated by both articulatory and perceptual concerns; in other words, it is difficult to find a natural reason to maintain a low rank of POSITION-BY-WEIGHT. Each variant seems to have occurred with enough frequency in some language to take over the role of default.

For example, the nasalization patterns seen in Pohnpeic reflexes of initial geminates have the articulatory advantage of helping the speaker maintain good moraic timing, especially since nasals allow for continual phonation and voicing despite oral closure. Abramson (1986, 1987) finds that speakers of Pattani Malay, a language with contrastive initial geminates, use closure duration as a primary cue for length contrasts. However, given the lower level of closure excitation in voiced and voiceless stops, Malay speakers differentiate the length contrast less reliably in stops than in nasals, liquids, and fricatives. Thus, quantity and rhythm is easier to perceive when associated to nasals because they are louder than obstruents. Moreover, nasalization of initial geminates allows for a clear sequence of two segments: a nasal followed by an obstruent. In other words, there is plenty of plausible grounding in the emergence of nasalization in pre-Pohnpeic as a variant of initial geminates.

Likewise, the pre-geminate epenthesis of Ralik Marshallese has similar plausible motivation in perception and articulation. In articulatory terms, long closure of an obstruent must be easier to hold stable and consistent between vowels than it would be following a consonant. The intervocalic environment makes similar ease for the perception of long closure: it is easier to hear long closure with vowels (loud things) on both sides than with relatively quiet consonants (or pauses) occurring before the geminate. Abramson's findings also confirm this, as do Kraehenmann *et al.* (2000) and Fulop (1996). In other words, there is also plausible grounding for pre-insertion as a variant of initial geminates.

Third, similar claims are possible for Ratak anti-geminates. For articulatory pressures, the maintenance of regular moraic rhythmic timing is easier with consecutive releases than with long initial closure. Likewise, the quantity associated with potential initial geminates is easier to perceive on the inserted anti-geminating vowel, while the duplicity of potential geminates is unambiguous when each member has its own vocalic release. Onset consonants tend to be perceived more accurately than codas (Wang & Bilger 1973, Boothroyd & Nitttrouer 1988, Benki 2002).

An apparent exception to the avoidance of initial geminates is seen in the Chuukic subgroup, which includes a wide range of languages, represented in this work only by Woleaian, Chuukese, and Puluwat. However, even these languages seem to show an effect of the pressures in the above table, but rather than use the phonological processes seen in other languages, Chuukic languages use a more abstract representation of initial length. Muller (1999) shows that initial geminates in Chuukese are distinct not so much by their length as by other articulatory features like burst frequency; even so, they behave as if they are long by helping satisfy minimal word requirements. Likewise, Woleaian initial geminates are cued in part by a change in manner for long variants of many segments: *l* as *nn*, *r* and *ʃ* as *cc*, *β* as *bb*, and *γ* as *kk*. Thus, hearing any of those segments initially will be a perceptual cue to its abstract moraic weight.

In summary, we can acknowledge two generalities: initial geminates are odd structures, and there are many ways of resolving such oddities. I summarize these pressures in Table (32)

(32) Reasons to prefer alternatives to initial geminates

<i>variant</i>	<i>articulatory advantage</i>	<i>perceptual advantage</i>
Pohnpeic nasalization	moraic rhythm/timing easier to associate to sonorant segments	quantity easier to perceive on sonorants; 2 segments easier to perceive if nasal-obstruent sequence
Ralik pre-geminate epenthesis	long closure easier to hold stable between vowels	long closure easier to perceive between vowels
Ratak anti-geminates	moraic rhythm/timing easier with consecutive releases than with long initial consonant	quantity easier to perceive on vowel; double consonants easier to perceive with two releases
Chuukic manner features		manner change cues underlying length

Each articulatory variant of an initial geminate, be it *mpek*, *pepek*, or *yeppek*, has a reasonable phonetic motivation. Crucially, however, none of these languages resolves initial geminates by neutralizing the length contrast in initial position: there is no **pek*. In other words, every strategy preserves the recoverability of the long initial segment, and with the sole exception of Chuukic languages, the strategy is also a structure that is not as articulatorily and perceptually marked as an initial geminate.

The Confluence model predicts that the articulatory and perceptual advantages of the attested variants make them likely to emerge as formally innovations. Furthermore, although the neutralized variant **pek* is also less structurally marked, the model accounts for the absence of such an innovation in any of the Western Micronesian languages. The incorporation of the Cognitive Counterbalance as a feedback loop checking for recoverability of lexical items accomplishes this: the neutralization of initial length is prevented by Cognitive Counterbalance, since the resulting loss of lexical recovery is too much of an expense. In contrast, Cognitive Counterbalance allows the other attested variants, since they all preserve the initial length distinction at the same time as incorporating a less-marked structure. In figure (33) I apply the Confluence mechanism to the transmission of forms with initial gemination. Here we see how the model allows variation, but the players involved avoid the neutralized form **pek*.

(33) Acquisition of initial geminate variants in proto-Western Micronesian

Source grammar: /ppek/	
↓	
“ppek ~ mpek ~ pepep yeppek ~ pek ~ etc.”	<i>Cognitive Counterbalance wants to maintain length distinction: thus the speaker avoids /ppek/ → [pek]</i>
↓	
[ppek ~ mpek ~ pepep yeppek ~ pek ~ etc.]	<i>Many variants are possible, and learner chooses one as default. Learner avoids choosing [pek] based on contextual clues (Cog. Counterbalance)</i>
↓	
Acquired grammar	<i>Learner creates grammar that formally requires the contrast-maintaining strategy, based on choice of default variant</i>

The model also offers a window into divergence among the modern members of the Western Micronesian group in their means of handling initial geminates. Because the learner settles on a single variant as a “default” form that her grammar is to prefer, variation among the ambient and perceived forms will ultimately resolve to an invariant system. Each attested descendent of proto-Western Micronesian represents a different path of choices in this process.

For example, a number of factors may have encouraged the rise in frequency of nasalized forms as output variants of initial geminates in Pohnpeic. First, the nasality and sonority may simply have been naturally driven strategies of maintaining length, and second, the caregiver-peer group may have tended to favour nasalization as a helpful way of preserving the length contrast. In addition, learners, figuring out that initial length can contrast lexical items, prefer nasalized items as their default forms, since they make the length contrast obvious. As a result, phonetic and cognitive pressure at both stages encourage a higher frequency of nasalized over other forms. As soon as a critical mass of learners in the Pohnpeic branch chose nasal variants as the default, they acquired grammars that made nasals the default instantiation of initial geminates, and thus share a formal innovation. I illustrate this sequence of events in Figure (34).

(34) Innovation of initial nasalization in Pohnpeic

Source grammar: /ppek/ ↓	
“ppek ~ mpek ~ pepek yeppek ~ pek ~ etc.” ↓	<i>Cognitive Counterbalance wants to maintain length distinction: speaker prefers /ppek/ → [mpek]</i>
[mpek ~ ppek ~ pepek pek ~ etc.] ↓	<i>[mpek] is frequent among perceived variants; Learner also prefers [mpek] anyway</i>
Acquired grammar	<i>Learner creates grammar that formally requires nasalization, thus innovating Pohnpeic system: POS × WGHT, *OBS/MORA, MAX-μ » IDENT-NAS, DEP</i>

A similar story is possible for the Marshallese dialects, but with different variants taking on default status. In the Marshallese case, phonetic and cognitive pressures encourage a higher frequency of prothesis or epenthesis on the part of the ambient system, as well as a preference by the learner to make such forms their defaults. Consequently, once a critical mass of learners all choose prothetic forms in Ralik, they share an innovative grammar that requires this strategy, and likewise for Ratak learners and epenthesis. I show this in Figure (35) for Ralik Marshallese.

(35) Innovation of prothesis in Ralik Marshallese

Source grammar: /bbek/ ↓	
“bbek ~ yebbek ~ mbek bebek ~ bek ~ etc.” ↓	<i>Cognitive Counterbalance wants to maintain length distinction: speaker prefers /bbek/ → [yebbek]</i>
[mbek ~ bbek ~ bebek bek ~ etc.] ↓	<i>[yebbek] is frequent among perceived variants; Learner also prefers [yebbek] anyway</i>
Acquired grammar	<i>Learner creates grammar that formally requires prothesis, thus innovating Ralik system: POS × WGHT, MAX-μ, DEP, OCP, IDENT-NAS » NOCODA, *OBS/MORA,</i>

One may ask why nasalization is particular to Pohnpeic, prothesis to Ralik, and epenthesis to Ratak, but I see this distinction as accidental. We need not be concerned with whether either of the Marshallese strategies are any more or less marked than the Pohnpeic one; simply that both are preferred over the basic initial geminate. Thus the model simply predicts that one of these variants will show up instead of basic initial gemination *and* instead of neutralization.

The prediction of Confluence is thus that languages will tend to avoid initial geminates, but will do so by introducing new articulatory variants rather than neutralizing length in initial position. As a consequence, there is no need to assign a likelihood of high ranking for POSITION-BY-WEIGHT and MAX- μ to account for the rarity of true initial geminates. The formal system thus need not encode the typological tendency: the high rank of POSITION-BY-WEIGHT across languages is a consequence of the nature of variation and learning.

Furthermore, with some creativity one could formalize a language that employs any of the strategies in (32), but for any initial segment, or for any geminate at all. Again, the theorist need not construct a model that disallows the typological prediction of languages with these traits. Instead, Confluence allows for the variants in (32) to be motivated directly by initial geminates, and thus, they are not as likely to arise as variants for any initial segment, or for any geminate.

In other words, the application of processes like nasalization or yV- insertion need not be restricted formally to initial geminates, as the restriction falls out of extra-theoretical motivating factors. Marshallese therefore adds support to the claims of Chapters 6 and 9 that Confluence offers an account for the restricted variation seen in the Micronesian family. In the following chapter, I pursue additional evidence in Kosraean.

11. The binarity effect and the two reduplicants of Kosraean

11.1 *Kosraean*

Kosraean, also known as Kusaiean (Lee 1975), is a Micronesian language spoken on the island of Kosrae, in the Eastern Carolines, as the map in §2.2 shows. As such it is geographically closest to the islands of Mokil and Pingilap, whose languages are members of the Pohnpeic sub-group, but in terms of the Micronesian language family, Kosraean is most peripheral: Jackson (1983) groups all other Micronesian languages (Marshallese, Gilbertese, and the Chuukic-Pohnpeic group) separately from Kosraean.

In this chapter, I describe and analyze the reduplicative affixes of Kosraean, drawing parallels with similar affixes in other Micronesian languages. Kosraean shows itself to be quite distinct in terms of how it reduplicates, which is consistent with its historical distance from the Chuukic and Pohnpeic languages. Even so, I will argue that it is essentially Micronesian in character, and its unique traits result from a rearrangement of constraints acknowledged in previous chapters.

I begin with a background on Kosraean phonology and introduce its two reduplicative morphemes. I then offer a theoretical account of the form of both morphemes, and conclude with a discussion of the constraint rankings that Kosraean has in common with other languages in the Micronesian family and those that make it unique. This discussion portrays Kosraean as further evidence for the Confluence hypothesis of Chapter 1.

11.2 *Kosraean phonology*

There are a number of phonological properties that distinguish Kosraean from its Micronesian relatives, particularly in its apparent tolerance of coda consonants, its lack of contrastive vowel length, and its stress pattern. In this section, I describe each of these aspects in detail—here and elsewhere I use a phonetic transcription instead of the Kosraean orthography in Lee’s grammar, which uses a great deal of vocalic and consonantal digraphs.

Kosraean seems to allow medial coda consonants to occur freely, which is shown most clearly in reduplicated forms like *ful-fule* ‘to twist little by little’, *kɪp-kɪpat* ‘to fall gradually’, and *tæf-tæfoŋ* ‘to make lots of mistakes’. I provide more forms with medial codas in Table (1); note that all codas in these forms result from derivational concatenation.

(1)	Kosraean coda consonants		
	kaɿ.kat	<i>a bird</i>	li.pɛ.roŋ.roŋ <i>sounds of waves</i>
	pək.pək	<i>sandy</i>	æk.fo.ko <i>make strong</i>
	laɿ.kæ.kɪn	<i>to pour out</i>	æk.mi.ni.ni <i>make thin</i>
	top.kɛ.kɪn	<i>to turn over</i>	ŋaɿ.ŋa.lis <i>to bite</i>
	loɿ.sæ.ki	<i>to stifle</i>	em.e.ma <i>to taste</i>

Lee makes no mention of any kind of excrescent vowel like Harrison (1976) does for Mokilese or Bender (1969) for Marshallese. This aspect of Kosraean is quite unlike the medial moraic consonants of Marshallese and the Pohnpeic languages, which require coda consonants to be place-linked, and the Chuukic languages, which require full identity between moraic consonants and the onsets that follow.

There is additional evidence for a Kosraean tolerance of coda consonants in a truncation pattern that affects derived verbs. I provide examples in Figure (2); the truncation pattern has the effect of reducing suffixed polysyllables to two syllables.

- (2) Verbal truncation for Kosraean suffixed polysyllables
- | | | | | | |
|----------------------------|------------------------------|-----------------------------|------------------|---|------------------|
| <i>sənak</i> _{RT} | + <i>ən</i> _{TRANS} | + <i>əl</i> _{3OBJ} | ‘to respect him’ | → | <i>sak.nəl</i> |
| <i>lɪpɛk</i> _{RT} | + <i>ən</i> _{TRANS} | + <i>əl</i> _{3OBJ} | ‘to hurl him’ | → | <i>lɛp.ŋəl</i> . |

An easy assumption is simply to posit a low rank of CODACONDITION, low enough so that Kosraean will violate it instead of inserting vowels or deleting consonants to satisfy it. I suggest an alternative which will be true of some reduplicated forms: that not all medial coda consonants are moraic, which means they satisfy CODACONDITION, but at the expense of WEIGHT-BY-POSITION as defined in (3):

- (3) WEIGHT-BY-POSITION Every coda consonant is associated to a mora.

WEIGHT-BY-POSITION is violated minimally elsewhere in the Micronesian family—in fact, only to satisfy FREE-VOWEL in final-deletion languages like Chuukese and Pohnpeian. Indeed, only extrametrical final consonants, a by-product of final-vowel deletion in such languages, defy WEIGHT-BY-POSITION. We will see in Section 11.3 that WEIGHT-BY-POSITION is violable to a greater extent in Kosraean; in other words, extrametricality is not limited to ultimate codas.

Moving to segment quantity, Kosraean is unique in the family in this aspect as well. Lee’s description suggests that any vowel can occur as a short or long vowel, but closer inspection of the data indicates that length, generally, is not contrastive. One exception is the high front vowel *i*; there is a minimal pair *sifɛ* ‘its head’ and *si:fɛ* ‘a fish’. All other vowels are always short in the initial syllable, and long otherwise, as the forms in Table (4) show. Because of this, I assume that all Kosraean vowels are phonologically monomoraic, except *i*, which may be bimoraic, but only in an initial syllable.

- (4)
- | | | | | | |
|----------------|-----------------|---------------|----------------|--------------|--------------|
| <i>nuku:m</i> | <i>to wear</i> | <i>lofo:ŋ</i> | <i>crazy</i> | <i>rɔtɔ:</i> | <i>west</i> |
| <i>fulu:s</i> | <i>to paste</i> | <i>toŋo:l</i> | <i>knock</i> | <i>səpə:</i> | <i>send</i> |
| <i>ene:nə:</i> | <i>need</i> | <i>soko:m</i> | <i>to wrap</i> | <i>kəsɔ:</i> | <i>sharp</i> |
| <i>epa:ŋ</i> | <i>south</i> | | | | |

The stress pattern in Kosraean is also somewhat unique among Micronesian languages. Lee’s generalization is that primary stress occurs on the penultimate syllable, with secondary stress on the antepenult. Like Gilbertese and the Chuukic and Pohnpeic

languages, then, primary stress occurs at the right edge of words. However, Kosraean seems to build feet from syllables, and not strictly from moras, for there is no indication that either the weight of syllables or the number of moras affects the distribution of stress. For example, forms like *mise-se* ‘frayed’ and *mutul-tul* ‘to blink’ will be stressed as *fisé-se* and *mùtúl-tul*, even though they may have different numbers of moras, given the presence of coda consonants in *mutul-tul*. Nevertheless, I will build an analysis of Kosraean in which Foot Binarity is measured by moras and not syllables. I return to this in Section 11.3; before doing so I describe the Kosraean reduplicative paradigm in greater detail below.

11.2.1 Data and generalizations

In this section, I will show that a potentially complicated pattern of reduplication in Kosraean is simply a function of two different affixes (or ‘duplemes’, to borrow a term from Spaelti 1997): a prefix and a suffix, the shape variants of which are predictable from the shape of the stem. Lee classifies reduplicated forms into three groups: initial reduplication, as in *fo-foʃ* ‘to smoke’ and *fur-furok* ‘to turn again and again’, total reduplication, as in *sa-sa* ‘to shout and shout’ and *yot-yot* ‘lots of stones’, and final reduplication, as in *mutul-tul* ‘to blink’ and *mise-se* ‘frayed’. I reduce this to two patterns by considering all total reduplication to be either prefixing or suffixing. This claim is based partly on the meanings of reduplicated forms; there are basically two functions: a prefix with an iterative sense of ‘little by little’ or ‘gradually’, and a suffix with a more adjectival effect, deriving meanings like ‘lots of’ or ‘covered with’.

In addition, as we will see below, the prefix/suffix distinction makes sense of a split among monosyllabic stems: CVC stems reduplicate as *fo-foʃ* or *pək-pək*; the generalization is that the former are prefixed and the latter are suffixed. There is a parallel in vowel initial forms, which reduplicate either fully, as in *ek-ek*, or with an intrusive glide, as in *af-yaf*. Again, this distinction is a predictable one if we assume that the former is prefixed and the latter is suffixed.

I provide additional examples of each subpattern in the following tables. First, in table (5), we see that initial reduplication adds a CV string to monosyllabic stems and to stems with vowels in hiatus. Disyllabic stems receive a CVC prefix.

(5)	Initial reduplication			
	foʃ	<i>smoke</i>	fo -foʃ	<i>to smoke</i>
	kæɭ	<i>to touch</i>	kæ -kæɭ	<i>to touch repeatedly</i>
	loŋ	<i>to step</i>	lo -loŋ	<i>to step repeatedly</i>
	fiyɔ	<i>sweat</i>	fi -fiyɔ	<i>sweating</i>
	fiyɛ	<i>to turn grey</i>	fi -fiyɛ	<i>to turn grey</i>
	fuon	<i>shy</i>	fu -fuon	
	moul	<i>alive</i>	mo -moul	<i>not completely dead</i>
	foul	<i>smell</i>	fo -foul	<i>to emit smell</i>

tæfoŋ	<i>to mistake</i>	tæf -tæfoŋ	<i>to make lots of mistakes</i>
furok	<i>to turn</i>	fur -furok	<i>to turn again and again</i>
fule	<i>to wring</i>	ful -fule	<i>to twist little by little</i>
mɪsɛ	<i>to be frayed</i>	mɪs -mɪsɛ	<i>being frayed</i>

Two disyllabic forms without obvious hiatus unexpectedly receive a CV prefix: *fɪ*-fiyɔ and *fɪ*-fiyɛ. However, given that they both have a high vowel followed by a medial y, and that length is not actually reflected in Lee's transcription, I propose that these are actually *fii*-fiyɔ and *fii*-fiyɛ (or *fiy*-fiyɔ and *fiy*-fiyɛ), where the long vowel reflects the *iy* sequence of the base. This is consistent with the generalization that only high vowels in initial syllables may be long. Alternatively, these stems actually are hiatic.

Table (6) shows examples of suffixed forms. All forms here receive either a CV or CVC suffix, depending on whether the stem has a final vowel or consonant. Note that I include CV stems here; we will see that these will reduplicate as CVCV regardless of whether we consider them to be prefixed or suffixed. Every other stem shape in this table, however, is necessarily suffixed.

(6) Final reduplication			
læs	<i>coral</i>	læs- læs	<i>lots of coral</i>
pək	<i>sand</i>	pək- pək	<i>sandy</i>
yot	<i>stone</i>	yot- yot	<i>lots of stones</i>
fa	<i>fern</i>	fa- fa	<i>covered with ferns</i>
nu	<i>coconut</i>	nu- nu	<i>lots of coconuts</i>
ʃa	<i>leaf</i>	ʃa- ʃa	<i>lots of leaves</i>
ʃanom	<i>juice</i>	ʃanom- nom	<i>juicy</i>
mutul	<i>to blink</i>	mutul- tul	<i>to blink</i>
kɪpat	<i>to break</i>	kɪpat- pat	<i>broken</i>
kiyɛp	<i>lie, tricky</i>	kiyɛp- yɛp	<i>lie, deceive</i>
luwos	<i>clean the bone</i>	luwos- wos	<i>lick</i>
suwɔs	<i>straight</i>	suwɔs- wɔs	<i>strict, inflexible</i>
siyək	<i>ask, request</i>	siyək- yək	<i>ask for permission to marry</i>
fiyɔ	<i>sweat</i>	fiyɔ- yɔ	<i>sweaty</i>
fiyɛ	<i>grey hair</i>	fiyɛ- yɛ	<i>grey-haired</i>
mɪsɛ	<i>to be frayed</i>	mɪsɛ- sɛ	<i>frayed</i>

As mentioned above, the prefix/suffix distinction handles the otherwise unpredictable split amongst CVC stems, which copy either the first CV, as in *fo-foʃ*, or the entire string, as in *yot-yot*. All forms like the former are prefixed, while all those like the latter are suffixed..

This two-dupleme claim also handles the generalization that any CVCV(C) stem copies only the first CVC or the second CV(C). Indeed, reduplication thus never creates

more than a single additional syllable: total reduplication only ever occurs with CV and CVC stems, as in *sa-sa* and *yot-yot*. There are no disyllabic stems that reduplicate totally.

In addition, the contrast of meanings in Tables (5) and (6) supports the prefix/suffix distinction. The Kosraean prefix functionally resembles the pan-Micronesian aspectual prefix, and its suffix resembles the pan-Micronesian derivative suffix. Furthermore, several stems are attested with either affix, as seen in pairs like *kɪp-kɪpat* ‘breaking’ ~ *kɪpat-pat* ‘broken’, *mɪs-mɪsɛ* ‘being frayed’ ~ *mɪsɛ-sɛ* ‘frayed’, and *pəʃ-pəʃæk* ‘slopping’ ~ *pəʃæk-æk* ‘sloppy’. Examples of monosyllables going either way are rare but still attested: *ʃɪ-ʃɪŋ* ‘tattoo’ ~ *ʃɪŋ-ʃɪŋ* ‘slap’ and *ʃɪ-ʃɪk* ‘very small’ ~ *ʃɪk-ʃɪk* ‘delicate, selective’.

The generalizations to be made are the following: the prefix, which I call the *iterative*, is either CV or CVC. If the stem is monosyllabic, the prefix is CV, as in *fo-foʃ*. If the stem is disyllabic, the prefix is usually CVC, as in *fur-furok*, but is CV if the stem contains vowels in hiatus, as in *fu-fuon*. Forms with the suffix, which I call the *denotative*, always copy the last syllable, as in *mutul-tul* and *fisɛ-sɛ*.

These generalizations also apply to vowel-initial stems. Like consonant-initial monosyllables, vowel-initial monosyllables are split into two unpredictable groups: some receive an intrusive glide. For example, while *on* reduplicates as *on-on*, *af* appears as *af-yaf*. This distinction is not predictable from the segmental content of the stem, since there are homophonous pairs like *ek* ‘change’ and *ek* ‘rub’ which reduplicate as *ekyek* and *ekkek* respectively. The prefix/suffix distinction allows us to generalize that the glide appears only in suffixed forms. I provide more examples of reduplicated vowel-initial forms in Table (7).

(7) Reduplication of vowel-initial monosyllables

a.	af	<i>rain</i>	af- yaf	<i>rainy</i>
	ef	<i>to fade</i>	ef- yef	<i>faded</i>
	ek	<i>to change</i>	ek- yek	<i>to keep on changing</i>
	eŋ	<i>wind, fart</i>	eŋ- yeŋ	<i>windy</i>
b.	ek	<i>to rub</i>	ek -ek	<i>to rub repeatedly</i>
	el	<i>to turn</i>	el -el	<i>look around</i>
	ɛʃ	<i>current</i>	ɛʃ -ɛʃ	<i>flowing</i>
	il	<i>grind, grate</i>	il -il	<i>intransitive</i>
	iŋ	<i>hurry</i>	iŋ -iŋ	<i>scurry, bustle</i>
	ip	<i>piece</i>	ip -ip	<i>in pieces</i>
	ir	<i>out of place</i>	ir -ir	<i>twisted, warped</i>
	ol	<i>hole, pore</i>	ol -ol	<i>holey, leaking</i>
	on	<i>to sing</i>	on -on	<i>to keep on singing</i>
	uk	<i>blow</i>	uk -uk	<i>intransitive</i>

A potential problem with this division is that for vowel-initial forms, the prefix-suffix distinction does not pattern neatly with the meaning contrast between the iterative and denotative affixes. Nevertheless, the functions of the iterative prefix and denotative

suffix are similar enough that it should be no surprise for some prefixed forms to receive denotative interpretations and some suffixed forms to receive iterative interpretations.

There is additional phonological evidence that the glide intrudes only on suffixed forms. When we turn to polysyllabic vowel-initial stems, we see prefixation of a VC element, which Lee describes as syllabified by itself, and almost never followed by a glide. I place syllable boundaries only in the first four forms in Table (8), as these are the only ones Lee's grammar discusses. The remainder of forms are from the Kosraean dictionary (Lee 1976).

(8) Prefixed vowel-initial disyllables			
ipɪs	<i>to roll</i>	ip .i.pɪs	<i>to roll bit by bit</i>
olaŋ	<i>to open</i>	ol .o.laŋ	<i>to open again and again</i>
ewə	<i>to lift</i>	ew .e.wə	<i>to lift little by little</i>
uʃi	<i>to sprinkle</i>	uʃ .u.ʃi	<i>to sprinkle off and on</i>
æŋon	<i>bother, irritate, poke</i>	æŋ -æŋon	<i>bother or disturb continuously</i>
ikɪl	<i>rock, roll</i>	ik -ikɪl	<i>to be rocking or rolling</i>
imɪs	<i>to drag along</i>	im -imɪs	<i>intransitive</i>
isoŋ	<i>stick in, cram</i>	is -isoŋ	<i>push in gradually</i>
iʃɛʃ	<i>to laugh</i>	iʃ -iʃɛʃ	<i>to laugh continuously</i>
utək	<i>to carry</i>	ut -utək	<i>to carry around</i>

There is really only one exception to this pattern: *alyalu* 'have overriding beliefs based in traditional values' from *alu* 'ceremony, rite'. I have no explanation for this form other than it is not derived by the same regular process. This is consistent with the stretch in meaning between stem and derived form: generally, reduplicated forms have a fairly transparent meaning, and if *alu* had a regular reduplicated form, we would expect it to have a meaning like 'lots of ceremonies' or 'always ceremonious'.

When vowel-initial polysyllables are suffixed, they are parallel to consonant-initial forms. That is, they receive a CVC or CV suffix, depending on whether the stem has a final consonant.

(9) Suffixed vowel-initial disyllables			
æloŋ	<i>tide</i>	æloŋ- loŋ	<i>low tide</i>
eka	<i>coral</i>	eka- ka	<i>lots of coral</i>
erar	<i>rattling sound</i>	erar- rar	<i>shake, rattle</i>
inut	<i>god, spirit</i>	inut- nut	<i>magic</i>
okæ	<i>root</i>	okæ- kæ	<i>rooty</i>
oræk	<i>crawl, creep</i>	oræk- ræk	<i>crawl around</i>
osak	<i>limp, hop</i>	osak- sak	<i>moving with a limp</i>

A last trait to acknowledge is a variable subpattern that affects only the prefix of polysyllables. Such stems optionally reduplicate with a light syllable, yielding forms like *e-ewə* and *fu-furok*. I return to this variable pattern in the discussion, at which point it

will be clear that only a small adjustment is required to handle these. First, in the next section, I develop a constraint hierarchy to account for all the subpatterns presented here.

11.3 *An Optimality-Theoretic account*

In this section, I develop a constraint hierarchy that selects the various subpatterns of both the iterative prefix and the denotative suffix. I begin with the iterative prefix for consonant-initial stems, followed by the denotative. I close with an account of the vowel-initial subpatterns.

11.3.1 *Consonant-initial iteratives*

For the iteratives of consonant-initial stems, there are three subpatterns to cover: the CV prefix of monosyllables, as in *fo-foʃ*, the CV prefix of hiatic stems, as in *fu-fuon*, and the CVC suffix of other disyllables, as in *fur-furok* and *ful-fule*.

A basic question for the Kosraean iterative prefix is why monosyllables receive CV prefixes, while disyllables receive CVC prefixes. In other words, why is *fo-fo_* better than **foʃ-foʃ*, while *fur-furok* is better than **fu-furok*? The descriptive generalization offers a starting point: the quantity of the prefix responds to the quantity of the stem, since longer stems create longer prefixes.

However, we must be careful about claims of moraicity for consonants in this language. Unlike its cousins, Kosraean has a fairly free distribution of both medial and final coda consonants. In contrast, the restrictedness of medial codas in Chuukic-Pohnpeic suggests an uncompromising system in which all medial codas are moraic, and thus subject to additional constraints, while all final ones are not. Given Kosraean's global tolerance of codas, we must consider the potential moraicity of all coda consonants.

Because of the contrast in shape between open prefixes like *fo-* and closed ones like *fur-*, I propose that the coda in the latter case is moraic. Thus, *fo-foʃ* has a monomoraic prefix, while the prefix of *fur-furok* is bimoraic. The weight of the word-final codas, however, is a little more difficult to deal with. As I have argued, we cannot assume in Kosraean that final consonants are extrametrical, because the language has no synchronic process of stem-final lenition, and allows (as the moraic *r* of *fur-furok* suggests) non-placed-linked moraic consonants.

Even so, suppose that all codas, including word-final ones, are moraic. The resulting odd generalization is that a bimoraic stem like *foʃ* receives a monomoraic prefix, while a trimoraic stem like *furok* receives a bimoraic prefix. In other words, the prefix is one mora lighter than the stem. I find this to be an unacceptable generalization, as it is difficult to formalize a statement like 'prefixes are one mora lighter than stems.'

In contrast, if we do allow the final consonants to be non-moraic, in violation of WEIGHT-BY-POSITION, the generalization is more plausible: *monomoraic* stems like *foʃ* receive monomoraic prefixes, while bimoraic stems like *furok* receive bimoraic prefixes. Thus, *fo-foʃ* has two moras in total while *fur-furok* has four: the prefixing pattern thus is constrained by a requirement of moraic binarity. I call this the 'Binarity Effect', and model it as an emergence of FOOTBINARITY, as defined in (10).

- (10) FOOTBINARITY Feet are bimoraic.

All else being equal, FOOTBINARITY will choose *(fo-fɔ)* over **(fọ-fɔ)* and *(fur)(furok)* over **(fu)(furok)*, as we will see in Tableaux (12) and (16). For example, FOOTBINARITY will rule out the bimoraic prefix of **fọ-fɔ*. However, given the fact that coda consonants may be non-moraic, a variant of **fọ-fɔ* is possible in which the prefix is monomoraic, as in (12c). While this form does satisfy FOOTBINARITY, it is still ruled out by the lower-ranked WEIGHT-BY-POSITION, which it violates twice, and which the optimal *fo-fɔ* violates only once. Another result from Tableau (12) is that we now know that WEIGHT-BY-POSITION must outrank MAX-BR, as defined in (11), to ensure that the less-faithful form emerges.

- (11) MAX-BR Every segment in the base has a correspondent in the reduplicant

(12)	fọ + ITERATIVE	FOOTBIN	WEIGHT-BY-POSITION	MAX BR
a.	$\mu\mu$ μ <i>(fọ-fɔ)</i>	*!	*	
b.	μ μ μ <i>(fo)(ji-fɔ)</i>	*!		
c.	μ μ <i>(fọ-fɔ)</i>		**!	
d.	μ μ <i>(fo-fɔ)</i>		*	*

A fifth competitor to consider is **(fọ)(fọ)*, with two bimoraic feet. Such a form would contradict the stress generalizations of the language by having a final stressed syllable, **(fọ)(fọ)*. We can rule such a form out with the constraint NON-FINALITY as defined in §9.2, and repeated as (13) below.

- (13) NON-FINALITY: The output segment bearing primary stress must not correspond to the rightmost element of the input.

Ranked above WEIGHT-BY-POSITION, NON-FINALITY will rule out any form with a final stressed syllable. As a result, it guarantees that the final foot in Kosraean will be disyllabic rather than a single heavy syllable. The ranking thus chooses the less-faithful *(fọ-fɔ)* over the bipodal **(fọ)(fọ)*, as summarized in Tableau (14).

It should be clear that CV stems like *sa* will be predicted to reduplicate exactly as *fọ*; that is, by creating a CV syllable and combining it with the stem to create a single foot. For *sa-sa*, neither FOOTBINARITY nor WEIGHT-BY-POSITION is violated.

(14)	foʃ + ITERATIVE	NON FINALITY	WEIGHT-BY-POSITION	MAX BR
a.	$\mu\mu \mu\mu$ (foʃ)(foʃ)	*!	*	
b.	$\mu \mu$ (foʃ-foʃ)		**!	
c.	$\mu \mu$ (fo-foʃ)		*	*

The iterative form of the disyllabic stem *furok* nearly follows from these two constraints, but will require the addition of another to the active set. FOOTBINARITY itself is enough to ensure that the prefix is bimoraic, but will not choose among the disyllabic prefix of **(furo)(furok)* and the optimal *(fur)(furok)*, nor will it handle an assimilated form like *(fuf)(furok)*—with a Chuukic-like medial geminate.

To prevent the disyllabic prefix from emerging, I propose the constraint ALL- σ -RIGHT, defined in (15), as a size-restrictor. ALL- σ -RIGHT has an emergent effect in the prefix by preferring a monovocalic prefix like *fur-* over a bivocalic one like **furo-*.

(15) ALL- σ -RIGHT All syllables are final.

The role of ALL- σ -RIGHT is shown in Tableau (16); it rules out the disyllabic prefix of **furo-furok*. Meanwhile, FOOTBINARITY rules out the monomoraic prefixes in (16b) *fu-furok* and (16c) *fur-furok* (with an extrametrical consonant in the prefix). Although there is no evidence yet for the rank of ALL- σ -RIGHT, we will see shortly that it must be above FOOTBINARITY. An independent effect of ALL- σ -RIGHT is that it helps guarantee that the form will follow Lee's generalizations of penultimate primary and antepenultimate secondary stress, which **(furo)(furok)* would not respect. It should also be noted that including ALL- σ -RIGHT in the system will not spoil the result for monosyllabic stems like *foʃ*, since every competitor in Tableau (12) violates it equally.

(16)	furok + ITERATIVE	ALL- σ -RIGHT	FOOTBIN	WEIGHT-BY-POSITION
a.	$\mu\mu \mu\mu$ (furo)(furok)	***!		*
b.	$\mu \mu\mu$ (fu)(furok)	**	*!	*
c.	$\mu \mu\mu$ (fur)(furok)	**	*!	**
d.	$\mu\mu \mu\mu$ (φ) (fur)(furok)	**		*
e.	$\mu\mu \mu\mu$ (fuf)(furok)	**		*

At this point I should add that a competitor like **(fu-fu)(rok)*, with two binary feet, could emerge incorrectly, but as with **(fo/)(fo/)*, it is ruled out with NON-FINALITY.

Tableau (16) leaves the optimal form tied with **fuf-furok*; this last competitor can be handled by ranking MAX-BR over CODACONDITION. To be more precise, given that the Chuukic-like medial geminate could come out in several different ways, a second Faithfulness constraint will need to outrank CODACONDITION, to prevent a construal of the suffix **fuf-* that has an assimilated maximization of the stem *r*, which would satisfy MAX-BR. Such a form would violate PLACE-IDENT-BR, as defined in (17).

- (17) PLACE-IDENT-BR Segments in correspondence have identical [place] specification.

In turn, MAX-BR takes care of a version of **fuf-furok* in which the moraic *f* is inserted, as well as of a third ‘multiplistic’ version, where both consonants of the prefix correspond to the stem’s *f*. Both interpretations fail to maximize the stem *r*, and thus lose out to the optimal candidate, which only violates the lower-ranked CODACONDITION.

(18)	furok + ITERATIVE	WEIGHT-BY-POSITION	MAX BR	PLACE IDENT-BR	CODA CONDITION
a.	$\mu\mu \quad \mu\mu$ inserted (fuf)(furok)	*	rok!		
b.	$\mu\mu \quad \mu\mu$ multiplistic (fuf)(furok)	*	rok!		
c.	$\mu\mu \quad \mu\mu$ assimilated (fuf)(furok)	*	ok	r!	
d.	$\mu\mu \quad \mu\mu$ ☞ (fur)(furok)	*	ok		r

Most disyllables receive iterative prefixes in the same way; for example, the hierarchy predicts *ful-fule* in a manner parallel to *fur-furok*. However, disyllabic stems with adjacent vowels do not receive bimoraic prefixes. For example, *fuon* is *fu-fuon* in the iterative, not **fuo-fuon*. This effect follows if we maintain a ranking of ALL- σ -RIGHT over FOOTBINARITY, which is illustrated in Tableau (19). While it may otherwise seem more intuitive to attribute the absence of **fuo-fuon* to an emergent requirement for syllables to have onsets, the appeal to ALL- σ -RIGHT is preferable because vowel-initial stems will be shown to reduplicate in some cases with additional onsetless syllables.

(19)	fuon + ITERATIVE	ALL- σ -RIGHT	FOOTBIN	WEIGHT-BY-POSITION
a.	$\mu\mu \quad \mu\mu$ (fuo)(fuon)	***!		*
b.	$\mu \quad \mu\mu$ ☞ (fu)(fuon)	**	*	*

The various forms of the iterative prefix now follow from a common constraint hierarchy. Monosyllables receive CV prefixes in order to satisfy both FOOTBINARITY and WEIGHT-BY-POSITION. Disyllables receive CVC prefixes for the same reason, plus the additional effect of ALL- σ -RIGHT, which also applies to stems with vowels in hiatus. In the next section, I show how the denotative suffix dodges the binarity effect.

11.3.2 Consonant-initial denotatives

With the constraint hierarchy established for the iterative prefix, it is now possible to test whether the system predicts the particular forms of the denotative suffix. Unlike the iterative prefix, there is a greater tendency for FOOTBINARITY to be violated in denotatives. There are three subpatterns to handle, as Table (20) shows. The suffix tends to be CVC, as in *mutul-tul* and *pək-pək*, unless the stem is vowel-final, as in *misε-sε*. In each case, the suffix is potentially monomoraic, depending on the moraicity of the ultimate consonants.

(20) Denotative subpatterns

mutul	<i>to blink</i>	mutul- tul	<i>to blink</i>
pək	<i>sand</i>	pək- pək	<i>sandy</i>
misε	<i>to be frayed</i>	misε- sε	<i>frayed</i>

In fact, the current system already nearly predicts *mutul-tul* and *misε-sε*, as the following tableaux illustrate. For *mutul* first, a totally reduplicated form like **(mutul)(mutul)* incurs one too many violations of ALL- σ -RIGHT. The remaining competitors are segmentally both *(mu)(tul-tul)*, but in one version, the final foot violates FOOTBINARITY by having a medial moraic *l*. The best form is thus one in which both *l* codas of the form are non-moraic, in violation of WEIGHT-BY-POSITION.

(21)	mutul + DENOTATIVE	NON FINALITY	ALL- σ -RIGHT	FOOTBIN	WEIGHT-BY-POSITION
a.	$\mu \mu\mu \mu\mu$ (mu)(tul)(tul)	*	**	*	
b.	$\mu \mu \mu \mu$ (mutul)(mutul)		***!		**
c.	$\mu \mu\mu \mu$ (mu)(tul- tul)		**	**!	*
d.	$\mu \mu \mu$ (mu)(tul- tul)		**	*	**

A fifth competitor is possible that would surpass *mutul-tul* were we not to add another constraint to the mix. The form **(mu)(tul-tu)* has the same minimal violation of FOOTBINARITY as the optimum, but also has one fewer violation of WEIGHT-BY-POSITION. To avoid it being an incorrect output, I include the ANCHOR constraint defined

in (22). The form $*(mu)(tul-tu)$ violates ANCHOR because its outermost segment, the u , is not a correspondent of the outermost segment of the stem.

- (22) ANCHOR The edgemoſt (outermoſt) ſegment of the reduplicant is a correspondent of the edgemoſt ſegment of the baſe.

Anchoring is leſſ of a concern for $miſe$, as Tableau (23) will ſhow. Again, full reduplication incurs too many violations of ALL- σ -RIGHT, ſo we are left only with monosyllabic options. One competitor is the form $*(mi)(ſe-miſ)$, which is reminiscent of Chuukic and Pohnpeic denotatives. Though it maximizes more of the baſe than the actual $(mi)(ſe-ſe)$, it violates the higher-ranked constraints ANCHOR and WEIGHT-BY-POSITION.

(23)	$miſe$ + DENOTATIVE	ALL- σ - RIGHT	FOOTBIN	ANCHOR	WEIGHT-BY- POSITION	MAX BR
a.	$\mu \mu \mu \mu$ ($miſe$)($miſe$)	***!				
b.	$\mu \mu \mu$ (mi)($ſe$ - $miſ$)	**	*	*!	*	ϵ
c.	$\mu \mu \mu$ \leftarrow (mi)($ſe$ - $ſe$)	**	*			mi

The other denotative ſubpattern is the complete ſuffixation pattern, as in $pək-pək$. A potential problem ariſes becauſe of the candidate $*(pək-ək)$, which can ſatisfy FOOTBINARITY, is well-Anchored on its right ſide, and violates WEIGHT-BY-POSITION leſſ than the optimum ($pək-pək$) does. To ensure the proper output, I appeal to a requirement that morpheſes align to ſyllable boundaries, as formalized in (24).

- (24) ALIGN-MORPHEME-SYLLABLE Every morpheſe edge coincides with a ſyllable boundary.

ALIGN-MORPHEME-SYLLABLE will rule out the form $*(pək-ək)$ as long as it outranks WEIGHT-BY-POSITION, as Tableau (25) ſhows. Additionally, ANCHOR takes care of the competitor $*(pək-pə)$. We are not yet in a poſition to clarify the rank of ALIGN-MORPHEME-SYLLABLE in any more detail, but as we will ſee in the diſcuſſion of vowel-initial forms, it muſt be ſomewhat violable, and needs to rank below ANCHOR.

(25)	pək + DENOTATIVE	FOOTBIN	ANCHOR	ALIGN-MORPH-SYLL	WEIGHT-BY-POSITION
a.	μ μ (pək- pə)		*!		*
b.	μ μ (pə.k- ək)			*!	*
c.	 μ μ (pək- pək)				**

The inclusion of ALIGN-MORPHEME-SYLLABLE will not have any undesired effects for the iterative prefix in Section 11.3.1, since the prefix and stem always meet at a syllable boundary. It is also consistent with the disyllabic denotative forms like *mutul-tul* and *mɪsɛ-sɛ*, which both fully satisfy it.

The constraint hierarchy developed so far makes accurate predictions for the shape of both the iterative prefix and denotative suffix. Kosraean is subject to a tendency for bimoraicity to emerge in the reduplicative context, which follows from the occurrence of stress on the final foot, but not on the final syllable. This structure accounts for the basic quantitative difference between the prefixes of *fo-foʃ* and *fur-furok*. This tendency is not categorical, however, as iteratives like *fu-fuon* show. Furthermore, though it initially looks like the suffixing pattern is not subject to FOOTBINARITY in the same way, as forms like *mutul-tul* and *mɪsɛ-sɛ* suggest, their tolerance of FOOTBINARITY violations is not a specific property of the denotative morpheme; instead, it is an epiphenomenon driven by concerns like ANCHOR and ALL-σ-RIGHT.

The fact that it is possible to obtain the various subpatterns using a single constraint hierarchy is a satisfying result: the two affixes are subject to a shared set of restrictions, and their prosody is a consequence of general constraints specific to neither. However, to this point only consonant-initial stems have been considered, and the set of vowel-initial reduplicative subpatterns needs yet to be incorporated into the analysis.

11.3.3 Vowel-initial iteratives

There are two subpatterns of vowel-initial iteratives. Both monosyllables and disyllables use a VC prefix, but the two groups syllabify differently: the morpheme boundary in *o.n-on* is within a syllable, whereas in *ip-ipɪs*, the prefix is syllabified by itself. In other words, vowel-initial iteratives follow the Binariness Effect: monomoraic stems receive monomoraic suffixes, and bimoraic stems receive bimoraic suffixes.

In Section 11.3.1, I attribute the monomoraicity of the prefix in *fu-fuon* to an emergent restriction on syllables, ALL-σ-RIGHT. This constraint prefers the actual form over the more faithful **fuo-fuon*. This is somewhat contrary to what might be more descriptively fitting, that the reduplicated form avoids placing vowels in hiatus, or more generally, that the reduplicated form avoids onsetless syllables. Either account, at least for consonant-initial stems, would correctly predict *fu-fuon*, but in the domain of vowel-initial forms, an Onset requirement like the constraint in (26) is a necessary augmentation, in particular for the iterative of monosyllables.

(26) ONSET Syllables have onsets

Stems like *on* are fully doubled when prefixed, appearing as *on-on*. However, a problem competitor the single form **(o-.on)*. This can be ruled out in any number of ways, but only one of them is ultimately acceptable. One possibility is to leave the choice to MAX-BR, which *on-on* obviously satisfies more. However, MAX-BR must rank below WEIGHT-BY-POSITION, because of the need in Section 11.3.1 to predict *fo-fof* instead of **fof-fof*. Given the rank of WEIGHT-BY-POSITION over MAX-BR, **o-.on* will emerge as an incorrect output, since *on-on* either violates ALIGN-MORPHEME- σ , as in *o.n-on*, or WEIGHT-BY-POSITION, as in *on-.on*, in which both *n* codas are non-moraic. Tableau (27) illustrates the problem.

(27)	on + ITERATIVE	FOOT BIN	ANCHOR	ALIGN-MORPH- σ	WEIGHT-BY-POSITION	MAX BR
a.	$\mu \mu$ (<u>on</u> .on)				**!	
b.	$\mu \mu$ (<u>o</u> -.on)				*	n
c.	$\mu \mu$ (<u>o.n</u> -on)			*!	*	

To avoid this result, I introduce ONSET as an operator in the scheme. As long as ONSET ranks above ALIGN-MORPHEME-SYLLABLE, VC iteratives reduplicate like *on-on*, as Tableau (28) shows. Happily, we also see that an overprediction of ONSET satisfaction is avoided. That is, one can imagine a competitor like **(yo.n-on)*, which fully satisfies ONSET. However, it is poorly anchored: its outermost segment *y* is not a correspondent of anything in the stem. This confirms the suggestion of Section 11.3.2 that ANCHOR outranks ALIGN-MORPHEME-SYLLABLE, as ONSET ranks critically between the two.

(28)	on + ITERATIVE	FOOTBIN	ANCHOR	ONSET	ALIGN-MORPH- σ	WEIGHT-BY-POSITION
a.	$\mu \mu$ (<u>on</u> .on)			**!		**!
b.	$\mu \mu$ (<u>o</u> -.on)			**!		*
c.	$\mu \mu$ (<u>o.n</u> -on)			*	*	*
d.	$\mu \mu$ (<u>yo.n</u> -on)		*!			

Before moving to the disyllable subpattern, I should acknowledge the choice of *o.n-on* over the kinds of forms other Micronesian languages would use. For example, Pohnpeian, Pingilapese, and all the Chuukic languages would call for a bimoraic prefix,

something like *oni-on* or *ono-on*. Both forms are prevented in Kosraean by the high rank of FOOTBINARITY. A Mokilese-like geminated *on.n-on* can satisfy FOOTBINARITY, as long as both *n* codas are non-moraic, but this loses to *o.n-on* by WEIGHT-BY-POSITION.

For vowel-initial disyllables like *ipis*, the prediction of the current constraint hierarchy is accurate, and reminiscent of the Binariness Effect seen in consonant-initial iteratives. For example, because of the high rank of ALL- σ -RIGHT, the prefix for *ipis* must contain but one vowel. Moreover, because of the high rank of FOOTBINARITY, the prefix must be bimoraic, since the stem is itself a foot, leaving the prefix in a foot of its own. The only option is thus to make the prefix (*ip*), with a moraic *p* to achieve binarity; this syllabification is as Lee describes. I illustrate this in Tableau (29); an important note is that to prevent (*i*)(*p-ipis*) from emerging, ONSET ranks below FOOT-BINARITY, which is consistent with the placement of ONSET for *o.n-on* in Tableau (28) above.

(29)	ipis + ITERATIVE	ALL- σ -RIGHT	FOOTBIN	ONSET	ALIGN-MORPH- σ	WEIGHT-BY-POSITION
a.	$\mu\mu$ $\mu\mu$ (ipis)(ipis)	***!		**		**
b.	$\mu\mu$ $\mu\mu$ (ip l)(ipis)	**!		**		*
c.	μ $\mu\mu$ (i)(p -ipis)	**	*!	*	*	*
d.	μ $\mu\mu$ (i)(ipis)	**	*!	**		*
e.	$\mu\mu$ $\mu\mu$ (ip)(ipis)	**		**		*

Vowel-initial stems thus derive iteratives just like consonant initial ones. For monosyllabic stems, which are also monomoraic, the hierarchy predicts a monomoraic prefix, and stuffs them both into a single bimoraic foot, as in (*o.n-on*). For disyllables, however, the stem must comprise its own foot, leaving the prefix stranded, and consequently footed by itself, binarily, as in (*ip*)(*ipis*). In the next subsection, I show how the one remaining subpattern, denotatives for vowel-initial stems, is also a function of the same constraint set.

11.3.4 Vowel-initial denotatives

We have seen that consonant-initial iteratives exhibit the Binariness effect, and vowel-initial stems follow the same pattern. The same is true of vowel-initial denotatives; they mirror the suffixing pattern of consonant-initial stems. Recall that I use the prefix/suffix distinction to handle the otherwise unpredictable appearance of an intrusive glide in some reduplicated VC stems. That is, all VC-VC forms are analyzed as prefixed, and their form is predicted by the extended hierarchy of Section 11.3.3. In contrast, all VC-y-VC forms are analyzed as suffixed, and I argue here that the hierarchy also accounts for this.

For the denotative of *af*, three competitors satisfy FOOTBINARITY; a fourth, **(af-yaf)*, has a moraic medial coda, creating a tri-moraic foot. The segmentally identical optimum, *(af-yaf)*, contains a medial extrametrical coda, and thus forms a bimoraic foot. Furthermore, its intrusive glide does not violate ANCHOR: the outermost consonant of the suffix is *f*, and is a correspondent of the edgemost Base *f*, so the form is well-Anchored. In other words, the intrusive glide is only possible under the following conditions: it is part of the reduplicant, and it is not at the periphery. Necessarily, then, it can only occur in suffixed VC stems.

Given the perseverance of the intrusive-glide form, it emerges as optimal, for it satisfies ONSET better than the form **af-af*, and satisfies ALIGN-MORPHEME-SYLLABLE, unlike **a.f-af*. I summarize the evaluation of *af-yaf* in Tableau (30).

(30)	af + DENOTATIVE	FOOTBIN	ANCHOR	ONSET	ALIGN- MORPH-σ	WEIGHT-BY- POSITION
a.	μμ μ (af- yaf)	*!		*		*
b.	μ μ (af- af)			**!		**
c.	μ μ (a.f- af)			*	*!	*
d.	☞ μ μ (af- yaf)			*		**

In disyllabic forms, there is no risk of creating an onsetless suffix. Thus we see forms like *osak-sak* and *inut-nut*. These receive denotatives exactly like other disyllables such as *mutul-tul*.

11.4 Discussion

In this chapter, I have developed a constraint hierarchy to cover the entire range of reduplicative subpatterns in Kosraean. Despite its unique free tolerance of medial coda consonants, Kosraean has a host of quibbling distinctions in its manner of reduplicating. Even so, the shape of the reduplicant is consistently predictable from two facts: the shape of the stem to which it attaches, and its position as a prefix or suffix.

The pattern can be summarized as follows: the prefix tends to be bimoraic, and if it is, the second mora is always a consonant. The prefix is bimoraic if it occurs in its own foot, as in *(fur)(furok)* and *(ip)(ipɪs)*. However, the prefix is monomoraic for monomoraic stems, as in *(fo-fo)* and *(o.n-on)*, and for stems with internal vowel sequences, as in *(fu)(fuon)*. The suffix, in contrast, is always monomoraic, to avoid copying more than one vowel. Its shape is always CV(C), where the second consonant appears only if the stem has a final consonant; thus we see *(mi)(sɛ-sɛ)* and *(mu)(tul-tul)*. The first consonant of the suffix is an intrusive glide if the stem is VC, as in *af-yaf*. These subpatterns all follow from a single hierarchy that incorporates a high rank of NON-FINALITY and ANCHOR, as well as a visible effect of FOOTBINARITY and ALL-σ-

RIGHT. In the remainder of this chapter, I address some residual empirical issues, and discuss the nature of phonological Confluence in Kosraean.

11.4.1 Alternative forms, alternative accounts

One final aspect of the Kosraean paradigm deserves some comment. Lee describes a variant pattern by which certain subsets have a different realization: namely, the iterative for all disyllables variable is monomoraic. Thus, instead of *fur-furok* and *ip-ipis*, we see *fu-furok* and *i-ipis*. The means of arriving at this system, in fact, is minimal: these are the only subpatterns which reduplicate using moraic consonants—and it is the association between consonants and moras that makes the distribution of medial codas so limited elsewhere in the Micronesian family. The strictest condition on moraic consonants is NOCODA, as defined in (31).

(31) NOCODA Moraic consonants are forbidden

The variant pattern can be predicted by the placement of NOCODA above FOOTBINARITY. This rank rules out the moraic coda consonants of *fur-furok* and *ip-ipis*, but correctly leaves *on-on* unchanged, and will also not affect any denotative forms at all, none of which have any moraic consonants. The following Tableaux offer an illustration.

(30)	furok + ITER VARIANT	ALL- σ - RIGHT	NOCODA	FOOTBIN	WEIGHT-BY- POSITION
a.	$\mu\mu\ \mu\mu$ (furo)(furok)	***!			*
b.	$\mu\ \mu\mu$ ☞ (fu)(furok)	**		*	*
c.	$\mu\ \mu\mu$ (fur)(furok)	**		*	***!
d.	$\mu\mu\ \mu\mu$ (fur)(furok)	**	*!		*

(31)	ipis + ITERATIVE	ALL- σ - RIGHT	NOCODA	FOOTBIN	ALIGN MORPH- σ	WEIGHT-BY- POSITION
a.	$\mu\mu\ \mu\mu$ (ip)(ipis)	***!				*
b.	$\mu\ \mu\mu$ (i)(p -ipis)	**		*	*!	*
c.	$\mu\ \mu\mu$ ☞ (i)(ipis)	**		*		*
d.	$\mu\mu\ \mu\mu$ (ip)(ipis)	**	*!			*

In more ways than one, the present account offers a unified constraint analysis of the Kosraean paradigm. An alternative account is provided by Raimy (2000), who uses the derivational ‘linear precedence’ model to handle the Kosraean prefix. Raimy is right to use Kosraean as evidence against a templatic model of reduplication, but his account only covers the bimoraic prefixing subset exemplified by *fur-furok* and *ip-ipis*. The real problem with a templatic approach for Kosraean is that it cannot handle the quantitative contrast between the prefixes *fo-foʃ* and *fur-furok*. Indeed, Raimy’s approach, devoid of prosody, requires some amendment to handle this pair, and cannot have a clear account of why the variant NOCODA pattern only affects the *furok/ipis* subsets.

11.4.2 Confluence in Kosraean

What is additionally interesting about the present account is that many aspects of Kosraean phonology are reflected in other Micronesian systems, although with clearly different priorities. For example, the rightward tendency for primary stress—assigned without regard to morphological category—is typical throughout the family, as is the pressure to copy no more than one stem vowel in reduplicated forms.

Other Micronesian languages also show a preference for binary feet when they reduplicate, as seen in the apparent ‘heavy-syllable’ prefixing patterns of Pohnpeian (Rehg & Sohl 1981, see §4), Mokilese (Harrison 1976, see §5), Pingilapese (Good & Welley 1989, see §5), Woleaian (Sohn 1975, see §7), Chuukese (Goodenough & Sugita 1980 see §8), Puluwat (Elbert 1973, see §8), and Gilbertese (Groves et al 1978). In addition, this account of Kosraean makes use of an evaluation of FOOTBINARITY at the moraic level. Similar arguments for moraic feet have been made for Pohnpeian (Rehg 1993), Gilbertese (Blevins & Harrison 1999), and Mokilese in Chapters 5 and 6.

Moreover, Kosraean shows a tendency towards alignment of affixes to prosodic units like syllables and feet. Similarly, all other Micronesian languages except Gilbertese fully satisfy ALIGN-MORPHEME-FOOT in reduplicated forms, while all other Micronesian languages except Mokilese fully satisfy ALIGN-MORPHEME-SYLLABLE in reduplicated forms. Even in these languages, as well as Kosraean, such constraints still play an emergent role in their lower ranks. Thus, while the Kosraean data may appear to be quite different from the patterns of languages of the Chuukic and Pohnpeic groups, they share many fundamental principles.

Four aspects of Kosraean jump out that make it distinct from its cousins: first, its apparent free distribution of medial coda consonants, second, its lack of contrastive segment length, third, its larger consonant and vowel inventory, and fourth, its tolerance of morpheme boundaries within feet, which I introduce in Section 11.3 as the Binariness Effect. I claim here that the coincidence of these four properties is an example of Confluence.

I will argue below that each property is related to a single innovation, the emergence of the pressure of size-restriction, which I refer to as Maximality. As a starting point, recall the truncation pattern exemplified in (2). Truncation occurs under affixation, and has the effect of reducing the number of syllables and feet in derived forms. In other words, Kosraean shows evidence of Maximality, or a preference of

shorter over longer words—not to the extent that there is a true upper bound on word size, but if something can be parsed in two feet instead of three, or one foot instead of two, the language does so. Reduplicated forms also show this: the only subpatterns to create additional feet are ones in which the stem itself is disyllabic, and likewise comprises its own foot: (*fur*)(*furok*), (*ip*)(*ipis*), (*mu*)(*tul-tul*).

This is consistent with the lack of contrastive vowel and consonant length: without the extra moras incurred by long segments, there is less foot structure than a contrastive-length language would show.

One of these—maximality or lack of length—has primacy, but it is not clear for us which. It is interesting that among Micronesian languages, Kosraean alone has no contrastive length, and there are three possible reasons for this. A basic possibility the innovation of long vowels and consonants occurred following the divergence of Kosraean from the rest of the family, and Kosraean thus missed out on the process. I do not accept this as a likely scenario, but rather propose that the greater segment inventory of Kosraean stands in to replace a lost length contrast.

The two remaining possible scenarios presume that proto-Micronesian had contrastive length which Kosraean lost. One possible source of this innovation is simply that: Kosraean innovated by losing length contrasts. The other is that the maximality effect in pre-Kosraean was strong enough to neutralize such contrasts.

Let us consider each possibility below; we will see that in either case, each uniquely Kosraean trait is connected to the same single innovation. Consequently, it is the case that the co-occurrence of these traits in a single language is an example of Confluence, which the Confluence model can account for.

11.4.2.1 *Loss of length precipitates maximality*

The first of the two possible historical scenarios for Kosraean is that the language simply lost its length contrast. The Confluence model here needs a motivation for such an innovation, which might remain a mystery, but we have seen evidence elsewhere of a dispreference for long vowels in particular (as in §8.4.1 for Chuukese). Certainly we can expect geminate segments to require more articulatory effort than singletons.

In a language that contrasts lexical items with segment length, the loss of phonemic length could result in a drastic loss of distinctions among lexical items. It is to avoid such a situation that Cognitive Counterbalance is included as a component in the Confluence model. The role of Cognitive Counterbalance is to require the recoverability of lexical items, and thereby avoid variants that compromise recoverability. Thus, where there are variants in the ambient and interpreted forms that preserve recoverability, Cognitive Counterbalance will allow them to pass while filtering out contrast-neutralizing forms.

Consider a hypothetical set of items that includes the pair /pees/ and /pes/, contrasted only by the length of the vowel. Should a speaker begin to submit to the avoidance of segmental length, some variants include *pes* and *pɛs* for both. Cognitive Counterbalance prevents the speaker from using *pes* as a variant of both /pees/ and /pes/. However, the adoption of a lax vowel in one form helps preserve the contrast between the

two items. This is reminiscent of the role Cognitive Counterbalance plays in the reflexes of initial gemination discussed in §10.6: such structures are avoided, but less-marked variants are chosen that preserve the original contrast rather than neutralize it.

An independent effect of Confluence model, but one with a similar result, operates at the level of the listener/learner. She may be exposed to ambient forms like “pees” and “pes”, and know that they are different lexical items, but interpret them as a pair contrasted by tenseness rather than by length. Thus, she will perceive even more tense/lax distinctions than what speakers provide in the ambient signal to begin with. Once she learns the distinction by tenseness, she fails to acquire the length distinction. I summarize this in Figure (32).

(32) Innovation of tenseness distinction out of length contrast

Source grammar: /pees ≠ pes/ ↓	
“pees ~ pes ~ pes ” “pes ~ pes ~ pes” ↓	<i>Length contrasts are avoided, some variants have lax vowels, speaker prefers lax vowels for short vowels</i>
[pees ~ pes] [pes ~ pes] ↓	<i>Learner chooses frequent variants as default She may even hear more tense/lax distinctions than what the speaker actually produces</i>
Acquired grammar /pes ≠ pes/ ↓	<i>Learner creates grammar that lacks length and has larger segment inventory</i>

An important claim to be made is that at some point all short/long segment pairs were replaced by pairs distinct by some other feature. In the case of vowels, this feature could be tenseness, laxness, or backness; for consonants, it could be place or manner features.

The repercussion is that the learner moves to a grammar that values short forms over long ones, precipitating the Maximality effect. Loss of length makes for fewer feet, which in some cases generalizes to fewer syllables. As the speaker encounters more and more forms that observe Maximality, the grammar she acquires will also posit morpheme boundaries within feet, as in (*fo-fo_*), and medial coda consonants, as in (*ful*)(*fule*). I summarize this in Figure (33).

(33) Innovation of Binariness Effect and medial coda tolerance out of Maximality

Source grammar	
↓	
“(ful)(fule) ~ (fule)(fule)” “(fo-fo] ~ (fo)([i-fo]”	<i>Size-restriction compresses word length; speaker prefers shorter words and shorter segments</i>
↓	
[(ful)(fule), (fo-fo)]	<i>Many variants are possible, and learner chooses one as default.</i>
↓	
Acquired grammar	<i>Learner creates grammar that lacks length, observes Binariness Effect, and formally tolerates medial codas</i>

What is interesting is that these innovations happen along the same path: misalignment and codas are forced by Maximality, which is encouraged by the lack of contrastive length. Thus, in this scenario, the coincidence of a number of formal properties unique to Kosraean are attributable to a simple reconfiguration of a length contrast into other featural contrasts. Once a critical mass of learners all follow the same path, the result is an innovative language that differs from its precursor in a number of ways.

11.4.2.2 Maximality precipitates loss of length and the rest

The other historical scenario for Kosraean is that the initiating innovation in the language’s history is not the loss of length contrasts, but the emergence of Maximality. In this case, speakers produce variants with different lengths—some have fewer feet, fewer syllables, and shorter segments. As soon as the shorter forms appear with enough frequency, learners consider them as default forms that their grammars should require.

Modeling this is no different from the sequence illustrated in Figure (33). The emergence of Maximality as an articulatory effect holding over the ambient forms of speakers results in the adoption of a new grammar that tolerates medial codas and observes the Binariness Effect by allowing morpheme boundaries within feet.

Moreover, Maximality drives the reduction of word-size by shortening long segments. As with the situation sketched out in the previous subsection, the loss of the length contrast does not actually result in a neutralization; instead, Cognitive Counterbalance reconfigures the contrast with other features, in order to maintain recoverability of lexical items.

Thus, the innovation of a Maximality effect results in four unique properties of Kosraean: medial codas, morpheme misalignment, a lack of geminates, and a larger consonant and vowel inventory.

11.4.2.3 *Kosraean Confluence: a summary*

In either of the above hypothetical scenarios, Maximality—formalized as a high rank of ALL-FEET-RIGHT and ALL- σ -RIGHT—goes hand in hand with an absence of geminate segments: Both constraints are satisfied better when fewer segments in words are moraic. Regardless of whether Maximality suppressed or neutralized contrastive length, or the absence of length propped Maximality up, a learner with evidence for one property also has evidence for the other.

In addition, regardless of Maximality as a source or a consequence of length-loss, the tolerance of medial codas and of ALIGN-MORPHEME-FOOT violations follows. These patterns involve a number of formal constraint rankings that are not seen elsewhere in the Micronesian family.

First, as argued in Section 11.3, ALL- σ -RIGHT, NON-FINALITY, and FOOTBINARITY outrank MAX-BR and ALIGN-MORPHEME-FOOT, which results in the reduplication of monosyllabic stems with monomoraic prefixes, as in (*fo-fo*). Second, FOOTBINARITY, ALL- σ -RIGHT, and DEP-BR outrank NOCODA and CODACONDITION, which results in the reduplication of disyllables with closed bimoraic syllables, as in (*fur*)(*furok*). Third, FOOTBINARITY outranks WEIGHT-BY-POSITION, as seen in the medial non-moraic codas of suffixed forms like (*pək-pək*) and (*mu*)(*tul-tul*).

In terms of ranking typology, the coincidence of these sets of rankings is accidental. One can imagine a language with Pohnpeian's consonant inventory that nonetheless tolerates morpheme misalignment, or a language with Kosraean's consonant inventory that also has contrastive length and requires reduplicative prefixes to respect ALIGNMENT and CODACONDITION. Instead, since other Micronesian languages did not experience the Maximality effect, their formal properties of coda restrictions and good alignment remain intact.

Likewise, a number of unique properties of Kosraean are actually linked to each other in a principled manner, as the Confluence hypothesis claims should happen. Aside from those properties that result from the Maximality effect, Kosraean is typically Micronesian. It uses prefixing and suffixing reduplication, and each affix shows a great deal of sensitivity to the shape of the stem. Regardless, the entire system can be modeled in a single constraint hierarchy, one composed of uncontroversial constraints, very few of which are morpheme-specific. In fact, only the notion of correspondence refers to the category of reduplicant in particular; every other constraint that relates morphology to phonology does so by referring to all morphemes in general, and not to any morpheme in particular. As is the case in its cousins, the shape of Kosraean affixes – bimoraic or not, with epenthesis or not – is a function of general constraints, some of which are always respected in the language, and some of which emerge only in the context of reduplication.

12. Implications and discussion

12.1 *Goals revisited*

The goals of this work have been threefold. First, each individual language has presented an observational fact that poses a challenge to the constraint-based Optimality-Theoretic model, and I have set out to account for such facts. Second, sisters and subgroups of the Micronesian family often share observational tendencies, and I have tested the implicit claim of Optimality Theory that such minor differences deserve accounts that are different to as minor a degree at a formal, descriptive level. Third, although some sister languages differ quite minimally, it is never the case that two languages differ by a single formal contrast. Instead, languages tend to differ by at least two contrasts, by two constraint rankings. I have formulated the hypothesis of phonological Confluence to account for this third phenomenon. In this chapter, I summarize each of these goals, and discuss their implications.

12.2 *Individual languages*

Each Micronesian language has presented some quirk that poses a challenge to Optimality Theory, and indeed to generative phonology overall. Many of these quirks are attributed to the interaction between constraints on adjacency, constraints on moraicity, and constraints on morphological alignment. In this section, I summarize these findings.

In Pohnpeian, Quantitative Complementarity requires adjacent syllables of duratives to be dissimilar in weight, but an apparently exceptional subset, with heavy-light stem sequences like in *duu-duupek*, resist it. Moreover, exceptions to the exceptions like *so-soupisek* exist, and respect Quantitative Complementarity. Chapter 4 attributes the restricted emergence of Quantitative Complementarity to the ability of *HH (which forbids adjacent heavy syllables) to emerge in forms with even numbers of moras.

Furthermore, the same set of formal generalizations extends to forms with initial vowels and syllabic nasals. In fact, the entire system, including all variants of the derivative suffix, is consistent with a single constraint hierarchy.

Mokilese almost looks like Pohnpeian without Quantitative Complementarity, but it also has a wider range of possible geminates, and an ability to misalign reduplicants and syllables, as vowel-initial forms like *on.n-o.nop* and *an.d-an.dip* show. Chapter 5 argues that this misalignment only occurs between morphemes and syllables; feet, built exclusively from moraic segments, are well-aligned to morphemes in such forms. Again, the whole paradigm follows from a uniform constraint hierarchy.

In contrast, Pingilapese shows an intolerance of moraic consonants altogether, and thus sits at the opposite end of the spectrum from Mokilese. In addition, Pingilapese shows a curious vowel-lengthening pattern that arises only in potential homorganic sequences at reduplicative junctures: thus, we see *paa-pap*, but *pili-pile*, not **pii-pile*. I argue that the homorganic forms can logically be represented with multiple correspondence, which is not possible in non-homorganic ones.

In the Chuukic subgroup, Woleaian satisfies FREE-VOWEL by devoicing rather than deleting final vowels. I attribute this in Chapter 7 to a preference not to strand word-

final consonants in extrametrical positions. In addition, Woleaian has a curious allomorphic distribution of its denotative marker, which arises unpredictably as initial gemination in some forms and partial suffixation in others. I argue that this can be handled with the use of a feature of lexical stress, [LEXSTR], the alignment of which forces some stems to take suffixes. Furthermore, the same feature guarantees the proper placement of the Woleaian prefix, which shows an odd assimilation to the stem's initial consonant.

Many of the same facts are also true of Chuukese and Puluwat, and Chapter 8 shows that the same formalism can capture these languages as well. While the distribution of initial gemination and partial suffixation is less clearly allomorphic, I offer an account that can handle the possibility that the two patterns expose distinct morphemes. In addition, I show how these languages' instantiation of final-vowel lenition helps clarify the formal representation of the Chuukic geminating habitual prefix.

The main hurdle in Marshallese is the contrast between how its two dialects, Ralik and Ratak, realize initial geminates. Ralik uses a pre-posed epenthetic *yV*-syllable, while Ratak splits initial geminates with an epenthetic vowel. In Chapter 10, I portray the difference as an opposition of NOCODA and the Obligatory Contour Principle. As such, the account does not rely on the placement of morpheme boundaries, nor on the morphological affiliation of the geminate segments, and as a result, it unifies the account for derived and underlying initial geminates.

Last, Kosraean allows a wider range of medial coda consonants, and the quantity of its reduplicative affixes does not respond to the stem as it would in other languages. In Chapter 11, I show that Kosraean's coda tolerance follows from a tolerance of violations not only of CODACONDITION, but also of WEIGHT-BY-POSITION. The system then generalizes across short and long stems, consonant-initial and vowel-initial stems, and prefixed and suffixed forms.

12.3 *Shared formalisms*

The Pohnpeic subgroup shares a great deal of formal structure, with a few notable individual differences. Each Pohnpeic language has a unique constraint ranking over the distribution of moraic consonants, and I provide these rankings in Figure (1). The Pohnpeian ranking restricts gemination to sonorants, and motivates nasal substitution where obstruents would otherwise be moraic. The Mokilese ranking allows all geminates, while the Pingilapese system allows none.

- (1) Pohnpeian *OBS/MORA, DEP-BR » IDENT-NASAL, NOCODA
 Mokilese MAX-BR, IDENT-NASAL » *OBS/MORA, NOCODA
 Pingilapese NOCODA, MAX-BR » DEP-BR

Two other subsystems deserve comment: Mokilese alone ranks DEP-BR over ALIGN-MORPHEME-SYLLABLE, a ranking motivated by gemination in vowel-initial

progressives. Meanwhile, Pohnpeian alone ranks *HH over FOOTBINARITY, which is motivated by Quantitative Complementarity.

Within the Chuukic subgroup, there is again a great deal of shared formal structure, with one notable distinction. Woleaian devoices word-final short vowels, while Chuukese and Puluwat, like those of the Pohnpeic subgroup, delete them. In formal terms, all the languages obey the CODACONDITION, but only Woleaian ranks WEIGHT-BY-POSITION over VOICEVOWELS. The rest of the languages have the opposite ranking.

- (2) Woleaian CODACONDITION, WEIGHT-BY-POSITION » VOICEVOWELS
 Chuukese, Puluwat CODACONDITION, VOICEVOWELS » WEIGHT-BY-POSITION

Apart from these, there are a few constraint sub-hierarchies that are quite consistent across the entire family. For example, the ranking in (3) creates feet that resemble an iterative right-to-left assignment of structure. The high rank of ALLFEETRIGHT forces the rightward pressure, while *CLASH and *LAPSE help maintain alternation of stressed and unstressed elements in lieu of a lower-ranked FOOTBINARITY.

- (3) ALLFEETRIGHT, *CLASH, *LAPSE » FOOTBINARITY, MAX-BR

This formal structure is most highly motivated for Pohnpeian, but is consistent with all of the Chuukic and Pohnpeic languages, as well as with Marshallese. Kosraean and Woleaian show some minor deviations from it, both of which are motivated by other innovations in their systems. For example, Kosraean allows *CLASH violations, but this follows from a higher respect for general size-restriction. Likewise, Woleaian tolerates fewer violations of FOOTBINARITY, but this follows from its final-vowel devoicing pattern.

Moreover, the sub-hierarchy in (4) is also consistent across the family. The higher rank of ALIGN-MORPHEME-SYLLABLE maintains reduplicants in their own syllables. As a result, the lower-ranked ALL- σ -RIGHT can emerge to minimize the size of the reduplicant, as it is ranked over MAX-BR, but its rank below ALIGN-MORPHEME-SYLLABLE prevents it from cramming its segments into a single syllable with base segments.

- (4) ALIGN-MORPHEME-SYLLABLE » ALL- σ -RIGHT » MAX-BR

A last shared formalism is in the representational domain: every language has been represented with strictly moraic feet, where the parsing of syllables occurs on a separate plane from the projection of feet. As a generality, syllables and foot boundaries tend to be well-aligned, but there are a few examples in Micronesian languages in which this is not the case. I discuss this and other implications in the following section.

12.4 *Implications*

There are several theoretical implications that emerge from the empirical chapters in this work. Aside from the successful accounts of individual languages, and the characterization of minimally distinct observational patterns with minimally distinct constraint hierarchies, the arguments have implications for templatic morphology and for the prosodic hierarchy. I discuss each in turn below.

12.4.1 *Templatic morphology*

In Chapter 3, I provide a survey of conceptual arguments against an output-based theory of reduplication that makes use of the morpheme-specific template constraint. Notable among these are the Kager-Hamilton problem, an objection to the typological prediction of templatic back-copy, and the morpheme-specificity of RED=PCAT constraints. The analyses in Chapters 4 to 11 additional empirical evidence to the same end: that the special relationship between reduplicants and prosodic categories is an epiphenomenon, albeit a very interesting one.

One could offer the red herring that the Kager-Hamilton problem is not a sufficient argument against a theory of templatic reduplicative morphology. Indeed, I have argued here that Confluence can illustrate why some typological predictions should not be of theoretical concern, because principled reasons outside of typological permutation can account for such gaps. Could the absence of templatic back-copy be such a gap, obviating the Kager-Hamilton problem as an anti-template argument? That may be, but Confluence is meant to characterize likely and unlikely permutations, not impossible ones.

Moreover, the notion of a quantitative template is one that is inadequate, for several reasons. In particular, quantitative templates lack empirical coverage and explanatory power. For example, the idea of a ‘heavy-syllable’ template is problematic for the Pohnpeian durative prefix, as I argue in Chapter 4. The issue arises in the language’s surface deviation from the heavy syllable generalization, which conflicts with the avoidance of adjacent heavy syllables and non-homorganic consonant sequences. Furthermore, a quantitative requirement is at a loss to explain the bimoraicity of the prefix, in opposition to the monomoraicity of the suffix—a phenomenon I refer to as *prefix-suffix disparity*, which actually arises in different ways in all Micronesian languages.

In all Pohnpeic languages, as well as in Chuukese and Puluwat, there is a tendency for a bimoraic prefix and monomoraic suffix. In Woleaian, both affixes are bimoraic, but the prefix is uniformly monosyllabic, while the suffix tends to be disyllabic. In Marshallese, there is no clear habitual prefix at all, while in Kosraean, the suffix must be monomoraic, while the prefix may not be.

In addition, a direct requirement of quantity fails in the Kosraean paradigm, given that the prefix varies between monomoraic and bimoraic variants. If either variant is understood as the basic requirement, the system fails to capture why the other is variant is an option. Failure to meet such a requirement could also actually result in full reduplication.

Crucially, however, these arguments are against *quantitative* templates. I have not yet provided any empirical evidence against the use of qualitative templates that would require more general prosodic-morphological associations like RED=FOOT or RED=SYLLABLE. In fact, these encounter fewer of the pitfalls of bimoraic and monomoraic requirements, but nevertheless, they offer no conceptual advantage over the generalized approaches of the preceding chapters.

One could imagine a templatic constraint requiring simply that the reduplicant be a foot, regardless of its quantity. If the left and right boundaries of the reduplicant are coextensive with the edges of a foot, then the constraint is satisfied, regardless of the number of moras within it.

(5) RED=FOOT: The reduplicant is a foot.

Unlike a constraint requiring bimoraic syllables, or bimoraicity in general, a non-quantitative constraint like this can capture some of the more curious subpatterns in Micronesian languages, such as Pohnpeian Quantitative Complementarity, general Pohnpeic vowel excrescence, and the Mokilese vowel-initial subpattern. Likewise, a use of RED=SYLLABLE might capture the Kosraean binarity effect.

Nevertheless, it is unclear that such constraints would add anything to our understanding of the individual systems. To capture Pohnpeian Quantitative Complementarity, we would still need to appeal to *HH, *CLASH, and ALL-FEET-RIGHT. To capture Pohnpeic vowel excrescence, we would still need to appeal to constraints over moraic consonants. To handle the Mokilese misalignment of vowel-initial progressives, we would still need moraic feet. To model the Kosraean Binarity Effect, we would still need FOOTBINARITY and WEIGHT-BY-POSITION.

Thus, using a non-quantitative template does not simplify the account of any language's paradigm. All the mechanisms needed to enrich the generalized approach are required for the explicit RED=FOOT approach. Moreover, the template remains a stipulative reason for the relationship between reduplicants and prosodic units. In contrast, the generalized approach makes reduplicative prosody an emergent function of well-formed morphemes. The two roles of explicit templates—prosodic association and size-restriction—are thus handled elsewhere in the constraint hierarchy.

A last problem with the reduplicant-specific approach is in its handling of initial gemination and its various instantiations. In particular, there is a contrast between the interpretations of RED=FOOT and ALIGN-MORPHEME-FOOT, in that initial gemination in Chuukic languages fails to satisfy the template, but does satisfy Alignment. This follows from their formalisms: the requirement that the *Reduplicant is coextensive with a foot* is not equivalent to *morpheme boundaries are aligned to foot boundaries*.

12.4.2 The Prosodic Hierarchy

In several places, notably Chapter 6, I suggest that a corollary of the Prosodic Hierarchy, Syllable-Integrity, ought to have a more relaxed role in theories of phonological representation. Prosodic orthodoxy holds that foot boundaries may not occur within syllables, which follows from a primitive of the Prosodic Hierarchy, that

prosody is projected into higher and higher orders of structure, from moras to syllables to feet. In contrast, the position I hold for Micronesian languages as a generality is that feet are parsed from moras, and that the ideal foot is one composed of two moras, irrespective of syllable projections. In other words, the analyses of the preceding chapters consider Syllable-Integrity to be a violable principle, rather than an inviolable primitive of prosodic representation.

Such a position obviously will have theoretical consequences. Foremost, an optimistic view is that it provides greater empirical coverage. For example, it is only with the violability of Syllable-Integrity that we can incorporate Pohnpeian and Gilbertese stress assignment. Moreover, it allows us to paint a picture of Mokilese reduplication using the generalized approach developed here instead of the quantity-templatic accounts typical of the Pohnpeian and Mokilese analytical literature.

A less optimistic point of view is that the relaxation of Syllable-Integrity predicts a much wider variety of possible languages than we know of. In other words, it amounts to a loss of an otherwise striking and robust generalization about language. Nevertheless, I think even within this gloomy perspective there can emerge a valuable lesson. This is especially true since I maintain that Syllable-Integrity can remain as a violable, rankable principle, and as such it remains as a well attested and robust generalization about language.

Indeed, this is exactly the kind of implication I hope is typical of this dissertation. The Prosodic Hierarchy and Syllable-Integrity remain as universals in the original sense of the term, and like other pre-Optimality Theoretic principles, fit well into a theory of prioritized and conflicting principled constraints.

Which leaves us with the question: if Syllable-Integrity is violable, why do so many languages respect it? Here is another opportunity to understand that phonological typology must be understood in deeper terms than mathematical permutation. Probability in a vacuum suggests that all else being equal, around 50% of the world's languages will tolerate violations of Syllable-Integrity. Yet far fewer do, and it is conceptually reasonable to argue that a number of factors might make the violability of Syllable-Integrity unlikely in most languages. I suggest Syllable-Integrity is another example of phonological Confluence: it is just highly likely to emerge in any language.

For example, we could presume that the arrangement of syllables and feet has an unequaled salience. Syllables, having sonorant nuclei, may seem to be the more salient bearers of stress than are moras, especially in languages with no length distinction. Thus, languages will converge upon prosodies in which feet are bisyllabic, with boundaries that co-occur with syllable boundaries. Indeed, the Prosodic Hierarchy, in terms of ALIGN-FOOT-SYLLABLE, is very salient even across Micronesia, with a mere few motivated violations.

12.5 *Confluent patterns*

Interspersed among the empirical chapters are discussions of expected constraint rankings and of coincidental phonological properties that I attribute to the hypotheses of Confluence. By Confluence, I refer to the coincidence of two formal innovations, where the reranking of A and B precipitates the reranking of C and D. Such situations may

scream conspiracy, but as the Confluence hypothesis of Chapter 1 claims, and as we have seen, such coincidences occur in a principled manner.

In fact, I have shown in each discussion of confluent patterns that a particular ranking tendency or a coincidence of two or more formalisms can be attributed to non-grammatical factors. As a result, the formal model does not need to be restricted to prevent the prediction of other imaginable but unattested languages. In Chapter 6, I discuss Confluence within Pohnpeic, and Chapter 9 I discuss Confluence in Chuukic as well as Chuukic-Pohnpeic. Meanwhile, §10.6 addresses Confluence in Marshallese, while §11.4 addresses Confluence in Kosraean. I summarize these findings below, and offer a broader perspective as well.

12.5.1 Confluence in Pohnpeic

There are two results in Chapter 6 that contribute to our understanding of divergence among related languages. First, I offer an account for the difference in each language's treatment of potential homorganic sequence, and the similarity in their treatment of non-homorganic sequences. Second, I argue that the Mokilese treatment of potential homorganic sequences creates a larger set of licit geminates, which in turn precipitates the misalignment seen in vowel-initial progressives. In other words, as the Confluence hypothesis predicts, two subsystems co-occur, and are expected to do so, but the formal model does not need to encode this.

12.5.2 Confluence in Chuukic

In Chapter 9 I discuss the formal constraint FREE-VOWEL, and provide a plausible and substantive account of its role in phonology. I then show how its observance can precipitate a vowel-deletion pattern out of a devoicing one, and is indeed likely to do so. Some justification for this claim is seen in the innovation of deletion in multiple languages. As a result, given the status of FREE-VOWEL, the rank of VOICEVOWELS is expected to be higher than WEIGHT-BY-POSITION, but the formal model does not need to encode this generality.

I then show that the innovation of deletion motivates a second formal change, in the ranking of ALLFEETRIGHT over FOOTBINARITY. Observationally and descriptively it is intuitive that this change is connected to the innovation of deletion, but raw typology suggests otherwise. Still, I account for the likelihood that the two formal innovations co-occur without resorting to any formal linkage between them in the constraint set.

12.5.3 Confluence in Chuukic-Pohnpeic

I conclude in Chapter 9 that the Chuukic instantiation of the habitual prefix differs in two clear ways from its Pohnpeic equivalent: it uniformly remains a single syllable, and it uniformly fails to maximize the second stem consonant. In contrast, the Pohnpeic prefix can be disyllabic, and it always reflects the second stem consonant. I argue that the two differences are related, mainly because a learner's evidence for gemination in the Chuukic subgroup is also evidence for failed maximization. However, I also show the formal model does not need to encode this connection.

12.5.4 *Confluence in Marshallese and Kosraean*

In Chapter 10 I formalize the two Marshallese strategies for avoiding initial geminates. I then acknowledge the observation that Marshallese reflects two of a number of imaginable strategies for dealing with such structures; Pohnpeic languages instead use nasalization, while Chuukic languages make use of manner and release features to mark initial geminates. I take this as evidence that the rank of POSITION-BY-WEIGHT will tend to be high, but that the formal model need not encode this tendency.

Finally, in Chapter 11 I investigate Kosraean, showing that despite a few peculiarities, it shares a lot of phonological properties with other Micronesian languages. Moreover, its unique traits—a lack of contrastive segmental length, a high tolerance of medial codas, as well as of morpheme-foot misalignment—are all attributable to a more general phenomenon of overall word-size restriction. As a result, Kosraean is not a language with its constraints in random free-fall; rather, the single innovative property of word-size restriction (itself seen to lesser degrees elsewhere) causes a chain reaction in the grammar.

12.5.5 *Other patterns of Confluence*

There is, in fact, another generalization to be made that fits the mould of Confluence. We have seen that all Micronesian languages have a prefix and a suffix, except Marshallese, which has lost its prefix. Some languages, including Marshallese, have another variant, initial gemination.

What is striking is that only those languages with a full range of geminates (or, in the case of Woleaian, with geminate options for each segment) use the initial gemination pattern as a productive morphological device. Why is there no initial gemination variant for the Pohnpeic denotative? Or in Kosraean?

The answer would probably have a lot to do with the smaller geminate inventories of those languages. In fact, it is clear for Kosraean, which has no real geminates, that gemination ought not to serve as a means of deriving denotative verbs. However, Mokilese and Pohnpeian still have reflexes of initial geminates in underived forms; why are such structures disallowed as derived geminates?

In these cases, the difference for the Pohnpeic languages is in their realization of initial geminates: despite the Mokilese tolerance of all geminates, only nasals (historically) can be moraic in initial position. Thus, both Pohnpeian and Mokilese require initial nasal substitution, which in turn necessarily creates two-root sequences. Moreover, a morpheme boundary would fall between those two roots, creating a potential for misalignment.

I illustrate with a hypothetical stem *pok* in Figure (6). An obstruent geminate like *ppok* is not possible in Pohnpeian, but *mpok* is, as long as it is not derived. If *mpok* were derived from *pok*, there would be a boundary between the *m* and *p*, which violates ALIGN-MORPHEME-FOOT.

into the fold would enrich the discussion: I have seen some data from each of these languages, and none seems randomly unique.

More globally, the claims of Confluence would have more support if they were tested in some other language family. Really, any language family will be suitable, but one with rich reduplicative paradigms and phonological complexities would be an ideal second test of the Confluence hypothesis.

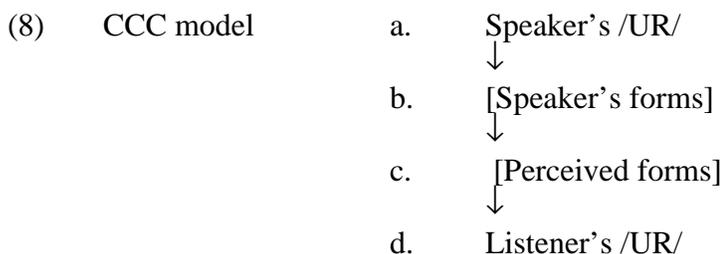
12.7 *Other models of change*

Confluence is a notion that synthesizes Optimality-Theoretic typology with diachronic information. It is similar to Blevins's (2003) model of "Evolutionary Phonology" and to the concept of Drift (Sapir 1949). We will see that Confluence crucially differs from Blevins's model in that rather than replace synchronic explanation with diachronic explanation, it restricts synchronic typology with extra-grammatical principles. In that sense, Confluence offers a resolution between Drift and formal synchronic models. In this section, I show how the Confluence model stands apart in its implications for formalisms.

12.7.1 *The Evolutionary-Phonological model*

The central premise of the Evolutionary Phonology model is that diachronic explanations of sound patterns should have priority over synchronic ones. There is more than one way of interpreting such a claim: essentially, diachrony replaces something. A strong reading of the premise is that diachronic accounts should replace the formal rule/constraint component. A less bold claim is that diachronic accounts replace any theory of rule or constraint naturalness. One consequence of the premise, consistent with either interpretation, is that *Markedness constraints are excised from the grammar* (Blevins's words). Neither reading is fully consistent with Confluence mechanism, which simply offers an account of the attested configurations of Markedness.

Blevins introduces a model of change called CCC (for "Chance, choice, change"). The gist of the model is that there numerous points between the grammar of the (adult) speaker and that of the (learner) listener which are possible loci of change. I offer a schema of the CCC model in Figure (8).



The development of the learner's phonological system follows several steps. First, at (10a) the speaker has a set of lexical items, and produces output forms at (10b), which I have referred to as the "ambient" forms. At this point, "universal and language-specific phonetics" produce a range of variants of the ambient form. Next, the utterance

is perceived, either accurately or inaccurately, at (10c). Last, at (10d) the utterance is associated with a phonological form—an underlying representation.

Phonological CHANGE occurs if there is a misperception between (10b) and (10c); this is similar to Perceptual Confluence. CHANCE is a consequence of the misapplication of phonetics-phonology mapping between (10c) and (10d). CHOICE occurs if a change in the frequency of variant outputs in (10b) results in a different perceived form being chosen as the default that the learner's grammar should produce.

Blevins specifies a number of theoretical consequences of the CCC model. First, sound change is not “goal-directed” in that there is not a more ideal grammar in any formal sense to which phonologies gravitate. Confluence has the same consequence, for the trend towards unmarked structures is only a prediction of Confluence, but not a built-in principle. Second, CCC characterizes common sound patterns as the result from phonetically-motivated sound change, as does Confluence. Third, as I have mentioned, Blevins claims the CCC model allows for the removal of formal Markedness constraints from synchronic grammar.

Note that this third consequence does not directly follow: while the CCC model *allows* for the removal of formal Markedness, it does not *force* it. In addition, the CCC model maintains informal markedness with its use of “universal and language-specific phonetics” that drive the appearance of variant output forms.

Regardless, Confluence makes a different claim: rather than seek to eliminate Markedness from synchronic explanation, Confluence makes sense of the conflicting priorities of formal Markedness: it has learners set formal requirements of Markedness based on the data they perceive. It provides an explanation for the configuration of constraints in synchronic grammars: while a constraint ranking offers a formalization of synchronic phonological generalizations, the Confluence model provides an explanation of the source of attested formal rankings. In addition, and crucially, Confluence includes the feedback of Cognitive Counterbalance to prevent the resolution of all languages towards less-marked structures.

12.7.2 *Confluence and Drift*

Confluence as presented here is a technical example of Drift, a concept pursued by Sapir (1921) and discussed by Lakoff (1972). Drift is exemplified by the tendencies of languages unbeknownst to each other to share the same direction of innovation. For example, Lakoff discusses several instances of Drift in Indo-European morpho-syntax: the emergence of definite and indefinite articles, the replacement of case endings with prepositions, and the adoption of periphrastic causatives and auxiliaries. Each of these innovations has arisen at several points in time in divergent branches of the family.

Sapir's focus is also Indo-European: the loss of case endings, the stabilization of word order, and the rise of the invariable word. Lakoff groups these together as a single instance of Drift, the replacement of case-endings, and notes that “these three [innovations] are the same: one leads to another, and in fact, implies another.” This is the reminiscent of the Confluence claim that some phonological subpatterns are expected to co-occur. However, Lakoff presents no formalization of Sapir's morpho-syntactic implication, but she does propose a hypothetical metacondition that pressures grammars

toward unbound morphology. In addition, she admits that the drift may operate in the opposite direction in other languages families, which suggests that neither totally synthetic nor totally analytic systems are inherently optimal.

Drift as Lakoff presents it is very similar to Confluence: both concepts acknowledge the likelihood of certain innovations and collocations of innovations to occur. Moreover, both concepts attribute such likelihood to things other than the rules of a language. In Lakoff's example, the metacondition may seem stipulative, but may be cognitive or computational in origin. In the cases of phonological Confluence to be discussed here, tendencies of innovation are consequences of articulatory and perceptual noise. In addition, the Confluence mechanism includes an explicit reference to the learner's tasks of formulating her grammar with ambient forms as her only evidence, as well as to the principled order of the ambient system. Lakoff's Drift uses no such overt mechanism, but presumably could.

12.7.3 Linguistic universals and linguistic change

A third approach to change is provided by Kiparsky (1968), who divides possible innovations into two classes. Rule addition, formally, is the addition of a new rule to a phonological system. It corresponds roughly to the formal notion of sound change (Halle 1962, Postal 1968), and Kiparsky attributes it to the borrowing of rules among adult speakers. In contrast, rule simplification (which includes rule deletion) involves the loss of specified information from the trigger, target, or environment of a rule. It corresponds roughly to the formal notion of analogy, and Kiparsky attributes it to the learning of language by children.

There is a parallel between Kiparsky's proposals and Confluence. Rule addition resembles Articulatory Confluence, as its genesis is in the appearance of new variants in adult forms. Likewise, rule simplification is like Perceptual Confluence, in that it involves the assignment of a novel perceptual representation to the intended ambient form. Confluence adds to this a means of restricting the kinds of additions or simplifications that plausibly can occur.

12.7.4 Optimality as a model of change

Confluence is not the first attempt at modeling change in Optimality Theory. McMahon (2000) questions the appropriateness of Optimality Theory as an explanatory diachronic model, as pursued by Green (1997), Anttila and Cho (1998), and Zubritskaya (1997). As a generality, such research portrays historical change as constraint reranking. McMahon suggests that while a difference in ranking can clearly describe the difference between conservative and innovative varieties, it does not address the motivation for innovation. If reranking *causes* innovation, there is no account of the reason for the reranking; it is as though constraints rank and rerank themselves. If the reverse is true – innovation causes reranking – there is no account internal to Optimality Theory of the origin of the innovation.

Confluence addresses this explanatory gap by acknowledging the effects of external factors on the generation of ambient forms which serve as evidence for the learner. Under Confluence, reranking is not the cause of change; ranking simply responds to the set of perceived forms, which are subject to noise in articulation and

perception. As a result, the rank of constraints is not the model of change; it is what the model changes.

12.8 Confluence and generative phonology

Confluence as I have presented it is closely linked to OT: the end result of the sequence of learning events is a synchronic grammar that characterizes surface generalizations in terms of ranked, violable formal constraints. Note this need not be the case: the step from perceived forms to synchronic grammar and underlying representations can follow any formal learning mechanism and settle on any kind of formal generative grammar. Consequently, a phonologist can subscribe to Confluence without subscribing to Optimality Theory.

However, the relationship between Confluence and Optimality remains an intriguing one. In one sense, Confluence portrays OT grammars as the formal end result of the conflict between cognition and phonetics, which OT neatly characterizes as a formal conflict between Markedness and Faithfulness. In another sense, Confluence actually risks suffocating OT. In this last section, I pursue both implications.

12.8.1 Confluence and Optimality constructs

Under the Confluence model, articulatory and perceptual variants arise because of phonetic pressures. As a result, the sets of ambient and perceived forms can differ from the source grammar's set of intended output forms. The phonetic pressures are grounded in articulation and perception, and need not be part of the formal synchronic structure of the source grammar. Nevertheless, since the learner bases her acquired grammar on the set of perceived forms, she ends up formalizing in her grammar an effect that was previously extra-grammatical. In other words, what first appears as an articulatory effect in the caregiver-peer's speech, or a perceptual effect in the learner's ear, eventually becomes formalized as a required aspect of the acquired grammar. Because of this, the learner's placement of Markedness constraints—notably in a higher rank than in the source grammar, is a direct reflection of such phonetic effects. In short, the Markedness constraint is a formal instantiation of natural phonetic pressures.

Conversely, not every phonetic pressure is powerful enough to take hold, since the contrast-preserving mechanism of Cognitive Counterbalance can withstand such pressure. Wherever the caregiver-peer resists phonetically-motivated variants to maintain contrast, or the learner rejects phonetically-motivated percepts as inappropriate learning data, the end result is a system that maintains formal faithfulness to lexical entries. In other words, the Faithfulness constraint is a formal instantiation of Cognitive Counterbalance.

This is of some interest since the mission of Faithfulness only partially reflects that of Counterbalance. Faithfulness encodes the pressure to maintain the recoverability of underlying forms from spoken ones, while Counterbalance is intended to maintain both recoverability and phonological contrast. Even so, the maintenance of contrast can be seen as a necessary strategy for the greater goal of recoverability. Moreover, though Faithfulness only encodes recoverability, it still has the additional effect of maintaining contrast.

An immediate consequence is that Confluence may obviate the formal requirement of contrast maintenance and creation, such as DISPERSION kinds of approaches (Flemming 1995, Lindblom 1990, Padgett 1997, Sanders 2003). The maintenance of contrast is achieved through the Confluence mechanism, and as a result, the synchronic model does not need to encode DISPERSION as a set of formal universal constraints.

A larger consequence is in the way the formal synchronic model of OT characterizes surface generalizations. Learners acquire grammars that have an ordered, ranked set of violable and conflicting constraints. This ordering and conflict directly reflects the conflict between phonetics and cognitive counterbalance at work in the learning path—wherever a learner follows phonetics, she values (and ranks highly) Markedness, and wherever she follows cognition, she maintains Faithfulness.

12.8.2 *Does Confluence replace OT and UG?*

The portrait of Confluence in the previous subsection leads to a second potential consequence: the model might actually subsume the role of OT and of Universal Grammar in accounting for patterns in languages and learnability. This would be ironic if it were true; however, I maintain that there is room in a theory of language for a Confluence explanation of phonological tendencies, an OT explanation of formal surface generalizations, and a UG explanation of acquisition.

To sort this out, we must agree on what the job of each is. Optimality Theory began as a phonological model for synchronic generalizations, but has the added panache of typological prediction: if a particular pattern is unattested, Optimality should not allow it as a possible formal system. Yet as we saw in Chapter 1, the typological power of Optimality is limited to *absolute* gaps in typology; statistical tendencies are outside the range of OT's explanation.

Confluence, at the very least, picks up the rest: it explains why some formally possible, imaginably computable phonological systems are less likely to be attested. A strong claim would be that Confluence can also account for absolute gaps; however, I maintain that as long as there are absolute gaps in phonological typology, Optimality must remain as a means of accounting for them.

As a result, we can continue to characterize phonological patterns in languages as the function of ranked, violable constraints: OT still formalizes surface generalizations and handles novel forms.

Moreover, OT and UG provide the tools for the learner to make generalizations. Confluence accounts for how learners use universal tools like constraints, phonemes, features, and prosodic structures to arrive at generalizations about the speech system to which they are exposed. In other words, OT and UG provide the constructs that separate learnable languages from all others, and Confluence explains why the set of attested languages is so much smaller than the set of learnable languages.

References

- Abo, Takaji, Byron Bender, Alfred Capelle, and Tony Debrum. 1976. *Marshallese-English Dictionary*. Honolulu: University of Hawaii Press.
- Abramson, Arthur S. 1986. The Perception of Word-Initial Consonant Length: Pattani Malay. *Journal of the International Phonetic Association* 16. 8-16.
- Abramson, Arthur S. 1987. The Perception of Word-Initial Consonant Length: Pattani Malay. *Haskins Laboratories Status Report on Speech Research* 91, July-Sept, 149-156.
- Anderson, Stephen. 1992. *A-Morphous Morphology*. Cambridge University Press, Cambridge.
- Anttila, Arto. 1997. Deriving variation from grammar. In Frans Hiskens, Roeland van der Hout, and W. Leo Wetzels (Eds.), *Variation, Change and Phonological Theory*. Amsterdam: Benjamins. 35-68.
- Anttila, Arto, and Young-mee Yu Cho. 1998. Variation and Change in Optimality Theory. *Lingua* 104, 31-56.
- Archangeli, Diana, and Douglas Pulleyblank. 1993. Two rules, or one, or none? Proceedings of the Berkeley Linguistics Society.
- Archangeli, Diana, and Douglas Pulleyblank. 1994. *Grounded Phonology*. Cambridge MA: MIT Press.
- Aronoff, Mark. 1994. *Morphology by Itself: Stems and Inflectional Classes*. Cambridge, MA: Cambridge University Press.
- Bender, Byron W. 1969. *Spoken Marshallese*. Honolulu: University Press of Hawaii.
- Bender, Byron W. 1971. Micronesian languages. In Thomas A. Sebeok (Ed.), *Current Trends in Linguistics 8: Linguistics in Oceania*. The Hague: Mouton.
- Benkí, José R. 2002. Analysis of English nonsense syllable recognition in noise. To appear in *Phonetica*
- Blevins, Juliette. 1996. Mokilese Reduplication. *Linguistic Inquiry* 27. 523-530.
- Blevins, Juliette. 2003. *Evolutionary Phonology*. Cambridge: Cambridge University Press.
- Blevins, Juliette, and Andrew Garrett. 1993. The Evolution of Ponapeic Nasal Substitution. *Oceanic Linguistics* 32. 199-236

- Blevins, Juliette, and Sheldon P. Harrison. 1999. Trimoraic feet in Gilbertese. *Oceanic Linguistics* 38. 203-230.
- Blust, Robert. 1978. *The Proto-Oceanic palatals*. Wellington: The Polynesian Society.
- Blust, Robert. 1996. Low Vowel Dissimilation in Ere. *Oceanic Linguistics* 35.1. 96-112.
- Boersma, Paul. 1997. How we learn variation, optionality, and probability. *Proceedings of the Institute of Phonetic Sciences of the University of Amsterdam* 21, 43-58.
- Boersma, Paul. 1998. *Functional phonology: Formalizing the interactions between articulatory and perceptual drives* [LOT International Series 11]. Doctoral dissertation, University of Amsterdam. The Hague: Holland Academic Graphics.
- Boersma, Paul, and Bruce Hayes. 2001. Empirical tests of the Gradual Learning Algorithm. *Linguistic Inquiry* 32-1. 45-86.
- Boothroyd, A., and Nittrouer, S. (1988). Mathematical treatment of context effects in phoneme and word recognition. *Journal of the Acoustical Society of America*, 84, 101-114.
- Clements, Samuel J., and George N. Clements. 1983. *CV Phonology*. MIT Press.
- Côté, Marie-Hélène. 1997. Phonetic salience and consonant cluster simplification. In B. Bruening, Y. Kang, and M. McGinnis (Eds.), *MIT Working Papers in Linguistics* 30. Cambridge, MA, MIT.
- Crowhurst, Megan. to appear. Mora Alignment. *Natural Language and Linguistic Theory*.
- Davis, Stuart. 1997. A Sympathy account of nasal substitution in Ponapean reduplication. *Phonology at Santa Cruz* 5.
- Davis, Stuart. 1999. On the Representation of Initial Geminates. *Phonology* 16.1. 93-104.
- Davis, Stuart. 2001. The Flowering of OT: A Sympathy account of nasal substitution in Ponapean reduplication. *Linguistic Circle of Korea*.
- Elbert, Samuel H. 1972. *Puluwat Dictionary*. Canberra: Pacific Linguistics.
- Elbert, Samuel H. 1974. *Puluwat Grammar*. Canberra: Pacific Linguistics.
- Elenbaas, Nine & René Kager 1999. Ternary rhythm and the lapse constraint. *Phonology* 16, 273-329.

- Everett, Daniel L. 1996. Prosodic levels and constraints in Banawa and Suruwaha. m.s., University of Pittsburgh.
- Everett, Daniel L. 1996. Syllable Integrity. Ms., University of Pittsburgh. ROA-163.
- Fitzgerald, Colleen. 1998. O'odham Rhythms. Doctoral Dissertation, University of Arizona.
- Flemming, Edward. 1995. Auditory representations in phonology. Doctoral dissertation, UCLA.
- Fulop, S. 1994. Acoustic correlates of the fortis/lenis contrast in Swiss German plosives. *Calgary Working Papers in Linguistics* 16. 55-63.
- Goldsmith, John. 1976. An Overview of Autosegmental Phonology. *Linguistic Analysis*; 1976, 2, 1, 23-68.
- Goldsmith, John. 1990. *Autosegmental and Metrical Phonology*. Oxford: Blackwell.
- Good, Elaine M., and Weldis Welley. 1989. A Preliminary sketch, text, and vocabulary of Pingilipese. In Elaine M. Good and Weldis Welley (Eds.), *Papers in Kosraean and Ponapeic*. Canberra: Pacific Linguistics.
- Goodenough, Ward H., and Hiroshi Sugita. 1990. *Truukese-English Dictionary*. Philadelphia: American Philosophical Society.
- Green, Anthony Dubach. 1997. *The Prosodic Structure of Irish, Scots Gaelic, and Manx*. Doctoral dissertation, Cornell University.
- Green, Thomas, and Michael Kenstowicz. 1995. The Lapse Constraint. Ms., MIT. ROA-101
- Halle, Morris, and Jean-Roger Vergnaud. 1979. Metrical Phonology. Ms., MIT. Presented in part at the fourth GLOW colloquium at Nijmegen.
- Halle, Morris, and Jean-Roger Vergnaud. 1987. *An essay on stress*. Cambridge: MIT Press.
- Halle, Morris, and Alec Marantz. 1993. Distributed Morphology and the Pieces of Inflection. In Kenneth Hale and S. Jay Keyser (Eds.), *The View from Building 20*. Cambridge MA: MIT Press. 111-176.
- Halle, Morris and Alec Marantz. 1994. Some key features of Distributed Morphology. In Andrew Carnie and Heidi Harley (Eds.), *MIT Working Papers in Linguistics 21: Papers on phonology and morphology*. Cambridge MA: MITWPL. 275-288.

- Hammond, Michael. 1991. "Parameters of metrical theory and learnability", in I. Roca, ed., *Logical issues in Language Acquisition*, Foris, 47-62.
- Harley, Heidi, and Rolf Noyer. 1998. Licensing in the non-lexicalist lexicon: nominalizations, vocabulary items and the Encyclopaedia. In Heidi Harley (Ed.), *MIT Working Papers in Linguistics 32: Papers from the UPenn/MIT Roundtable on Argument Structure and Aspect*. Cambridge MA: MITWPL. 119-137.
- Harrison, Sheldon P. 1973. Reduplication in Micronesian Languages. *Oceanic Linguistics* 7. 407-454.
- Harrison, Sheldon P. 1976. *Mokilese Reference Grammar*. Honolulu: University Press of Hawaii.
- Hayes, Bruce. 1981. *A Metrical Theory of Stress Rules*. Indiana University Linguistics Club, Bloomington Indiana.
- Hayes, Bruce. 1989. Compensatory lengthening in moraic phonology. *Linguistic Inquiry* 20, 253-306.
- Hayes, Bruce. 1995. *Metrical Stress Theory: Principles and Case Studies*. University of Chicago Press: Chicago.
- Hicks Kennard, Catherine. 2002. Copy but don't repeat: the Conflict of Dissimilation and Reduplication in the Tawala Durative. Paper presented at Texas Linguistics Society/SWOT 7, Austin TX.
- Hyman, Larry. 1985. *A theory of phonological weight*. Dordrecht: Foris.
- Itô, Junko. 1986. *Syllable Theory in Prosodic Phonology*. Doctoral Dissertation, University of Massachusetts.
- Itô, Junko. 1989. A prosodic theory of epenthesis. *Natural Language and Linguistic Theory* 7. 217-259.
- Jackson, Frederick H. 1983. *The internal and external relationships of the Trukic Languages of Micronesia*. Ph.D. dissertation, University of Hawaii at Manoa.
- Jun, Jongho. 1995. *Place assimilation as the result of conflicting perceptual and articulatory constraints*. In *Proceedings of WCCFL 14*. 221-237.
- Kager, René. 1993. Alternatives to the Iambic-Trochaic Law. *Natural Language and Linguistic Theory* 11. 381-432.
- Kager, René. 1994. Ternary rhythm in alignment theory. Ms., Utrecht University. ROA-35

- Kager, René. 2001. Rhythmic directionality by positional licensing. Unpublished manuscript. Utrecht: Utrecht University. [Handout of talk presented at Fifth HIL Phonology Conference (HILP 5), University of Potsdam, 11 January 2001.]
- Kennedy, Robert. 2000. An Inkinconsistent Temtemplate Constraint. *Proceedings of SWOT V*, UCSD.
- Kennedy, Robert. 2002. Stress and reduplication in the Ponapeic languages. Paper presented at GLOW 25, Amsterdam.
- Kiparsky, Paul. 1968. Linguistic Universals and Linguistic Change. In E. Bach and R. Harms (eds.), *Universals in Linguistic Theory*, New York: Holt, Rinehart and Winston, 1968.
- Kiparsky, Paul. 1973. 'Elsewhere' in Phonology. In S. Anderson and P. Kiparsky (Eds.), *A Festschrift for Morris Halle*. New York: Holt, Rinehart & Winston.
- Kiparsky, Paul. 2000. Opacity and Cyclicity. *The Linguistic Review* 17:351-366.
- Kotchetov, A. 1999. What makes a coda contrastive? Plain and palatalized coronal stops in Russian. In E.Hume and K.Johnson (Eds.) *The Role of Speech Perception Phenomena in Phonology*, Academic Press.
- Kraehenmann, Astrid, Jennifer Fitzpatrick, Aditi Lahiri, and Tara Mohanan. 2000. Word-initial ggeminates in SSwiss GGerman and MMalayalam: production and perception. Poster, Laboratory Phonology 7, Nijmegen, the Netherlands.
- Lakoff, Robin. 1972. Another look at Drift. in Robert P. Stockwell and Ronald K.S. Macaulay (Eds.) *Linguistic Change and Generative Theory*. Bloomington: Indiana University Press.
- Lamontagne, Greg, and Keren Rice. 1995. A correspondence account of coalescence. In Jill Beckman, Suzanne Urbanczyk, & Laura Walsh (Eds.), *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality Theory*. Amherst, MA: Graduate Linguistic Student Association.
- Leben, William. 1973. *Suprasegmental phonology*. Doctoral thesis, Massachusetts Institute of Technology, Cambridge. [New York: Garland Press, 1980]
- Lee, Kee-Dong. 1975. *Kusaeian Reference Grammar*. Honolulu: University Press of Hawaii.
- Levin, Juliette. *A metrical theory of syllabicity*. Doctoral dissertation, Massachusetts Institute of Technology.

- Liberman, Alvin M., Franklin S. Cooper, Donald P. Shankweiler, and Michael Studdert-Kennedy. 1967. Perception of the Speech Code. *Psychological Review*. 74(6). 431-461.
- Liberman, Mark, and Alan Prince. 1977. On stress and linguistic rhythm. *Linguistic Inquiry* 8, 249-336.
- Lieber, Rochelle. 1981. *On the organization of the lexicon*. Doctoral dissertation, MIT. Available from MITWPL.
- Lightner, T. 1968. On the use of minor rules in Russian phonology. *Journal of Linguistics* 4. 69-72.
- Lindblom, B. 1990. Explaining phonetic variation: A sketch of the H and H theory. In W. Hardcastle & A. Marchal (Eds.), *Speech production and speech modelling*, pp. 403-439. Dordrecht: Kluwer.
- Lombardi, Linda. 1995. Laryngeal neutralization and syllable well-formedness. *Natural Language and Linguistic Theory* 13. 39-74
- Lombardi, Linda. 1996. Postlexical rules and the status of privative features. *Phonology* 13.1, 1-38.
- Maddieson, Ian. 1984. *Patterns of Sounds*. Cambridge: Cambridge University Press.
- Maddieson, Ian. 2002. Typological patterns of phonological systems in geographical perspective. Paper presented at Linguistic Society of America, San Francisco.
- Marantz, Alec. Re reduplication. *Linguistic Inquiry* 13. 483-545
- Marck, Jeff. 1975. *The origin and dispersal of the Proto-Nuclear Micronesians*. MA thesis, University of Iowa.
- Marck, Jeff. 1977. A preliminary manual of Micronesian sound correspondences. Paper presented at the Symposium on Austronesian Linguistics, LSA summer meeting, Honolulu, Hawaii.
- Marck, Jeff. 1991. Sixteen Nuclear Micronesian Verbs. In Robert Blust (Ed.), *Currents in Pacific Linguistics: Papers on Austronesian languages and ethnolinguistics in honour of George W. Grace*. Canberra: Pacific Linguistics. 223-239.
- Matthews, Peter H. 1974. *Morphology: An introduction to the theory of word-structure*. Cambridge University Press., Cambridge, Ma.
- Matthews, Peter H. 1972. *In_ectional Morphology: A Theoretical Study Based on Aspects of Latin Verb Conjugation*. Cambridge: Cambridge University Press.

- McCarthy, John J. 1979. *Formal problems in Semitic phonology and morphology*. Doctoral dissertation, Massachusetts Institute of Technology.
- McCarthy, John J. 1986. OCP effects: gemination and antigemination. *Linguistic Inquiry* 17:207-263.
- McCarthy, John J. 1995. Extensions of faithfulness: Rotuman revisited. Ms., University of Massachusetts, Amherst.
- McCarthy, John J., and Alan Prince. 1986. Prosodic Morphology. Ms., University of Massachusetts and Brandeis University.
- McCarthy, John J., and Alan Prince. 1990a. Foot and word in prosodic morphology: the Arabic broken plural. *Natural Language and Linguistic Theory* 8. 209-283.
- McCarthy, John J., and Alan Prince. 1990b. Prosodic morphology and templatic morphology. In M. Eid and J. McCarthy, eds., *Perspectives on Arabic Linguistics: Papers from the Second Symposium*:1-51. Amsterdam: Benjamins.
- McCarthy, John J., and Alan Prince. 1993a. Prosodic Morphology I: Constraint Interaction and Satisfaction. Ms., University of Massachusetts & Rutgers University.
- McCarthy, John J., and Alan Prince. 1993b. Generalized Alignment. In G.E. Booij and J. van Marle (Eds.), *Yearbook of Morphology 1993*. Dordrecht: Kluwer. 79-153.
- McCarthy, John J., and Alan Prince. 1994. The Emergence of the Unmarked. In M. González (Ed.), *Proceedings of NELS 24*. Amherst MA: Graduate Linguistic Student Association, University of Massachusetts. 333-379.
- McCarthy, John J., and Alan Prince. 1995. Faithfulness and Reduplicative Identity. In J. Beckman, L. Walsh-Dickey, S. Urbanczyk (Eds.), *University of Massachusetts Occasional Papers* 18, 249-384. Amherst: Graduate Student Linguistic Association. 249-384.
- McCarthy, John J., and Alan Prince. 1999. Faithfulness and identity in prosodic morphology. In René Kager, Harry van der Hulst, and Wim Zonneveld, eds., *The Prosody-Morphology Interface*. Cambridge University Press.
- McClintock, Susan Louise. 1999. *Consonant Sequence Constraints in Fijian and Micronesian Languages*. Doctoral Dissertation, University of Hawaii.
- McMahon, April. 2000. *Change, Chance, and Optimality*. Oxford University Press.
- Mester, R. Armin. 1986. *Studies in tier structure*. Doctoral dissertation, University of Massachusetts.

- Muller, Jennifer S. 1999. A unified mora account of Chuukese. In Sonya Bird, Andrew Carnie, Jason D. Haugen, and Peter Norquest (Eds.), *Proceedings of WCCFL 18*. 393-405.
- Myers, Scott. 1993. OCP effects in Optimality Theory. ROA 6.
- Myers, Scott. 2002. Gaps in Factorial Typology: The Case of Voicing in Consonant Clusters. Paper presented at Southwest Optimality Theory Workshop/Texas Linguistics Society, Austin TX. ROA 509.
- Nelson, Nicole 1998. Right Anchor, Aweigh. Ms. Rutgers University. ROA-284
- Nespor, Marina, and Irene Vogel. 1989. On clashes and lapses. *Phonology* 6. 69-116.
- Ohala, John. 1981. The listener as a source of sound change. *Papers from the Regional Meetings of the Chicago Linguistics Society* 17.
- Ohala, John. 1990. The phonetics and phonology of aspects of assimilation. In J. Kingston and M. Beckman (Eds.), *Papers in Laboratory Phonology 1*, (pp. 258-275) Cambridge University Press.
- Padgett, Jaye. 1997. Perceptual distance of contrast: Vowel height and nasality. In Rachel Walker, Daniel Karvonen, and Motoko Katayama, eds. *Phonology at Santa Cruz* 5. 63-78.
- Palmer, Bill. 2000. Sum: Phonological Change Driven by Imitation. *Linguist List* 11.2186.
- Pater, Joe. 1995. On the nonuniformity of weight-to-stress and stress preservation effects in English. Ms. McGill University. ROA-107.
- Pater, Joe. 1995. Austronesian nasal substitution and other NC effects. In René Kager, Harry van der Hulst, and Wim Zonneveld (Eds.), *Proceedings of OTS/HIL Workshop on Prosodic Morphology*.
- Pawley, Andrew. 1972. On the internal relationships of Eastern Oceanic languages. In: R. Green and M. Kelly (eds) *Studies in Oceanic Culture History*, vol. 3. pp. 1-142. Honolulu: Bishop Museum.
- Pawley, Andrew, and Roger C. Green. 1984. The Proto-Oceanic language community. *The Journal of Pacific History* 19.3. 123-146.
- Prince, Alan. 1980. A metrical theory for Estonian quantity. *Linguistic Inquiry* 11, 511-62.

- Prince, Alan, and Paul Smolensky. 1993. *Optimality Theory: Constraint Interaction in Generative Grammar*. RuCCs Technical Report #2. Piscataway: Rutgers Center for Cognitive Science.
- Rehg, Kenneth, and Damian G. Sohl. 1981. *Ponapean Reference Grammar*. Honolulu: University Press of Hawaii.
- Rehg, Kenneth. 1984. Nasal Substitution rules in Ponapean. In B.W. Bender (Ed.), *Studies in Micronesian Linguistics*. Canberra: Pacific Linguistics. 317-337.
- Rehg, Kenneth. 1991. Final vowel lenition in Micronesian languages: an exploration of the dynamics of drift. In Robert Blust (Ed.), *Currents in Pacific Linguistics: Papers on Austronesian languages and ethnolinguistics in honour of George W. Grace*. Canberra: Pacific Linguistics. 383-401.
- Rehg, Kenneth. 1993. Proto-Micronesian Prosody. In J.A. Edmondson & K. J. Gregerson (Eds.), *Tonality in Austronesian Languages*. Honolulu: University of Hawaii Press. 25-46.
- Rice, Keren. 1996. Default variability: The coronal-velar relationship. *Natural Language and Linguistic Theory* 14. 493-543.
- Richards, Norvin. 1995. An Optimality-Theoretic account of Ponapean reduplication. ms., Massachusetts Institute of Technology.
- Robins, Robert H. 1959. In defense of WP. *Transactions of the American Philological Society* 116-44. Reprinted in *Transactions of the Philological Society* 99(2).116-44, 2001.
- Rosenthal, Samuel. 1996. *Vowel/Glide Alternation in a Theory of Constraint Interaction* Doctoral Dissertation, University of Massachusetts.
- Sanders, Nathan. 2003. *Opacity and Sound Change in the Polish Lexicon*. Doctoral dissertation, University of California-Santa Cruz.
- Selkirk, Elisabeth O. 1980. Prosodic domains in phonology: Sanskrit revisited. In M. Aronoff and M.-L. Kean (Eds.) *Juncture*:107-129. Anma Libri. Saratoga, California.
- Selkirk, Elisabeth O. 1980. The Role of Prosodic Categories in English Word Stress. *Linguistic-Inquiry* 11, 3. 563-605.
- Selkirk, Elisabeth O. 1984. *Phonology and syntax: The relation between sound and structure*. Cambridge, MA: MIT Press.

- Selkirk, Elizabeth O. 1990. A two-root theory of length. *University of Massachusetts occasional papers in linguistics* 14. 123-171.
- Smolensky, Paul. 1996. On the Comprehension/Production Dilemma in Child Language. *Linguistic Inquiry* 27-4. 720-731.
- Tesar, Bruce-B, and Paul Smolensky. 1998. Learning Optimality-Theoretic Grammars. *Lingua* 106. 161-196
- Tesar, Bruce-B, and Paul Smolensky. 1998. Learnability in Optimality Theory. *Linguistic-Inquiry* 29-2. 229-268.
- Sohn, Ho-Minh, and Anthony F. Tawerilmang. 1976. *Woleaian-English dictionary*. Honolulu: University Press of Hawaii.
- Sohn, Ho-Minh, and Byron W. Bender. 1973. *A Ulithian Grammar*. Canberra: Pacific Linguistics.
- Sohn, Ho-Minh. 1975. *Woleaian Reference Grammar*. Honolulu: University Press of Hawaii.
- Spaelti, P. 1997. *Dimensions of Variation in Multi-Pattern Reduplication*. Doctoral Dissertation, University of California-Santa Cruz.
- Steriade, Donca. 1997. Phonetics in Phonology: the Case of Laryngeal Neutralization. In M.Gordon (Ed.), *UCLA Working Papers in Phonology* 2.
- Steriade, Donca. 1999. Alternatives to the syllabic interpretation of consonantal phonotactics. In O. Fujimura, B. Joseph, and B. Palek (Eds.), *Proceedings of the 1998 Linguistics and Phonetics Conference*. The Karolinum Press, 205-242
- Steriade, Donca. 2000. Directional asymmetries in place assimilation: a perceptual account. In E. Hume and K. Johnson (Eds.), *Perception in Phonology*. Academic Press.
- Stevens, Alan M. 1968. *Madurese phonology and morphology*. American Oriental Series 52. New Haven CT: American Oriental Society.
- Stevens, Alan M. 1985. Reduplication in Madurese. In *Proceedings of the Second Eastern States Conference on Linguistics*. Columbus OH: Linguistics Department, Ohio State University. 232-242.
- Stevens, K.N. 1989. On the quantal nature of speech. *Journal of Phonetics* 17. 3-45.
- Stevens, K.N. and S.E. Blumstein. 1975. Quantal aspects of consonant production and perception: a study of retroflex consonants. *Journal of Phonetics* 3. 215-234.

- Stevens, K.N., and S.E. Blumstein. 1978. Invariant cues for place of articulation in stop consonant. *Journal of the Acoustical Society of America* 64. 1358-1368
- Struijke, Caro. 2000. Existential Faithfulness: A Study of Reduplicative TETU, Feature Movement, and Dissimilation. Ph.D. dissertation, University of Maryland.
- Suh, Chang-Kook. Consonant Gemminates: Towards a Theory of Integrity and Inalterability. Doctoral Dissertation, University of Arizona.
- Suzuki, Keiichiro. 1997. *A typological survey of dissimilation*. Doctoral dissertation, University of Arizona.
- Takano, Michi. 1996. Coronal Consonants in Ponapean revisited. In Brian Agbayani and Naomi Harada (Eds.), *Proceedings of SWOT 2*, University of California-Irvine Working Papers in Linguistics.
- Walker, Rachel. 1998. *Nasalization, Neutral Segments and Opacity Effects*. Doctoral Dissertation, University of California-Santa Cruz.
- Wang, MD and RC Bilger. 1973. Consonant confusions in noise: A study of perceptual features. *Journal of the Acoustical Society of America* 54, 5: 1248-1266.
- Zec, Draga, 1988. *Sonority constraints on prosodic structure*. PhD dissertation., Stanford University.
- Zubitskaya, Katya. 1997. Mechanism of sound change in Optimality Theory. *Language Variation and Change* 9. 121-148.