

PARTICULARIZED REPRESENTATIONS AND RICHNESS OF THE BASE:
EVIDENCE FROM PONAPEAN CONSONANT PHONOLOGY

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Abstract

This paper addresses a complex set of phonological restrictions on potentially adjacent consonants in Ponapean (Rehg 1981). Such sequences may be partially nasalized, fully assimilated, or broken up by an intervening vowel. The choice of strategy depends on the place and manner of articulation of the consonants involved, and is particularly complex where both segments are coronal. I present an account of these data that relies on particularized representations, a narrow conception of underlying forms. Despite the serious potential conflict this poses with Richness of the Base, an axiomatic tenet of Optimality Theory, I show that these particularized representations are optimized. This analysis therefore bears directly on other phonological constructs that have been difficult to compromise with Optimality Theory, such as Underspecification Theory and the Obligatory Contour Principle.

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The segmental phonology of Ponapean (Rehg 1979, 1981, 1984a) presents some asymmetrical patterns of assimilation and nasalization among potential consonant sequences, but coronal consonants pattern differently from non-coronals. For example, where identical obstruents are potentially adjacent at morpheme junctures, the first is rendered nasal, as in [pam-pap] and [ton-tot]; however, if the consonants are non-identical but still homorganic, nasalization can only occur if they are not coronal, as seen in the difference between [m^wom^w-m^wop^w] and [nete-net]. This paper provides an account of this asymmetry in part by invoking *particularized input structures* reminiscent of underspecified representations. Specifically, it relies on a narrow conceptualization of underlying representations, utilizing feature geometric representations which I characterize as contextual underspecification.

The analysis has important implications for the role of Underspecification Theory (Archangeli 1984, 1988, Kiparsky 1982, Mester and Itô 1989, Pulleyblank 1988, Steriade 1987), Feature Geometry (Sagey 1986, Clements and Hume 1995), and the Obligatory Contour Principle (OCP, Leben 1973, Goldsmith 1976) in Optimality Theory (OT, Prince and Smolensky 1993). Underspecification and the OCP are theoretical constructs which predate Optimality Theory and which are difficult to compromise with OT's central tenet of Richness of the Base, a guiding principle that structural markedness constraints may only evaluate candidate outputs.

A central assumption of Underspecification Theory is that underlying representations may lack values for a particular feature specification; this is true of two variations of the theory, Radical and Restricted Underspecification. Under Radical Underspecification (Kiparsky 1982, Archangeli 1984, Pulleyblank 1988) certain feature values are never underlyingly present within

individual languages; for example, [-lateral] is argued to be absent from lexical representations in English, and [-voi] is absent from underlying representations in Russian. Restricted Underspecification permits a subset of a language's segment inventory to lack a particular feature value; for example, Mester and Itô (1989) argue that Japanese /ɾ/ has no underlying [CORONAL] specification, while other coronal consonants are specified as such. Likewise, Steriade (1987) proposes that Russian non-affricate obstruents are specified for [±voiced], while affricates and sonorants lack an underlying voicing specification. Underspecification, whether Radical or Restricted, is difficult to compromise with OT, in which underlying representations may not be so stipulated.

This conflict between Richness of the Base and Underspecification has been visited before, notably by Inkelas (1994), Itô, Mester, and Padgett (1995), and Smolensky (1993). Inkelas (1994) argues that underspecified representations are plausible within OT wherever alternations motivate them. For example, alternating suffix vowels in Turkish are underspecified, while non-alternating suffix vowels are fully specified underlyingly. Itô, Mester, and Padgett (1995) argue that underspecified representations are optimized; given an exhaustive choice of possible underlying representations which all converge on the same output, the learner chooses the underspecified one. Smolensky (1993) proposes that instances of phonological inertia, taken as evidence for underspecification, can alternatively be taken as evidence for unmarkedness. I return to these issues in the discussion in Section 6, as the roles of predictability, redundancy, and optimization play out rather differently in Ponapean, because underspecified and fully specified input representations do not converge on the same outputs.

Similarly, the OCP has proven useful as a morpheme structure constraint, a theoretical means of restricting the form of underlying representations. Again, because of Richness of the

Base, OT does not tolerate such input-oriented restriction. The OCP has thus been recast as an output-oriented constraint (Myers 1997, Rose 2000), and as such it does not directly affect the nature of underlying representations. The OCP occupies a violable position in the present analysis, but also ends up influencing the structure of underlying representations.

Ponapean has a lengthy analytical literature dedicated to its nasal consonants and reduplicative system (Itô 1986, 1989, McCarthy and Prince 1986, Spaelti 1997, Kennedy 2002, 2003, Davis 2001, Blevins and Garrett 1993, Goodman 1995, Rehg 1981, 1984a), but the specific phonological issue I address has largely gone untouched. The analysis I present uses principles of underspecification and the OCP and ultimately relies on a limitation of underlying forms to what I call particularized inputs. It thus serves as a test of OT against these seemingly incompatible constructs. I argue that the OCP as an output constraint, along with other markedness constraints, would lead a learner to posit contextually underspecified representations, so that such forms are learned without being arbitrarily stipulated as such.

This paper is organized as follows. Section 1 is a summary of data that illustrate the restrictions on consonant sequences in Ponapean, and Sections 2-4 present an account of these data. Section 5 is an overview of other approaches to these data (Davis 2001, Goodman 1995, Spaelti 1997). I conclude in Section 6 with a summary of the implications of the analysis in light of Inkelas (1994) and Itô, Mester, and Padgett (1997), and a discussion of learnability, particularized inputs, and Richness of the Base.

1. Data¹

The Ponapean consonant system employs five places of articulation among obstruent stops: labial [p], labiovelar [p^w], alveolar [t], post-alveolar [c], and velar [k]. For nasal consonants,

¹ I transcribe data in IPA transliterations of Ponapean orthography. Thus, I use [t] for Ponapean *d* and [c] for Ponapean *t*. I also transcribe Ponapean *ng* as [ŋ], and indicate vowel length with double vowels (e.g., [ii]) rather than with the Ponapean device of vowel + *h* (e.g., *ih* for long /i/).

there are four contrastive places of articulation: labial [p], labiovelar [p^w], coronal [n], and velar [k]. In addition, there is a coronal fricative [s] and two coronal liquids [l] and [r]. This inventory is summarized in Table (1) below.

(1)

	Labial	Labio-velar	Alveolar	Post-alveolar	Velar
Stops	p	p ^w	t	c	k
Fricatives			s		
nasals	m	m ^w	n		ŋ
liquids			l r		
glides		w	j		

Ponapean imposes an intricate set of restrictions on consonant sequences brought about through morphological derivation. These restrictions are notably evident in prefixing reduplication, which precipitates a potential consonant sequence comprising the final consonant of the prefix and the initial consonant of the base. Most generally, if the two consonants are not homorganic, a vowel always intervenes (2).²

(2) Heterorganic sequences

<i>basic</i>	<i>durative</i>	<i>gloss</i>
caman	cama-caman	‘to remember’
tep	tepe-tep	‘to kick’
tep	tepi-tep	‘to begin’
ker	kere-ker	‘to flow’
lɔŋe	lɔŋi-lɔŋe	‘to pass across’
par	para-par	‘to cut’
pet	peti-pet	‘to be squeezed’
p ^w il	p ^w ili-p ^w il	‘to flow’

² Whether this intervening vowel is a copy of a base segment or an inserted default vowel is a separate question which I address in §4.

If the consonants are homorganic, the potential sequence is resolved either with an intervening vowel, nasalization of the first consonant, or full assimilation of the first consonant to the second. The choice of resolution depends on the place features of the homorganic sequence; for example, non-coronals always undergo nasalization (3).

(3)	Non-coronal homorganic sequences		
	m ^w op ^w	m ^w om ^w -m ^w op ^w	‘out of breath’
	pap	pam-pap	‘to swim’
	p ^w ap ^w	p ^w am ^w -p ^w ap ^w	‘to fall’
	kik	kiŋ-kik	‘to kick’
	mem	mem-mem	‘sweet’
	kaŋ	kaŋ-kaŋ	‘eat’

If the consonants are both coronal, the choice is more complicated. For identical coronal obstruents, the first is nasalized (4a), while identical sonorants remain as such (4b). If the first consonant is sonorant, it is nasalized before an obstruent (4c) but assimilated completely to another sonorant (4d). Finally, if the first of two non-identical coronals is an obstruent, a vowel intervenes (4e).

(4)	Homorganic coronal sequences		
a.	tot	ton-tot	‘frequent’
	tit	tin-tit	‘build a wall’
	sis	sin-sis	‘to speak with an accent’
	cac	can-cac	‘to writhe’
b.	rer	rer-rer	‘tremble’
	lal	lal-lal	‘make a sound’
c.	til	tin-til	‘to penetrate’
	tar	tan-tar	‘to strike, of a fish’
	cal	can-cal	‘to make a click-like sound’
	cir	cin-cir	‘narrowing’
	sel	sen-sel	‘tied’
	sar	san-sar	‘to fade’
	tune	tun-tune	‘tie together’
d.	nur	nun-nur	‘contract’
	lirrooro	lil-lirrooro	‘protective’
	linenek	lil-linenek	‘oversexed’
e.	set	sete-set	‘artificially ripen breadfruit’

secik	seci-secik	‘quick in performing’
net	nete-net	‘smell’
nec	neci-nec	‘sell’
lus	lusu-lus	‘jump’
lec	lece-lec	‘flick’
lituii	liti-lituii	‘serve as female companion’
rese	resi-rese	‘saw’
roc	roco-roc	‘dark’

The analytical challenge is to generalize the system without predicting vowel insertion for the non-identical homorganic sequences in (4cd) and without predicting nasalization or assimilation for the non-identical homorganic coronals in (4e). I expand upon these challenges in the following section.

a formal analysis that, in its final form, will adequately model the differential behavior of coronal obstruents and sonorants. The analysis will incorporate two important claims: (a) homorganic consonants share place specification wherever possible, and (b) contrastive secondary features must associate to an appropriate host segment.

It is the potential conflict among these demands that ultimately produces the resistance among some coronal sequences to nasalization. I provide evidence for each of these claims below, first by exploring generalizations among Ponapean roots (§2), and second by testing them against the reduplicative system (§3). I address a number of remaining analytical issues in §4, including the source of the intervening vowel, the size of the reduplicative prefix, and the presence of other patterns of nasal substitution in the language.

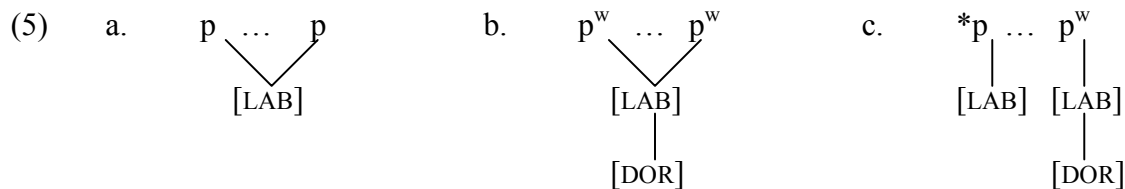
2. Lexical representations

Ponapean roots respect restrictions on co-occurring consonants; these restrictions are evident if we group labials and labiovelars together under a major place specification of [LABIAL], and likewise alveolars and post-alveolars under a major place specification of [CORONAL]. Labials and labiovelars are therefore homorganic, and the contrast between them is represented with a

secondary specification of [DORSAL].³ Similarly, alveolars and post-alveolars are homorganic, and the contrast between them is represented with a secondary specification of [±anterior]. This organization of place features for Ponapean parallels Goodman (1995). We will see that this grouping of features provides evidence for contextually underspecified, feature-geometric representations of underlying forms.

Under the Ponapean co-occurrence restrictions, two heterorganic consonants can occur within the same root, but homorganic consonants are relatively limited. If both consonants are labial, they are also identical in their secondary specification, regardless of the nasality of either member. Thus, neither /p/ nor /m/ co-occurs with /p^w/ or /m^w/ in the same root, but both can co-occur with another /p/ or another /m/, as in [pap] ‘swim’ and [mem] ‘sweet’. Conversely, neither /p^w/ nor /m^w/ co-occurs with /p/ or /m/ in the same root, but both can co-occur with another /p^w/ or another /m^w/, as in [p^wap^w] ‘fall’ and [m^wop^w] ‘out of breath’.

Like Goodman (1995), I represent homorganic roots with a single place node shared among two consonants (5a), using Feature Geometric association between segment nodes and their place specification (Sagey 1986, Clements and Hume 1995). Homorganic roots thus necessarily share their secondary place specification (5b), which is reflected in the absence of roots that comprise labial and labiovelar consonants. Labials and labiovelars could only co-occur if they had distinct primary place nodes (5c), but such representations are systematically missing from the Ponapean lexicon.



³ In this paper, I assume privative specifications for place features and binary specifications for other features such as [±anterior] and [±sonorant]. This choice does not impact the details or implications of the analysis.

The representations in (5ab) are *particularized inputs*, in that the analysis of the asymmetry in Ponapean assimilation presented in Section 3 will only work if homorganic consonants within roots share a single autosegmental place feature underlyingly. Because of this place-sharing, the consonants are not truly underspecified, but I refer to these representations as *contextually underspecified*: the consonants do not have autonomous specifications of their own.

While Goodman attributes this generalization to a formal Morpheme Structure Constraint holding over the form of underlying representations, I portray it as an emergent consequence of an optimized lexicon. Suppose that representations such as those in (5) are candidate output forms, and that (5c) violates an output oriented instantiation of the Obligatory Contour Principle (Leben 1973, Goldsmith 1976) holding over place specifications, defined as (6).

(6) OCP-PLACE Adjacent identical place nodes are forbidden

Even though OCP-PLACE evaluates output forms, it ultimately has influence over the form of underlying representations via Lexicon Optimization (Inkelas 1994, Prince and Smolensky 1993, Smolensky 1994), the process by which learners choose the optimal input-output pairing. Recall that Richness of the Base prevents stipulation upon the form of underlying representations. Yet scenarios exist in which multiple possible underlying representations converge on the same output representation: the claim of Lexicon Optimization is that the learner compares violations incurred by each potential input-output pair and chooses the optimal pairing.

Ponapean roots present the additional complication that singly and doubly specified output representations are possible for homorganic roots. For example, confronted with a surface

form such as [pap], a learner must first posit whether the consonants share a single place feature, and only then can the learner posit an appropriate underlying form. A singly-specified output representation satisfies OCP-PLACE at the expense of UNIFORMITY (7), which demands that each segment have its own place specification.

(7) UNIFORMITY For each segment, there is exactly one primary place specification.

Thus, if the learner can determine that OCP-PLACE outranks UNIFORMITY, she will then choose a shared-place representation for both the input and output representations of homorganic roots, as summarized in the Lexicon Optimization tableau in (8); a “tableau des tableaux” that evaluates input-output pairs. The input-output pair (8a), in which a single specification occurs at both levels, is the optimal pairing, since its output member satisfies the OCP and its input-output relationship satisfies the Faithfulness constraint MAX-PLACE. Note that at this point, the ranking OCP >> UNIFORMITY is unexplained, but we will motivate it in §4.

(8)		MAX-PLACE	OCP	UNIFORMITY
a. ☞	$\begin{array}{cc} /p a p/ \rightarrow [p a p] \\ \backslash / \quad \backslash / \\ \text{LAB} \quad \text{LAB} \end{array}$			*
b.	$\begin{array}{cc} /p a p/ \rightarrow [p a p] \\ \quad \quad \quad \\ \text{LAB LAB} \quad \text{LAB LAB} \end{array}$		*!	
c.	$\begin{array}{cc} /p a p/ \rightarrow [p a p] \\ \backslash / \quad \quad \\ \text{LAB} \quad \text{LAB LAB} \end{array}$		*!	
d.	$\begin{array}{cc} /p a p/ \rightarrow [p a p] \\ \quad \quad \backslash / \\ \text{LAB LAB} \quad \text{LAB} \end{array}$	*!		*

A similar set of observations exists for the coronal consonants /t/ and /c/: there are roots that contain two of the same coronal plosive, but no native roots contain both /t/ and /c/ in either order. If we ascribe the contrast between /t/ and /c/ to a secondary specification of [\pm anterior], dependent on the major place node of [coronal], we arrive at the same generalization as for labials: roots may contain two coronal plosives that share a primary consonant place node, and along with it, its secondary specification, but do not contain two coronal plosives with autonomous place nodes.

The distribution of coronal sonorants may suggest that similar co-occurrence restrictions might also apply to them; for example, Goodman (1995) notes an absence of roots in which /l/ and /r/ co-occur, and an extreme rarity of roots that include /l/ with /n/ and /s/ with /c/. Nevertheless, I argue that they are not subject to such restrictions, for several reasons. First, as the data in (4cde) show, /n/, /s/, /l/, and /r/ occur with either coronal plosive, and with each other. Second, there is no phonemic secondary place contrast for the coronal nasal /n/ to parallel the contrast between /m/ and /m^w/, and /n/ alternates between an alveolar and a retroflex articulation sensitive to the anteriority of nearby coronals (Rehg 1984a: 318). The other coronals do not clearly undergo a similar alternation, but Rehg notes some flux in the anteriority of /s/; whether this flux is conditioned by the anteriority of adjacent consonants is an open question.

The existence of forms such as [secik] ‘quick in performing’, [nur] ‘contract’, and [linenek] ‘oversexed’ is problematic for the notion of an MSC holding over underlying representations, especially if the coronals are held to be autonomously specified for place. However, if we implement Lexicon Optimization for homorganic coronal roots, we predict that roots such as /net/ ‘smell’ and /nec/ ‘sell’ both contain a single coronal specification; the same

prediction extends to roots such as /tal/, /sel/, /nur/, /cal/, and /set/. In fact, this would allow any of /s, n, l, r/ to occur with each other and with either the alveolar /t/ or post-alveolar /c/.

See for example Tableau (9), which chooses the optimal input-output pair for the root /nec/. Like Tableau (8), this tableau-des-tableaux chooses an input-output pair in which a single specification occurs at both levels (9a), whose output satisfies the OCP and whose input-output relationship satisfies MAX-PLACE.

(9)		MAX-F	OCP	UNIFORMITY
a. ☞	$\begin{array}{cc} /nec/ \rightarrow [nec] \\ \backslash / \quad \backslash / \\ \text{COR} \quad \text{COR} \end{array}$			*
b.	$\begin{array}{cc} /nec/ \rightarrow [nec] \\ \quad \quad \quad \\ \text{COR COR} \quad \text{COR COR} \end{array}$		*!	
c.	$\begin{array}{cc} /nec/ \rightarrow [nec] \\ \backslash / \quad \quad \\ \text{COR} \quad \text{COR COR} \end{array}$		*!	
d.	$\begin{array}{cc} /nec/ \rightarrow [nec] \\ \quad \quad \backslash / \\ \text{COR COR} \quad \text{COR} \end{array}$	*!		*

The appeal to place-sharing representations captures the observed distributional gaps for co-occurring consonants, and also matches what we know of contrast among Ponapean consonants. The overall generalization is that a root may not contain two adjacent identical place specifications. Among coronals, any sonorant may share place with any other coronal.

This is a second crucial departure from Goodman (1995), who argues that all coronal consonants are underlyingly fully specified for primary and secondary place and are also subject to the same MSC that holds over coronal plosives and over labials in general. In her analysis, /l/ and /s/ are anterior coronals and may co-occur with /t/, while /r/ is non-anterior may co-occur with /c/. She thus portrays forms such as [secik], [nur], and [linenek] as rare exceptions to the

MSC. In contrast, we will see that the optimized approach requires no such exceptionality, and is further supported by the assimilatory properties of the consonants involved. In the next section, I show how these optimized representations help account for observed patterns of consonant sequence resolution.

3. Consonant sequences at reduplicative junctures

Recall from the data in Section 1 that the peculiarities we observe among potential consonant sequences apply at the boundary between a reduplicative prefix and the stem to which it attaches. Such sequences comprise the reduplicant's final consonant and the base's initial consonant. The reduplicant's final consonant may either nasalize, fully assimilate, or be offset from the stem by a vowel.⁴ In Correspondence-Theoretic terms (McCarthy and Prince 1995), nasalized and assimilated consonants within the reduplicative substring violate at least one Correspondence constraint over featural specification, by virtue of not fully rendering the same features that associate to their base correspondent.

Among coronal consonants, obstruents nasalize only prior to fully identical consonants, as in /tot + tot/ → [ton-tot]. Otherwise, if the final reduplicative consonant is an obstruent and the initial stem consonant is a non-identical coronal, a vowel appears between them at the morpheme juncture, as in /net + net/ → [nete-net]. In the latter case, we may presume there is at least one constraint violated by the nasalized candidate *[nen-net] but satisfied by [nete-net].

⁴ Because the affected consonant belongs to a reduplicative morpheme, some elaboration on the base-reduplicant relationship is warranted. The analysis below relies on the Optimality Theoretic notion of Correspondence (McCarthy and Prince 1995, 1999). Under correspondence, reduplicated structures are evaluated in the degree of similarity that exists between the reduplicative substring (essentially, the affix) and the base substring (essentially, the stem). Similarity is evaluated by assigning indices to each element of each substring: an element in one substring thus may have a corresponding element (or correspondent) in the other substring. The correspondence relation allows a constraint system to detect whether the reduplicative substring lacks (i.e., fails to copy) a corresponding element of the base, whether it includes (inserts) an element that lacks a correspondent in the base, or whether two elements in correspondence differ by some feature specification.

Let us follow the observation that /t/ is faithfully rendered in the reduplicant if it is the *only* /t/ in the base, as is the case in /net/. Recall that [±ant] is contrastive for coronal plosives but not for coronal nasals. Furthermore, roots with two /t/s nevertheless contain a single place specification. If we formalize the reduplicative system to require faithful copying of contrastive place specifications with Max-BR-[place] (10), we can rule out a nasalized candidate of *[nen-net] which fails to copy the [+anterior] specification of the second consonant (see 12a).

(10) MAX-BR-PLACE: A base place specification has a correspondent in the reduplicant.

A second constraint is required to handle candidates in which the nasalized consonants of the reduplicant do maximize the anteriority feature of the base, such as the representation of *[nen-net] in (12b), where the initial reduplicative consonant is associated to a [+ant] feature. I formalize this with the constraint LICENSE[ant], which requires secondary [±anterior] features to associate to at least one [-son] segment, and which is violated by (12b).

(11) LICENSE[ANT]: [±anterior] associates to [-son].

(12)	a.	*n e n n e t	b.	*n e n n e t
		\ / \ /		\ / \ /
		[cor] [cor]		[cor] [cor]
		[+ant]		[+ant] [+ant]

The tandem of MAX-BR-PLACE and LICENSE[ANTERIOR] ensures that the [t] of the base in /net/ has a fully faithful [t] correspondent in its reduplicant. Further, both constraints are satisfied by the licit nasalized candidate [ton-tot], because its initial [t] *does* maximize the contrastive place feature of the base. These effects are summarized in Tableaux (13) and (14).⁵

⁵ The full set of constraints needed to properly predict the form of the reduplicant is quite richer. The system must include constraints that forbid medial coda obstruents, to rule out candidates such as *[net-net]. The system must

(13)	RED + n e t cor +ant	MAX-BR PLACE	LICENSE [ANT]	*STRUC- σ
a.	n e t e n e t \ / \ / cor cor +ant +ant			***
b.	n e n n e t \ / cor cor +ant +ant		*!	**
c.	n e n n e t \ / cor cor +ant	*!		**
d.	n e n n e t \ / \ / \ / cor +ant	*!		**

(14)	RED + t o t \ / cor +ant	MAX-BR PLACE	LICENSE [ANT]	*STRUC- σ
a.	t o t o t o t \ / \ / cor cor +ant +ant			***!
b.	t o n t o t \ / cor cor +ant +ant			**
c.	t o n t o t \ / \ / \ / cor +ant	*!		**

The predictions readily extend to roots with other combinations of non-identical coronals.

For example, nasalization occurs if the root's second consonant is sonorant, as in /til/, yielding

also force the reduplicant to be bimoraic, to prevent outputs such as *[ne-net]. These other constraints can be posited to outrank MAX-BR-PLACE; note that each candidate in Tableau (13) is satisfactory in terms of its mora count and its coda structure. I address these issues more explicitly in Section 4.

[tin-til] (15b) without violating MAX-BR-PLACE or of LICENSE[ANT]. However, a vowel intervenes if the root's initial consonant is sonorant, as in /lec/, yielding [lece-lec]. Changing the reduplicant's final consonant to yield *[lel-lec] would violate LICENSE[ANT] if [-ant] were copied (16b) or MAX-BR-PLACE if [-ant] were not copied (16c).

(15)	RED + c a l cor -ant	MAX-BR PLACE	LICENSE [ANT]	*STRUC-σ
a.	c a l a c a l \ / \ / cor cor -ant -ant			***!
b.☞	c a n c a l \ / cor cor -ant -ant			**
c.	c a n c a l \ / \ / \ / cor -ant	*!		**

(16)	RED + l e c cor -ant	MAX-BR PLACE	LICENSE [ANT]	*STRUC-σ
a.☞	l e c e l e c \ / \ / cor cor -ant -ant			***
b.	l e l l e c \ / cor cor -ant -ant		*!	**
c.	l e l l e c \ / \ / \ / cor -ant	*!		**

The obstruent /s/ presents some difficulty, because its co-occurrence with /t/ and /s/ within roots suggests it is underlyingly placeless, but its non-assimilatory behavior suggests that

it is subject to a faithfulness constraint for the feature [+continuant], parallel to MAX-BR-PLACE.

I thus include a constraint MAX-BR-[+CONT] (17). If the root contains two identical continuants,


as in /sis/, nasalization can produce [sin-sis] (18b) while still satisfying MAX-BR-[+CONT]. If

only the second base consonant is [s], as in /lus/, a vowel must intervene, because *[lul-lus]

(19bc) violates MAX-BR-[+CONT]; consequently [lusu-lus] (19a) is the proper output.


(17) MAX-BR-[+CONT]: A base [+cont] specification has a [+cont] correspondent in the reduplicant.

(18)	RED + s i s \ / cor	MAX-BR- [+CONT]	MAX-BR PLACE	LICENSE [ANT]	*STRUC-σ
a.	s i s i s i s \ / cor cor				***!
b. 	s i n s i s \ cor cor				**
c.	s i n s i s \ / cor		*!		**

(19)	RED + l u s \ / cor	MAX-BR- [+CONT]	MAX-BR PLACE	LICENSE [ANT]	*STRUC-σ
a. 	l u s u l u s \ / cor cor				***
b.	l u l l u s \ cor cor	*!			**
	l u l l u s \ / cor	*!	*		**


A vowel also intervenes if the root comprises [s] and some other coronal obstruent. For example, *[sen-set] is ruled out by MAX-BR-[PLACE] if no [-ant] feature is copied in the reduplicant (21c). The representation in which the reduplicant's initial [s] is [+anterior] motivates a more refined definition of LICENSE[ANTERIOR] (20), requiring that [\pm ant] features must associate to [t] or [c]. This is violated by (21b), and [sete-set] (13) is then the proper output.

(20) LICENSE[ANT]: [\pm anterior] associates to [-son, -cont].

(21)	RED + s e t cor +ant	MAX-BR- [+CONT]	MAX-BR PLACE	LICENSE [ANT]	*STRUC- σ
a. 	s e t e s e t \ / \ / cor cor +ant +ant				***
b.	s e n s e t \ / cor cor +ant +ant			*!	**
c.	s e n s e t \ / \ / \ / cor +ant		*!		**

The sonorant coronals do not receive identical reduplicative correspondents when occurring within the same root as other coronals, because they are contextually underspecified. Under these circumstances, they have no autonomous place features that would require faithful maximization in the reduplicant. If the reduplicant's final consonant is sonorant, it appears as /n/ before obstruents, as in [can-cal] in Tableau (15); forms such as [san-sar] and [tin-til] are parallel. If the base contains two sonorant coronals, the reduplicant's final consonant fully assimilates to the initial consonant of the base, as in [nun-nur] (22b). Such assimilation occurs without

violating MAX-BR-PLACE, because there is no [\pm ant] feature in the root that requires maximization. Forms such as [lil-linenek] show the same effect.

(22)	RED + n u r \ / COR	MAX-BR PLACE	LICENSE [ANT]	*STRUC- σ
a.	n u r u n u r \ / COR \ / COR			***!
b. 	n u n n u r \ \ COR \ \ COR			**
c.	n u n n u r \ \ \ \ \ COR	*!		**

One last note regarding sonorant coronals is that they are indeed underlyingly specified as [CORONAL] when they occur in the same root as non-coronals, as in /p^wil/. Since there is no other coronal consonant with which they may share place, they must be encoded with an autonomous place specification. It follows that such roots reduplicate with intervening vowels, as in [p^wili-p^wil].

4. Other issues

There remain several unaddressed aspects of the analysis that require some discussion: in particular, the mechanism for inserting vowels, the requirement that the reduplicant be bimoraic, and the ranking of OCP-PLACE over UNIFORMITY. In addition, Ponapean consonants undergo other processes of nasalization outside of reduplication, a fact which also merits some comment.

I discuss each of these below.

4.1 Vowel insertion

As we saw in Section 1, reduplicative prefixes in Ponapean receive additional vowels wherever the reduplicant's final consonant maintains its own full specification, which is the case if the root's consonants are heterorganic, as in [p^wili-p^wil] and [tepe-tep], or if the second root consonant is a non-identical coronal obstruent, as in [nete-net] and [lusu-lus]. The source of these vowels deserves some comment, as it is not immediately obvious whether they are reduplicative correspondents of base vowels or whether instead they are inserted as default vowels.

The choice between these analyses can be recast as follows: if the vowel is itself a reduplicative correspondent, then it fails to be copied under particular conditions of homorganicity. If it is instead an epenthetic vowel, then it is inserted only under particular conditions of heterorganicity and coronal non-identity. The insertion account is supported by the observation that a vowel appears in the reduplicative substring when no base correspondent is evident at the surface; for example, in [tepe-tep], the reduplicant's final vowel has no corresponding final vowel in the stem.

Nevertheless, there is also evidence in favor of the alternative account, that the intervening vowel is reduplicative. Ponapean has a pattern of final vowel apocope, which deletes root-final vowels just in case they are not followed by a suffix consonant (Rehg 1984b, 1991). As a result, it may be that the reduplicant's second vowel maximizes a stem vowel which is in turn missing from the stem itself. For example, it may be that the lexical form is /tepe/, which reduplicates as [tepe-tep]. In addition, the features of the intervening vowel are not clearly predictable; for example, we see [i] in [tepi-tep] but [e] in [tepe-tep].

The copy account also faces an obstacle: among bisyllabic roots, there are cases where the intervening vowel does not clearly reflect an expressed second root vowel, as in [sipi-sipet].

Thus, some evidence suggests the vowel is inserted, while some suggests it is copied. The copy account, however, is more suitable, since cases of overt non-identity such as [sipi-sipet] can be attributed to a phonological alternation that raises vowels between high vowels.

The origin of the intervening vowel can then be summarized as follows: if the root is CVC at the surface, the intervening vowel is [i] if there is no underlying root final vowel, as in [tepi-tep]. If there is a second root vowel, the reduplicant copies it; thus /tepe/ would reduplicate as [tepe-tep]. Third, if the second vowel occurs in a raising environment, it is realized as [i], as in [sipi-siped].

A consequence of the copy account is that the reduplicant in [tepe-tep] maximizes an underlying vowel not present in the base. To account for this, we can appeal to the model of reduplicative correspondence (McCarthy and Prince 1995), where some correspondence constraints hold between input and reduplicant, alongside standard input-output and base-reduplicant constraints. Alternatively, we can appeal to constraints of existential faithfulness (Struijke 2002, Fitzgerald 2001), which requires each segment to have a correspondent somewhere in the output; reduplicant and base segments are both eligible correspondents.

Regardless, whether this vowel is epenthetic or reduplicative is orthogonal to the more central issue that it appears under particular conditions based on the place features of the consonants in question. In particular, it occurs wherever the reduplicant's final consonant has autonomous place features: that is, where it is not homorganic with the stem-initial consonant, or where it is a coronal obstruent and the stem initial consonant is not identical.

Previous research on Ponapean coda structure (Itô 1989) already accounts for some of this phenomenon: the vowel appears wherever the consonant before it would violate the CODA CONDITION were it to appear as a coda. Kennedy (2003) reframes this as an interaction between

coda position and moraicity: that coda consonants must be moraic to satisfy WEIGHT BY POSITION (Hayes 1989), and moraic consonants must be sonorant and share place features with what follows, while word-final consonants are not moraic and thus not restricted in their place features. However, missing from their analyses is an account of the vowel insertion among non-identical coronals, as in [lusu-lus], [sete-set], and [nete-net].

4.2 Reduplicant size

Reduplicative prefixes in Ponapean are subject to a size requirement that they be bimoraic, which is what essentially drives the reduplicative system to produce a correspondent for the root's second consonant, and is responsible for both the moraicity of the second consonant in heavy syllable reduplicants and the appearance of the second vowel in bisyllabic reduplicants.⁶

It is therefore important that a subsystem that derives bimoraicity can co-exist with the assimilatory system developed in §3. Kennedy (2002, 2003) provides such a system; in brief, reduplicated forms are subject to a requirement that morpheme boundaries be aligned to foot boundaries, and as a result, all reduplicative prefixes are single feet.

4.3 OCP outranks UNIFORMITY

The discussion in §2 regarding Lexicon Optimization relies on a ranking of OCP over UNIFORMITY. Without this ranking, the underlying representations of homorganic roots would not be guaranteed to contain a single place specification. However, this ranking has no explicit evidence in the outputs of such roots. Nevertheless, there is support for it in the reduplicative system developed in §3. The formalization of UNIFORMITY from (7) is repeated in (23) below.

⁶ Reduplicants larger than this are not observed, but monomoraic reduplicants appear under a limited and predictable set of circumstances, namely before roots with initial heavy syllables and an even number of moras. Monomoraic reduplicants therefore appear in [tu-tuup], [so-soupisek], and [co-cooroor], but not in [tuu-tuuppek]. Kennedy argues that the reduplicative feet in these forms are forced to be degenerately monomoraic wherever root begins with a heavy syllable, and as long as such monomoraicity does not also precipitate a stress clash, which accounts for the differential behavior of [tuu-tuuppek].

(23) UNIFORMITY For each segment, there is exactly one primary place specification.

As such, this constraint is violated by nasalized outputs such as [ton-tot] in (14) and [can-cal] in (15). In each form, the moraic nasal shares a place feature with the following obstruent. This must be the case as an autonomous place specification for the nasals in such forms would violate the same coda condition that prevents forms such as *[tep-tep].

Meanwhile, surface data also provide evidence for the existence of single place features for roots such as /tot/ and /cac/. The reduplication of these as [ton-tot] and [can-cac] respectively provides evidence that there is but one place specification in each root, since it is only in roots with two place specifications that disyllabic prefixing occurs. This representation would force a learner to posit a ranking of Uniformity below OCP.

4.4 Other nasal phenomena

Ponapean consonants undergo assimilation in contexts other than prefixing reduplication, but with some differences in detail. First, the coronal nasal /n/ assimilates its place of articulation word-finally if followed by a consonant-initial word (Rehg 1981: 56). For example, /ciin kidi/ ‘bone of a dog’ is realized as [ciin̩ kidi], and /kilin p^wiik/ ‘skin of a pig’ appears as [kilim p^wiik]. In contrast, root-final /m/ and /ŋ/ maintain their place features. This suggests that /n/ may lack its own underlying place feature even if it is the only coronal segment in the root. Alternatively, it may be captured formally with a constraint ranking that does not prioritize faithfulness of coronal place for nasals. Thus, a License constraint like that in (20) may be active here as well.

Second, if a root-final labial or velar obstruent precedes a homorganic consonant, whether as part of a suffix or a following word, it surfaces as a nasal (Rehg 1981: 61-62). For example, /kalap men/ ‘always want’ appears as [kalam men], and /saik kenwini/ ‘not yet take medicine’

surfaces as [saiŋ keŋwini]. Spaelti (1997) formalizes this as a preference for shared place features and nasalization over the alternative of vowel insertion. Since his account relies on the relative markedness of different place features, and deals only with non-reduplicative morpho-phonology, it neither conflicts with nor duplicates the formal system developed in §3.

5. Other accounts

Ponapean phonology has seen a variety of treatments, each of which with some aspect of the nasal system, but none to completion. Itô (1986, 1989) and Kennedy (2002, 2003) handle other aspects of the Ponapean reduplicative system such as its unique property of Quantitative Complementarity and its restrictions on word-internal coda consonants, but not the coronal asymmetry evidenced in [nete-net]. Spaelti (1997) analyzes the pattern of nasal substitution at Ponapean suffix boundaries (discussed in 4.4), whereby stem-final non-coronal obstruents are realized as nasals before suffixes with homorganic initial consonants. His analysis does not address nasal substitution in reduplication, and could not generalize without amendment, as it actually predicts vowel excrescence among all adjacent coronals.

Blevins and Garrett (1993) deal specifically with the emergence of a nasal consonant in non-final coda position, and propose that this nasal has its historical origins in a glottal consonant. In short, they offer an account of why nasalization occurs instead of plain gemination or compensatory vowel lengthening. Their discussion does not address the lack of nasalization among non-identical coronals, nor the assimilatory behavior of other sonorant consonants.

Davis (2001) does attempt to address the coronal asymmetry in reduplicative nasal substitution, using Sympathy Theory (McCarthy 1999) to account for the lack of parallelism between [nete-net] and [tin-tit]. Under Sympathy Theory, a selector constraint chooses the intermediate (sympathetic) candidate, and a sympathy constraint evaluates correspondence

between all candidates and the sympathy candidate. In essence, the sympathy candidate stands in for the underlying representation in the input-output relationship, but only for the purposes of the sympathy constraint.

In Davis's account, the selector constraint IDENT-BR selects the faithful form *[tit-tit] as the sympathy candidate. The sympathy constraint MAX- μ_C - \otimes then requires all moraic consonants in the sympathy form *[tit-tit] (24a) to have moraic correspondents in the true output. In this case, the moraic [t] (i.e., the first half of the geminate in *[tit-tit]) must have a moraic correspondent in the output. The moraic [n] in [tin-tit] (24b) satisfies MAX- μ_C - \otimes , but *[titi-tit] (24c), with an excrescent vowel, does not; the nasalized form is thus optimal, as summarized in Tableau (24).

(24)		CODA-CONDITION	MAX- μ_C - \otimes	IDENT-BR[SON]	IDENT-BR
a. \otimes	tit-tit	*!			✓
b. ☞	tin-tit			*	*
c.	titi-tit		*!		✓

It is crucial in this account for *[tit-tit] to be selected as the sympathy candidate, yet this choice is difficult to defend, because the sympathy candidate should be the most optimal form of all those that satisfy the selector constraint. The competing form *[titi-tit] also satisfies IDENT-BR, because all of its base-reduplicant pairings are identical; the middle vowel does not incur a violation, and it also satisfies high-ranking constraints on coda consonants which *[tit-tit] violates. Because *[titi-tit] should really be selected as the sympathy candidate, the output [tin-tit] is not at any advantage by having a moraic [n]. Thus, Davis's account actually predicts *[titi-tit] as the reduplicated form of [tit].

The same counter-argument applies to Davis’s treatment of non-identical homorganic forms such as [tar]: his account relies on *[tar-tar] (with a moraic medial [r]) as a sympathetic candidate, but his model instead predicts *[tari-tar] as the sympathetic candidate, which then would be the predicted surface form as well.

Davis does address this issue, suggesting that the selection constraint IDENT-BR is violated by the appearance of the medial vowel in *[titi-tit] and *[tari-tar], thus leaving *[tit-tit] and *[tar-tar] unequivocally as the respective sympathy candidates. However, were this the interpretation of IDENT-BR, heterorganic roots would then be assigned incorrect sympathy candidates. For example, the reduplicated form for /tep/ would use *[tep-tep] (25a) as a sympathy candidate, incorrectly predicting *[ten-tep] (25b) instead of [tepi-tep] (25c).

(25)		CODA-CONDITION	MAX- μ C-*	IDENT-BR[SON]	IDENT-BR
a. *	tep-tep	*!			✓
b. ☞	ten-tep			*	*
c. ☹	tepi-tep		*!		*

Of all accounts of Ponapean consonant sequences, Goodman (1995) provides the most thorough treatment, but explicitly rejects underspecified representations for coronal consonants. Her study includes a quantitative analysis of consonant co-occurrence across the Ponapean lexicon, and she finds that other coronals besides /t/ and /c/ are restricted in their distribution. Indeed, she finds a statistical dispreference for roots that contain non-identical coronal sonorants; thus, /n/, /l/, and /r/ tend not to co-occur, which Goodman takes as evidence that each is fully specified both for coronality and for secondary place. In turn, Morpheme Structure Constraint forbids underlying representations that combine such fully specified coronals unless they share a primary place node; as a result, /rar/ and /lal/ satisfy the MSC, but /nur/ – an attested form – exceptionally violates it.

Meanwhile, Goodman's analysis of Ponapean reduplication is somewhat problematic in its treatment of the coronal asymmetry discussed in §3. She allows underlying representations to have the form CVC only where the consonants are fully identical; thus, /pap/ and /tot/ are possible underlying representations, but */net/ is not; the root in the latter case must be /nete/. Assimilation or nasalization in reduplication is thus restricted to CVC roots; the second vowel in /nete/ precipitates the second vowel of the reduplicant, precluding assimilation in [nete-net].

This approach then predicts disyllabic reduplicants wherever a polysyllabic stem includes an initial obstruent and a homorganic second consonant: for example, /tune/ is incorrectly predicted to reduplicate to *[tune-tune], and /nelelek/ is incorrectly predicted to reduplicate to *[nele-nelek]. Furthermore, relying on the presence of a second vowel in /nete-/ to prevent assimilation leaves some additional gaps in the lexicon unexplained. For example, it is merely stipulated that the lexicon has no CVC roots with non-identical consonants such as /net/, which would assimilate in Goodman's account, yielding *[nen-net]. The same is true for underlying CVCV forms with identical consonants such as /pepe/, which would not assimilate, appearing as [pepe-pep]. Richness of the Base demands that such underlying representations not be stipulatively ruled out, and indeed even the MSC does not account for their absence; nor can they emerge for the learner in the same way as the particularized inputs of Section 2.

6. Discussion

This analysis has addressed some asymmetrical effects in the resolution of consonant sequences in Ponapean morpho-phonology. The argument can be summarized as follows: roots with homorganic consonants contain single primary place features at the surface and underlyingly, which may also dominate secondary place features. It is in roots with single primary place features that assimilation may occur in the context of prefixing reduplication: the second

consonant of the reduplicant may nasalize or fully assimilate without incurring any violation of faithfulness to place features.

If the secondary place feature is dependent on [CORONAL], then it must associate to an obstruent segment. Consequently, if the second of two non-identical but homorganic consonants within a root is an obstruent coronal, then its reduplicative counterpart is faithfully rendered. If the two consonants are identical coronal obstruents, nasalization applies.

The account relies on particularized inputs as underlying representations, but this choice is guided for hypothetical learner without relying on an explicit Morpheme Structure Constraint over the form of underlying representations. Instead, the learner arrives at these particularized inputs without compromising Richness of the Base. These inputs are also contextually underspecified, in that homorganic consonants share their place features.

The account also captures the effect of the OCP on the lexicon, even while situating it as a violable and output-oriented principle. Given the occurrence of forms such as [tot] in the ambient data, the learner may posit a single-place or a multi-place output representation. Despite their homophony, the single-place form is optimal given that it satisfies the OCP, even if the OCP is ranked violably in the language. In turn, the underlying representation for this form, without evidence to the contrary, is the same.

Further, the language does not have an explicit input-oriented restriction on underlying representations: borrowings can contain violations of the OCP, and native roots can violate Goodman's MSC. That is, if representations like /secik/, /nur/, and /linenek/ were fully specified, they transgress the explicit MSC, but the fact that they do assimilate under reduplication is a natural consequence of the contextual underspecification account. If we were to adhere to full specification of all coronals, the assimilatory behavior of sonorant coronals to

non-identical coronals, as opposed to the non-assimilatory behavior of obstruent coronals, is unexplained.

As mentioned in the introduction, the conflict between Richness of the Base and Underspecification has been explored by Inkelas (1994), Itô, Mester, and Padgett (1995), and Smolensky (1993). Inkelas (1994) argues that underspecified representations are plausible within OT wherever alternations motivate them. For example, in Turkish, some root-final obstruents alternate in their voicing while others do not; the former can be construed as underspecified while the latter are specified underlyingly. The present analysis of Ponapean differs in that there is not a contrast between alternating and non-alternating consonants: that is, there is not a set of roots with final /t/ that nasalizes under reduplication, as opposed to another set of roots with final /t/ that demands an intervening vowel in the same context. Consequently, although alternation provides evidence for underspecified lexical representations in both languages, the Ponapean analysis relies on an absence of certain types of underlying forms, namely, those in which sonorant coronals do not share place features with other coronal consonants in the same root. Although this is an example of a particularized input representation, it is also derived in principle for and by the learner.

Smolensky (1993) proposes that as a theoretical tool to account for some segments being invisible to certain phonological processes, underspecification can be subsumed by a theory of markedness. Given Inkelas's discussion of alternating and non-alternating vowels in Turkish, it is not clear that all uses of underspecification can be reconfigured in this way. Furthermore, in the present account, it is the relatively underspecified segments that participate in the phonological process of interest.

Itô, Mester, and Padgett (1995) propose that underlying representations in Japanese are optimized to be underspecified, based on intricacies of Rendaku compound voicing. They claim that a learner, given an exhaustive choice of possible underlying representations which all converge on the same output, would in some cases posit the underspecified one. However, their argument includes an assumption that Japanese sonorant consonants are unspecified for voicing *even at the surface*. In contrast, the present analysis of Ponapean provided here also uses optimized input representations, but this aspect of the analysis is crucial, as underspecified and fully specified input representations do not converge on the same outputs. Moreover, the contextually underspecified segments in Ponapean do appear at the surface with an association to some place feature.

I have framed the analysis in light of Underspecification Theory because it relies on a strict notion of what constitutes the input: the constraint hierarchy only works if roots such as /nec/, /net/, /tet/, /ten/, and so on each have only one underlying coronal specification. I have characterized this aspect of the analysis as the requirement of a *particularized representation*. These forms are not underspecified in the same way as Japanese sonorants are underspecified for voice, where the association of the sonorant consonant to a voicing feature, underlyingly, is absent. Instead, the Ponapean sonorants *are* associated to coronal specifications underlyingly; it is just that this specification is not autonomous: they always share that feature with another coronal if one is present. I have characterized this as *contextual underspecification*: coronal sonorants avoid having autonomous place specifications only if there is another coronal present, but they do have an autonomous coronal specification if they are the lone coronal in the root.

The parallel is that the Ponapean analysis relies on a particular set of representations – those using shared place features – in the same way that the Japanese analysis relies on a

particular set of representations in which voicing features are absent. Both scenarios may appear to address a formal redundancy: voicing is redundant for Japanese sonorants, and coronality is redundant for Ponapean sonorants in proximity to other coronals. But the evidence for the particularized underlying representations in Ponapean is not drawn from feature redundancy; instead, sonorant consonants have no place features of their own because they alternate at the surface.

The Ponapean pattern may also appear to address formal predictability, in that the place feature [CORONAL] is characterized as predictable for sonorant consonants. Indeed, such consonants need not be specified with their own feature if it can come from somewhere else in the root. Nevertheless, this is an example of contextual underspecification, if we assume that coronal sonorants must have their own place specification if they co-occur in roots with non-sonorants. The fact that root-final /n/ assimilates to following consonants, as discussed in §4.4, suggests that it even lacks place when it is the only coronal in the root.

Ultimately the implication of this account is that, despite the output orientation of Markedness constraints in Optimality Theory, the nature of the input representation remains crucial in some analyses. Our adherence to Richness of the Base has led to an analytical stance in which particular input representations may not be arbitrarily dropped from consideration. Such a stance is relatively easier to maintain when several competing input representations converge on the same output representation. Where they do not, as is the case here, it is still possible to show that a particularized input, chosen from a set of competing input representations, can be posited in a principled manner without invoking any explicit principle to restrict underlying forms.

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