Faithfulness in Prosodic Morphology & Phonology:
Rotuman Revisited[1]

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1. Introduction

Optimality Theory (Prince & Smolensky 1993) deals with constraints on surface forms. Yet it also depends crucially on constraints that regulate the *faithfulness* of the surface form to the lexical structure. The interaction of surface constraints on phonological markedness and faithfulness constraints, through ranking, is essential to characterizing particular grammars within OT. Thus, without faithfulness constraints, the claim that individual grammars differ only in how they rank a set of universal constraints would be untenable. Indeed, without faithfulness constraints, there would be no explanation for why every word in every language isn't driven inexorably toward some maximally unmarked form, like *ba*, *ti*, or *ʔəʔə*.

Faithfulness, then, is indispensable to the construction of Optimality-Theoretic grammars. It follows that the precise way in which faithfulness is understood — the implementation, rather than the core concept — is an area that should be examined closely. In this article, I will argue for a particular conception of faithfulness based on a relation of *correspondence* between strings of phonological elements. Correspondence was introduced as a theory of reduplicative copying (McCarthy & Prince 1993a, 1994a). Parallels between reduplicative copying and faithfulness lead to a generalized theory of correspondence (McCarthy & Prince 1994b, 1995), enlarging in several directions the conception of the nature and role of faithfulness in earlier OT work, which begins with Prince & Smolensky (1991, 1993).

I will explore several ways in which correspondence permits an expanded view of faithfulness, with a variety of desirable empirical consequences. After an introduction to Correspondence Theory in section 2, the article continues with the examination of these main themes:

- The extension of faithfulness constraints to alternations involving phonological metathesis (section 3), which has not been considered in most previous OT work.

- The extension of faithfulness constraints to the preservation of prosodic structure (section 4), subsuming both familiar faithfulness effects and phenomena previously attributed to prosodic circumscription (McCarthy & Prince 1990a). This work further develops some ideas about prosody in reduplicative correspondence (the constraint STROLE) in McCarthy & Prince (1993a, 1994a), and parallels the independent developments realized in Itô, Kitagawa, & Mester (1995).

- The extension of faithfulness constraints to relations other than the one between lexical and surface forms (section 5), pursuing proposals about reduplicative correspondence in McCarthy & Prince (1994b, 1995) and about output-output correspondence in Benua (1995, forthcoming). Following Benua, this work connects with traditional notions of paradigm uniformity (see, e.g., Bybee 1985) and more recent developments along these lines, such as Burzio (1994ab), Flemming & Kenstowicz (1995), Kenstowicz (1995), Kraska-Szlenk (1995), and Orgun (1994).

These topics are strongly interconnected, since all depend crucially on Correspondence Theory and since all come to the fore in the analysis of Rotuman, which serves as the empirical focus for this article.

Rotuman is a central Oceanic language spoken on an island about 300 miles north of Fiji. This language was comprehensively described and analyzed by Churchward (1940). A very extensive secondary literature starts from Churchward's results, including contributions by Haudricourt (1958ab), Biggs (1959, 1965), Milner (1971), Anttila (1989), Cairns (1976), Saito (1981), van der Hulst (1983), Janda (1984), McCarthy (1986, 1989), Mester (1986), Besnier (1987), Hoeksema & Janda (1988), Odden (1988), and Blevins (1994).

The phenomenon that has captured most of this attention is the morphological distinction of "phase", first recognized by Horatio Hale, philologist to the United States exploring expedition of 1838–1842. Rotuman has a contrast in major-category words between two phases, the *complete* and the *incomplete*, distributed according to syntactico-semantic principles (see Appendix B). The phase distinction has diverse morpho-phonological effects, evidenced in examples like the following (Churchward 1940, Besnier 1987):[2]

(1) Phase Differences in Outline

Complete	Incomplete	
a. Deletion		
tokiri	tokir	'to roll'
tiʔu	tiʔ	'big'
sulu	sul	'coconut-spathe'
rɑko	rɑk	'to imitate'
b. Metathesis		
iʔɑ	iɑʔ	'fish'
sesevɑ	seseɑv	'erroneous'
hosɑ	hoɑs	'flower'
pure	puer	'to rule'
parofitɑ	parofiɑt	'prophet'
c. Umlaut		
tɒfi	taf	'to sweep'
hо̤ti	hö̤t	'to embark'
mose	mös	'to sleep'
futi	füt	'to pull'
d. "Diphthongization"		
pupui	pupu͡i	'floor'
lelei	lele͡i	'good'
keu	ke͡u	'to push'
joseuɑ	joseu͡ɑ	'Joshua'
e. No Formal Distinction of Phase		
rī	rī	'house'
rē	rē	'to do'
sikā	sikā	'cigar'

The principal descriptive goal of this study is to comprehend these various formal properties of the phase distinction within a single coherent view of Rotuman phonology, keeping a sharp eye on the relevance of the analysis to the theory of faithfulness.

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[2]On the transcriptional details, see Appendix A.

In addition to these theoretical and empirical objectives, this article also offers discussion of several other issues of potential interest. Throughout the article, but particularly in section 3.4, evidence is presented in support of Optimality Theory over operational approaches to phonological description. The same section also addresses the question of substantive versus formal restrictions on linguistic expressions, when the matter of "C/V tier segregation" in Rotuman is addressed. The theory of templates in prosodic morphology is touched on in connection with the proper characterization of the incomplete phase (section 3.2). Also within prosodic morphology, the derivational theory of positive prosodic circumscription is called into question, and an Optimality-Theoretic alternative is presented (section 4.2).

2. Correspondence in Optimality Theory

The results in this article are set within Optimality Theory (Prince & Smolensky 1993), and they rest upon correspondence (McCarthy & Prince 1993a, 1994b, 1995), which extends and develops the original OT conception of faithfulness. Correspondence is a general way of relating representations to one another. The representations related by correspondence may be lexical and surface, base and reduplicant, or other pairs, such as a base and a derived form in root-and-pattern or truncatory morphology. Rankable constraints apply to correspondent elements, demanding completeness of correspondence, preservation of linear order under correspondence, and the like. Correspondent segments are often identical to one another, but identity of correspondents is also enforced by rankable, and therefore violable, constraints.

Correspondence was proposed as a theory of reduplicative copying in McCarthy & Prince (1993a); it is generalized to the lexical-surface relation in McCarthy & Prince (1994b, 1995); further extension of correspondence to intra-paradigmatic relations is pursued in Benua (1995, forthcoming) and below, in section 5.

Correspondence is defined as follows:

(2) Correspondence

Given two strings S_1 and S_2, *correspondence* is a relation $\Re$ from the elements of S_1 to those of S_2. Elements $\alpha \in S_1$ and $\beta \in S_2$ are referred to as *correspondents* of one another when $\alpha \Re \beta$.

The output-generating component Gen supplies candidate forms S_2 together with S_1 and the relation $\Re$ between them. The particular $\Re$ for any (S_1, S_2) pair expresses the dependency, if any, of S_2 on S_1. The harmony-evaluating component Eval then considers each candidate pair with its associated correspondence relation, assessing the completeness of correspondence in S_1 or S_2, the featural identity of correspondent elements in S_1 and S_2, and so on.

The following constraints on correspondent elements will be particularly important in the discussion below (McCarthy & Prince 1994b, 1995):

(3) MAX

Every element of S_1 has a correspondent in S_2.

(4) DEP
   Every element of S_2 has a correspondent in S_1.

(5) LINEARITY
   S_1 is consistent with the precedence structure of S_2, and vice versa.
      Let x, y $\in S_1$ and x′, y′$\in S_2$.
      If xℜx′ and yℜy′, then
         x < y iff ¬ (y′ < x′).

(6) UNIFORMITY
   No element of S_2 has multiple correspondents in S_1.
      For x,y $\in S_1$ and z $\in S_2$, if xℜz and yℜz, then x=y.

(7) IDENT(Feature)
   Correspondent segments have identical values for the feature F.
      If xℜy and x is [ξF], then y is [ξF].

Additional constraints are defined in McCarthy & Prince (1995: Appendix A), and a few of them will be presented as they are needed below. In particular, constraints demanding that correspondent elements have the same prosodic role are introduced and discussed in section 4.

The first four constraints cited govern the perfection of the relation between S_1 and S_2 as strings. MAX demands that correspondence be string-wise complete, from S_1 to S_2. Thus, if MAX pertains to the lexical/surface relation, it prohibits phonological deletion, or if it pertains to the base/reduplicant relation, it demands that reduplication be total. DEP is the symmetric counterpart of MAX, demanding completeness of correspondence in the opposite direction, prohibiting phonological epenthesis or its reduplicative analogue, fixed segmentism. LINEARITY prohibits metathesis, by requiring that correspondence preserve linear-order relations (see also Hume 1994, 1995, Gnanadesikan 1995). And the similar UNIFORMITY constraint militates against segmental coalescence, by prohibiting situations in which multiple segments of the input map onto a single segment of the output (see also Lamontagne & Rice 1995, Gnanadesikan 1995, Pater 1995a).

Constraints of the IDENT family require identity of correspondent elements in their featural composition; when segmental processes of harmony or assimilation are visibly active, one or more IDENT constraints are violated. As stated, IDENT presupposes that featural identity is mediate by *segmental* correspondence; features themselves are not in correspondence, so there is no direct analogue to "PARSE-FEATURE". This assumption, which follows McCarthy & Prince (1994b, 1995), is an implementational rather than substantive one at this point, but for relevant discussion see sections 4.3 and 5.3 below, Gafos (1995), Gnanadesikan (1995), Lombardi (1995), and Orgun (1995).

The constraints on correspondent elements are identified with the particular correspondence relation involved (McCarthy & Prince 1994b, 1995; Urbanczyk 1994, 1995, 1996; Benua 1995). This means, for example, that there are distinct MAX constraints for lexical-surface and base-reduplicant correspondence. These distinct constraints — dubbed MAX-IO and MAX-BR — may be ranked separately. For example, the ranking MAX-IO ≻ ℂ ≻ MAX-BR characterizes one type of "emergence of the unmarked", in which the constraint ℂ

(NO-CODA, for example) is obeyed in the reduplicant, by virtue of incomplete reduplication (violating MAX-BR), but violated in the language as a whole (satisfying MAX-IO). This relativization of the constraints to the particular type of correspondence is discussed in section 5; I will ignore this detail until then.

Correspondence Theory expands on the original Optimality-Theoretic treatment of faithfulness in Prince & Smolensky (1991, 1993), implementing faithfulness in a different way. Originally, faithfulness received a representational treatment. Inputs (lexical forms) consist of unprosodized segmental strings, and outputs (surface forms, approximately) consist of the same segmental strings provided with prosodic structure. Differences between the lexical form and the form as pronounced can be read off of the output by looking for any mismatches between the prosodic analysis and the segmental string. Inserted segments are recognizable as prosodic nodes without segmental content, violating the constraint FILL; deleted segments are recognizable as segments without a prosodic analysis, violating the constraint PARSE. This PARSE/FILL theory will be discussed at various junctures below, and reasons for moving toward the Correspondence model will be presented. (On which, see also McCarthy & Prince 1994b, 1995.)
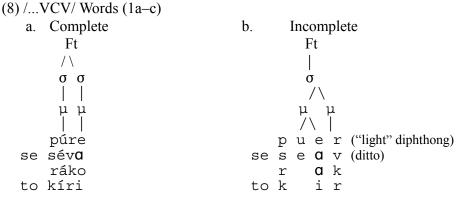
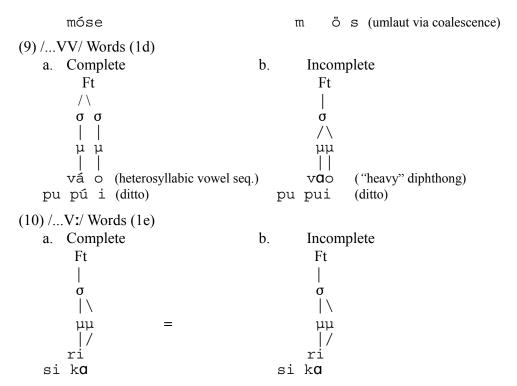## 3. The Prosodic Morphology of Phase in Rotuman

This section explores several of the main aspects of the phonology of phase in Rotuman. The section begins with an important preliminary: justification of several claims about the prosodic structure of Rotuman (3.1). The core results of the section are in 3.2, where the prosodic morphology of the language is examined in light of Correspondence Theory and the extended view of faithfulness that it provides. The results are then summarized briefly in 3.3, and the section concludes by comparing the analysis here to an important previous treatment in work by Saito (1981), van der Hulst (1983), and Besnier (1987).

3.1 The Prosodic Structure of Rotuman

The first order of analytic business is to determine the prosodic structure of the Rotuman, focusing on the differences in prosody between the two phases, which are significant. This section will also begin the Optimality-Theoretic analysis, with most of the balance to be presented in section 3.2.

I will argue that the prosodic structure of examples like those in (1) is as follows:

(8) /...VCV/ Words (1a–c)

```
   a.  Complete              b.      Incomplete
        Ft                            Ft
        /\                            |
       σ σ                           σ
       | |                           /\
       μ μ                          μ   μ
       | |                          /\  |
        púre                     p  u  e  r   ("light" diphthong)
   se  sévɑ                   se  s  e  ɑ  v  (ditto)
        ráko                     r     ɑ  k
   to  kíri                  to  k     i  r
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      móse                          m    ö  s  (umlaut via coalescence)
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(9) /...VV/ Words (1d)

    a. Complete   b.   Incomplete

```
        Ft                          Ft
       / \                          |
      σ  σ                          σ
      |  |                         / \
      μ  μ                         μμ
      |  |                         ||
      vá o  (heterosyllabic vowel seq.)   vɑo   ("heavy" diphthong)
    pu pú i  (ditto)               pu pui  (ditto)
```

(10) /...Vː/ Words (1e)

    a. Complete   b.   Incomplete

```
       Ft                          Ft
       |                           |
       σ                           σ
      | \                         | \
      μμ            =             μμ
      | /                         | /
      ri                          ri
    si kɑ                       si kɑ
```

All forms end in a bimoraic foot, the moraic trochee of Hayes (1987, 1994) and McCarthy & Prince (1986). Except for words with final long vowels, the foot is disyllabic in the complete phase and monosyllabic in the incomplete phase. Again except for final long vowels, syllables are limited to (C)V shape in the complete phase, while in the incomplete phase final syllables may be closed, they may contain a diphthong, or both. Two distinct types of diphthongs are claimed to occur, a monomoraic or light diphthong in closed syllables like *seseav* or *puer*, and a heavy diphthong in open syllables like *va͡o* or *pupu͡i*.

      The remainder of this section will present evidence in support of these structures and the differences among them But first, I begin by analyzing the basic (C)V syllable structure of the normal complete phase form.

      In Rotuman generally — except in the final syllable of an incomplete-phase word or in words with long vowels, which are also limited to final syllables (see below) — the only possible syllables are of the form (C)V. That is, there are no closed syllables and no diphthongs. Two constraints are high-ranking in Rotuman or any other (C)V language: NO-CODA and NO-DIPHTHONG (Prince & Smolensky 1993, Rosenthall 1994, Sherer 1994). Let us assume that both are encapsulated by a single constraint limiting syllables to (C)V monomoraicity:

(11) SYLL=μ

    Syllables are monomoraic.

The constraint SYLL=μ holds high rank in the Rotuman hierarchy, to ensure the normal (C)V structure. For one thing, SYLL=μ must dominate ONSET (Itô 1989). Thus, hiatal treatment of V-V sequences is preferred to parsing them as diphthongs:

(12) SYLL=μ > ONSET

vɑo (Com. Ph.)	SYLL=μ	ONSET
a. ☞ .vɑ.o.		*
b. .vɑ͡o.	* !	

Syllable boundaries are indicated by ".", and the ligature is used to emphasize the diphthongal analysis of form (b) (cf. (1d)). As this tableau shows, hiatus is preferred to analysis with a diphthong, one of the hallmarks of a (C)V language.

Violation of ONSET in forms like *va.o* has other consequences for ranking. Since obedience to ONSET could be achieved by deleting one of the offending vowels (*vɑ, *vo), ONSET must also be dominated by MAX, which requires that every input segment have an output correspondent. Likewise, since obedience to ONSET could also be obtained by consonant epenthesis (*vɑʔo), it must also be dominated by DEP, which demands completeness of correspondence in the other direction: every *output* segment must have an *input* correspondent.

To complete the picture of a (C)V language, we must ensure an unfaithful analysis of any potential coda-producing input. For instance, an input like /pɑn/ must receive an analysis as something like *pɑ* or *pɑni*, avoiding a coda by deletion or epenthesis. This indicates that SYLL=μ — specifically, the encapsulated constraint NO-CODA — must dominate some faithfulness constraint, either MAX (if *pɑ* is to be optimal) or DEP (if *pɑni* is to be optimal). No evidence from morphophonemic alternations supports one option or the other, though loan phonology generally invokes epenthesis in response to potential codas. On this basis, we might say SYLL=μ dominates DEP, though nothing hinges on this.

These rankings secure the prosodic structure of Rotuman as a whole. But in the final syllable of incomplete-phase stems, configurations are met with that are incompatible with the overall (C)V pattern. In particular, I have claimed that there are final heavy syllables in incomplete-phase forms like *puer, tokir*, *mös*, and *vɑ͡o*. Direct evidence of this comes from Churchward's statements about the syllabificational and accentual properties of the two phases. Stress in Rotuman falls on the penult in complete-phase forms like *púre*, *tokíri*, *móse*, and *vɑ́o*. But the accentuation of the corresponding incomplete phase is significantly different. We will first consider /...VCV/ words, like *pure* or *forɑ*:

> [T]he stress seems to be levelled out, so to speak, in the inc. phase. Thus: *fo*ra [with penultimate stress] becomes *foar*, which is pronounced almost, though perhaps not quite, as one syllable, the stress being evenly distributed ... (Churchward 1940: 86)

This "even distribut[ion]" of stress over the *oɑ* sequence requires a diphthongal analysis of *oɑ* — it is a tautosyllabic sequence, and the final *r* is a coda of the single syllable *foɑr* (or *puer*). The stress facts also support that claim that forms like *fóɑr*, *tokír*, and *mós* end in heavy (i.e., bimoraic) syllables. Rotuman stress is based on the moraic trochee, consisting of two light syllables (*pú.re*) or one heavy syllable (*púer, fóɑr, tokír*).

In diphthongal closed syllables like *puer* or *seseav*, the moras are allocated with one to the whole diphthong and the other to the coda. There are two sources of evidence for this structure, one direct and the other strongly inferential. Direct evidence comes from Besnier's (1987) transcriptions, which differ slightly from Churchward's. Besnier records forms like the incomplete phase of *rito* as as *ryot*. In all but one example, Besnier writes the lower-sonority vowel as a pre-nuclear high glide, consistent with the claim that this sequence is a light diphthong. The inferential evidence is even stronger. It is known that monomoraic or light diphthongs are always restricted to vowel sequences of rising sonority (Kaye 1983, Kaye & Lowenstamm 1984, Rosenthall 1994). And, in fact, the only possible diphthongs occurring in closed syllables of Rotuman also must rise in sonority (Churchward 1940: 80):

(13) Metathetic /...VCV/ Cases

iʔa	iaʔ	'fish'
tiko	tiok	'flesh'
sesevɑ	seseɑv	'erroneous'
hosɑ	hoɑs	'flower'
pure	puer	'to rule'
lukɑ	luɑk	'short'

These are just exactly the vowel sequences of rising sonority (i.e., decreasing height) that are possible within the limits of the Rotuman vowel system. In comparison to these cases, all of which have a metathetic incomplete phase, vowel sequences of equal or falling sonority in /...VCV/ roots show the deletion or umlaut patterns, as in (1a, c). This limitation of metathesis to forms where the resulting diphthong falls in sonority only makes sense only if the resulting diphthong is monomoraic. Why is it monomoraic? Straightforwardly, a monomoraic diphthong is the only possibility if the coda usurps one mora and if trimoraic syllables are prohibited categorically in the language. (More on this shortly.)

This restriction on the diphthongs that can be derived by metathesis is particularly striking when we turn to the phase alternation in /...VV/ roots like (1d). These roots can consist of any pair of Rotuman vowels, standing in any sonority relationship to one another — rising, falling, or equal. The following list exhausts the vowel combinations possible in /...VV/ words:[3]

(14) Phase Alternation in /...VV/ Roots
    a. Falling Sonority

čei	čei͡	'cricket (insect)'
lelei	lelei͡	'good'
reu	reu͡	'tail (of bird, fish, snake, etc., but not of horse or cow)'
fɒi	fɒi͡	'to cut or chop down (a tree or branch)'
tæe	tæe͡	'to touch'
vɑo	vɑo͡	'net, esp. fishing-net'
vɑu	vɑu͡	'bamboo'
ʔoi	ʔoi͡	'to scrape or grate'
čou	čou͡	'bottle'

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[3]Though Churchward does not usually represent the phase distinction in /...VV/ words in his transcription, we know that all of these words follow the pattern he describes, because they are listed in the dictionary as belonging to the same "declension" as (1d).

b. Rising Sonority

fia	fi͡a	'pouch of a sling'
kɒmia	kɒmi͡a	'dog (< come here)'
hio	hi͡o	'(to perform a) certain kind of *maka* or action-song'
mea	me͡a	'the temples'
foa	fo͡a	'grater'
čua	ču͡a	'(to have) very serious elephantiasis of the testicles'
joseua	joseu͡a	'Joshua'
ʔuo	ʔu͡o	'very bony kind of fish'
ŋarue	ŋaru͡e	'work'

c. Equal Sonority

iu	i͡u	'to change'
meo	me͡o	'to feel resentment'
fui	fu͡i	'to pick up (fallen leaves, etc.)'

The only sequences of unlike vowels missing from this list are *ie* and *oe*; they never occur in /...VV/ words anyway (cf. Krupa 1966, Kawasaki 1990). From these facts, it's clear that there is a significant difference between the vowel sequences in (14) and the light diphthongs in (13).

If the vowel sequences in (14) are not light diphthongs, what are they, then? According to (9), they are heterosyllabic in the complete phase (*če.i*, *fi.a*, *i.u*), but tautosyllabic heavy diphthongs in the incomplete phase. There are several arguments in support of this. Most striking is the evidence of the permissible vowel sequences. Heavy diphthongs are not subject to any known universal limitation on sonority cline, so we neither expect nor observe that the diphthongs represented as in (9b) would be limited to any particular sonority profile. This is an obvious point of contrast with the light diphthongs in (13), which can only rise in sonority.

We also have Churchward's direct testimony about the prosody of these words:

> In dec. 3 [the /...VV/ "declension"], [the stress is] thus: pu*pu*i, pu*pui*; le*le*i, le*lei*. (Churchward 1940: 86) Most words ending in two or more vowels form their inc. ph. by shortening the penultimate vowel. In the foll. exs. Roman type is used for distinguishing short vowels ... *pupui*, *pup*ui floor; *lelei*, *lel*ei good; *iria*, *ir*ia them (two)... (Churchward 1940: 85)

In the first statement, Churchward's transcription (which uses italics for the stressed syllable) marks stress on the penult in the complete-phase forms "pu*pu*i" and "le*le*i" but on the whole final CVV syllable in the incomplete-phase forms "pu*pui*" and "le*lei*". This, of course, is fully consistent with the structures in (9) and the bimoraic foot of Rotuman. Churchward's remark that the penultimate vowel is shortened in the incomplete phase also supports the proposal in (9): the penultimate vowel is syllable-final in the complete phase (9a), but syllable-medial (and therefore plausibly somewhat shorter) in the corresponding incomplete phase (9b).

Additional phonological considerations also support the proposed prosodic-structural difference between the incomplete phase of /...VV/ words in (9b) and of /...VCV/ words in (8b). The incomplete-phase forms *puer* and *va͡o* both respect the familiar bimoraic upper bound on syllable size. Thus, though syllable monomoraicity (i.e., SYLL=μ) is violated in Rotuman, syllable bimoraicity is not; trimoraic syllables are literally impossible in this language. In *va͡o*, with no final consonant to parse, each vocoid can be assigned to its own mora, yielding the structure (9b). But in *puer*, the final consonant seizes one of the moras, and so both vocoids must be

associated with the single mora that is left, yielding (8b). In the latter case, the monomoraicity of the diphthong has an important consequence, already noted: only rising-sonority sequences are possible. Other potential vowel sequences, which can't be analyzed as light diphthongs, are simplified by deletion or umlaut, both discussed later.

There is one remaining aspect of Rotuman prosody to consider: the analysis of long vowels. Blevins (1994) observes that Rotuman long vowels have a highly restricted distribution: they are found only root-finally, in either native monovocalic roots (*rī*, *rē*) or in polysyllabic loans (*sikā*, *hanē* 'honey'). She proposes that long vowels of both types are responses to Foot Binarity (Prince 1980, Broselow 1982, McCarthy and Prince 1986, 1991a), which requires that all feet be binary, syllabically or moraically. A footed monomoraic root *rí is a direct offense against Foot Binarity; the observed long vowel is a response to it. Loans like *sikā*, Blevins proposes, are represented lexically with an exceptional final stress: /sikǽ/, /hané/. Again, Foot Binarity demands bimoraicity, which is satisfied by lengthening. Thus, there is no lexical contrast in vowel length, and the restricted distribution of long vowels follows from the restricted distribution of stress. (The formal details of this argument are presented in section 4.3 below.)

Words with final long vowels, whether native or borrowed, make no distinction of phase (1e). This is completely expected if, as I have suggested, the incomplete phase is characterized by having a final heavy syllable. A word with a final long vowel in the complete phase "already" ends in a heavy syllable, so we neither anticipate nor observe that its incomplete phase is any different. The real peculiarity of words with final long vowels is that they contain heavy syllables even in the complete phase, contrary to the consistent (C)V character of the language. This is an effect of constraint interaction, to be obtained through high ranking of Foot Binarity.

In summary, we have seen that Rotuman generally fits the (C)V type, with domination of ONSET and faithfulness constraints by SYLL=μ. But at the right edge of an incomplete-phase stem, heavy syllables are not only permitted, they are literally required. The observed types of heavy syllables take various forms, depending on the segmental material at hand: CVC sequences (*tokir*), CVVC sequences with light diphthongs (*puer*), CVV sequences with heavy diphthongs (*va͡o*), and long vowels (*rī*). Constraints on prosodic structure determine the form of the incomplete phase, its relation to the complete phase, and its behavior under suffixation. It is to those constraints and their interaction that we now turn.

3.2 The Prosodic Morphology of the Incomplete Phase

Having established the structural elements of Rotuman prosody and the phase alternation, we must now provide a grammar that is responsible for these facts. Taken together, the various examples we've seen support the following descriptive generalization:

(15) The Phase Alternation, Descriptively
   The incomplete phase is identical to the complete phase, except that the *final foot* of the complete phase
   is realized as a *monosyllabic foot* in the incomplete phase.

	Complete	Incomplete
	to{kíri}	to{kír}
	se{sévɑ}	se{séɑv}
	le{lé.i}	le{léi}
	si{kɑ̃}	si{kɑ̃}

The umlaut cases are also compatible with this generalization — see 5.3 for justification. In the cited examples, which represent all the relevant word-types, brackets delimit the stress-foot, a bimoraic trochee. Except with long vowels, this foot is disyllabic in the complete phase, because of high-ranking SYLL=μ. But in the incomplete phase, the foot is obligatorily monosyllabic, while still bimoraic; thus, incomplete-phase words all end in a stressed heavy syllable.

This descriptive generalization, as stated, involves a kind of templatic requirement — the incomplete phase must end in monosyllabic foot (= heavy syllable) — combined with a kind of circumscriptional requirement — the final foot of the complete phase is mapped onto this template (cf. McCarthy & Prince 1990a). The form and satisfaction of the templatic requirement is the subject of this section, while the role of the circumscriptional requirement is taken up below, in section 4.2. The statement of the circumscriptional constraint leads to further exploration of the relation between the phases, which is the subject of section 5.

The incomplete-phase template pertains only to the right edge of the stem; pre-final syllables are not affected by the phase alternation and respect the normal (C)V prosody of the language. But the final syllable of the incomplete phase is always heavy, a regularity that we can express in terms of an alignment constraint:[4]

(16) INC-PH
   Every incomplete-phase stem ends in monosyllabic foot (or heavy syllable).
   Align(Stem$_{\text{Inc. Ph.}}$, Right, $[\sigma]_{\text{Ft}}$, Right) (or Align(Stem$_{\text{Inc. Ph.}}$, Right, $\sigma_{\mu\mu}$, Right))

This constraint demands that the right edge of any incomplete-phase stem be aligned prosodically with a monosyllabic foot or, equivalently, a heavy syllable. The choice of prosodic category — foot or heavy syllable — has no direct consequences in the analysis, though one or the other may make more sense in the context of an overall theory of morphological reference to prosodic categories (see McCarthy & Prince 1991ab, 1994b). INC-PH is one of a family of constraints favoring various neutralizations of syllabic distinctions finally: final light syllables, final heavy syllables, final consonants, and the like. For other examples, see McCarthy and Prince (1990b, 1994a), Piggott (1991), and McCarthy (1993a).

Except for syllables containing long vowels, there is a striking dichotomy in Rotuman prosody: heavy syllables are impossible anywhere in a complete-phase stem and medially in an incomplete-phase stem, but they are *required* finally in an incomplete-phase stem. The explanation for this prosodic dichotomy of phase is that INC-PH, and only INC-PH, crucially dominates the constraints encapsulated as SYLL=μ.

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[4]This constraint, like all (MCat, PCat) alignment constraints, can be formulated in terms of correspondence. See McCarthy & Prince (1995: Appendix A) on ANCHORING.

(17) INC-PH ≫ SYLL=μ

vɑo (Inc. Ph.) pure (Inc. Ph.) rɑko (Inc. Ph.) mose (Inc. Ph.)	INC-PH	SYLL=μ
a. ☞ .v͡ɑo. ☞ .puer. ☞ .rɑk. ☞ .mös.		*
b. .vɑ.o. .pu.re. .rɑ.ko. .mo.se.	*!	

Only when INC-PH is relevant — that is, only in the final syllable of an incomplete-phase stem — are heavy syllables possible and, in fact, required. This follows from the ranking of SYLL=μ; it is dominated only by INC-PH, so INC-PH alone is sufficient to compel violation of SYLL=μ. Other constraints of possible relevance are out of the picture because they are low-ranking (see (12)).

Obviously, INC-PH (16) accounts with no special pleading for words ending in long vowels, which have no distinction between the phases. The fact that the complete phase also ends in a heavy syllable/monosyllabic foot is irrelevant to determining the form of the incomplete phase; thus, there is complete phase syncretism in words like *rī* or *sikā*.

We've now dealt with the elements of Rotuman prosody, the prosody of the incomplete phase, and the responsible templatic alignment constraint INC-PH. We have a comprehensive account of the incomplete phase of /...VV/ words (1d) and /...Vː/ words (1e). But nothing has been said yet about the choice among metathesis, deletion, and umlaut in the incomplete phase of /...VCV/ words (1a–c). INC-PH says that words in the incomplete phase must end in a heavy syllable, and this leads inevitably to an unfaithful analysis of underlying /...VCV/ roots like /pure/, /rɑko/, or /mose/. By itself, though, INC-PH cannot determine the *type* of unfaithfulness that ensues; there are many ways to make a final heavy syllable, and it is up to the ranked faithfulness constraints to determine the optimal one. At this point, Correspondence Theory becomes crucial.

Even prior to extensive analysis, we can see a rough pattern of ranking in the realization of the incomplete phase:

(i) The metathesis pattern is preferred as most faithful. It occurs whenever the resulting vowel sequence is a possible light diphthong — that is, it rises in sonority.
(ii) The umlaut pattern is dispreferred relative to metathesis. Thus, it is observed only when metathesis is impossible, because the vowel sequence does not rise in sonority. (E.g., there is umlaut in *mose/mös* but not in *pure/puer*.) Umlaut is subject to a featural restriction too, in that it occurs only with back+front vowel sequences.

(iii) The deletion pattern is least faithful and therefore least harmonic. It is found with any vowel sequence where metathesis or umlaut are impossible: when the vowels are identical (in which case nothing else would be expected), and when they don't rise in sonority (so they can't make light diphthongs) and aren't back+front (so they can't lead to umlaut).

From this perspective, (i)–(iii) represent conditions of decreasing faithfulness to the input vowel, because deletion is least faithful to it, umlaut more so, and complete preservation (through metathesis) most of all. Unfaithfulness of any stripe is demanded by undominated INC-PH, which must be satisfied.

We begin with the most faithful form of the incomplete phase, metathetic words like *puer*. Metathesis between input and output is a violation of the faithfulness constraint LINEARITY (5). This constraint demands that the linear precedence relations of the input segments be preserved by their output correspondents. Violation of LINEARITY is compelled by INC-PH, of course, and by MAX (3), which requires that every segment of the input have a correspondent in the output. (The precise character of the input is an issue of some significance; see section 5 below.) The following tableau proves domination of LINEARITY by MAX:

(18) Metathesis from MAX ≻ LINEARITY

pur_1e_2 (Inc. Ph.)	MAX	LINEARITY
a. ☞ .pue_2r_1.		*
b. .pur_1.	* !	

(The indices are a convenient way to keep track of correspondent elements; they have no theoretical status and should not be given, e.g., an ordinal interpretation.) In the input, the order of segments is $r \succ e$. The output correspondents of those elements occur in the reverse order in form (a), violating LINEARITY. The failed candidate (b) spares this violation, but at the expense of violating MAX by positing no correspondent at all for input *e.* Since (a) is optimal, MAX ≻ LINEARITY. Either way, the final *e* cannot remain *in situ*, because INC-PH is undominated.

This ranking is one of the core elements of Rotuman phonology. Because of it, metathesis occurs rather than deletion, though on the basis of cross-linguistic frequency we might have expected deletion to prevail. This analysis therefore emphasizes the significance of constraint ranking in defining particular grammars within OT. Moreover, since deletion *does* occur in some circumstances, the analysis supports the fundamental idea of OT that the output constraint as target must be separated from the process or alternation that responds to the target. (I return to this point below, in section 3.4.)

The ranking MAX ≻ LINEARITY is inextricably tied up with Correspondence Theory, not only because the constraints involved are defined in terms of Correspondence, but also because it is not possible for the PARSE/FILL model to achieve the effect of this ranking. The PARSE/FILL model must regard metathesis as copy+deletion, because candidates in this model are governed by a principle dubbed "Containment" in McCarthy & Prince (1993a):

(19) Containment[5]
>   No element may be literally removed from the input form. The input is thus contained in every
>   candidate form.

If input /pure/ must be "contained" in every candidate, then literal *puer* is not even in the candidate set, since /pure/ $\not\sqsubseteq$ *puer*, stringwise. Under Containment, the real output form should be *puEr⟨e⟩*, with epenthetic *E* copying the unparsed final vowel. Yet how can this form, which violates *both* FILL and PARSE, ever compete with **pur⟨e⟩*, which violates only PARSE? To put the matter differently, if metathesis is copy+deletion, how will it ever be favored over straight deletion, since deletion receives a subset of the marks that metathesis receives? To escape this consequence of its core assumptions, the PARSE/FILL model would need to introduce considerable elaboration of the conception of what is PARSEd or FILLed, perhaps distinguishing effects on the Root nodes of the vowels from their Place nodes.

Metathesis occurs only in /...VCV/ word-types, and then only when the two vowels are in the appropriate sonority relation to form a light diphthong. In /...VV/ words, there is no question of metathesis, because MAX is fully obeyed without further ado, simply by positing a final heavy syllable instead of a hiatal sequence, as in (9b). And in /...Vː/ words, obedience to INC-PH is obtained with no additional unfaithfulness whatsoever, as the identity between (10a) and (10b) emphasizes.

The metathetic examples are rather straightforward, from this perspective. The deletion examples are also straightforward — they involve violation of MAX when the metathetic option is barred by high-ranking constraints. Following Kaye (1983) and Kaye & Lowenstamm (1984), Rosenthall (1994) posits a constraint, LIGHT-DIPH, which demands that light diphthongs rise in sonority. It crucially dominates MAX in Rotuman, as shown by the following tableau:

(20) Deletion from LIGHT-DIPH ≫ MAX

$rɑk_1o_2$ (Inc. Ph.)		LIGHT-DIPH	MAX
a.	☞ .$rɑk_1$.		*
b.	.$rɑo_2k_1$.	* !	

Both of these candidates obey undominated INC-PH, because they end in heavy syllables. Form (b) has a monomoraic diphthong followed by a moraic coda, like *puer*, but since the diphthong falls in sonority, LIGHT-DIPH is fatally violated. Deletion of *o* ensues; input *o* has no output correspondent in the optimal form *rɑk*.

Thus far, we have motivated the following ranking:

(21) Interim Ranking
    LIGHT-DIPH, INC-PH ≫ MAX ≫ LINEARITY

---

[5]Paul Smolensky has pointed out to me that this term is a bad one, since literally *any* theory of faithfulness, Correspondence Theory included, must somehow ensure that the form under evaluation "contains" comprehensive information about the form to which it is faithful. Unfortunately, "Containment" has achieved the status of a technical term for a theory of faithfulness implemented as in (19), so we may be stuck with it.

The two top-ranked constraints are undominated in Rotuman (indeed, Rosenthall (1994) finds no evidence of violation of LIGHT-DIPH in any language). Both are able to compel violation of MAX, but metathesis (a LINEARITY violation) is preferred to outright deletion. The following summary tableaux put the full system to the test:

(22) Summary Tableaux
  a. Metathesis Case

pur_1e_2 (Inc. Ph.)		LIGHT-DIPH	INC-PH	MAX	LINEARITY
a.	☞ .pue_2r_1.				*
b.	.pur_1.			*!	
c.	.$pu.r_1e_2$.		*!		

  b. Deletion Case

$rɑk_1o_2$ (Inc. Ph.)		LIGHT-DIPH	INC-PH	MAX	LINEARITY
a.	☞ .$rɑk_1$.			*	
b.	.$rɑo_2k_1$.	*!			*
c.	.$rɑ.k_1o_2$.		*!		
d.	.ro_2k_1.			*	*!

The only new candidate introduced here is *rok* (d), which combines metathesis and deletion. Since a candidate with deletion only is available in *rɑk* (a), *rok* can never be optimal.

Other candidates naturally come to mind; most involve violation of structural or faithfulness constraints that are consistently unviolated in Rotuman. From input /rɑko/, for instance, a candidate like *$r\widehat{ao}$ is imaginable; it ought to tie with *rɑk*, since both violate MAX equally. This shows, quite expectedly, that deletion of a consonant and deletion of a vowel have a very different status, and that constraints regulating them are ranked differently in Rotuman. To be concrete, we require something like MAX-C ("every consonant in the input has a correspondent in the output") and MAX-V ("every vocoid in the input has a correspondent in the output"), with the ranking MAX-C ≫ MAX-V to select *rɑk* over *$r\widehat{ao}$.

Another candidate — this time more interesting — is *roɑk*, in which *o* metathesizes past both *k* and *a* to produce a licit light diphthong. This form experiences multiple violation of LINEARITY, but that is not decisive, because low-ranking LINEARITY must always be superseded by MAX, no matter how many times it is violated (see Prince & Smolensky 1993 on "the strictness of strict domination"). Rather, the difference here is categorical, not quantitative: *roɑk* has V-V metathesis, while *puer* has V-C metathesis. While V-C metathesis is not uncommon, to my knowledge processes of V-V metathesis have been proposed on just three occasions,

in Kasem (Chomsky & Halle 1968), Latvian (Halle & Zeps 1973), and Old English (Keyser 1975). All three involve very abstract analyses, in which the underlying representations and/or the consequences of metathesis are by no means apparent, and all except Latvian have been reanalyzed in ways that do not involve V-V metathesis at all. It therefore seems reasonable to prohibit V-V metathesis outright, perhaps universally (cf. Ultan 1978). The deeper reasons for this prohibition remain obscure, but it is sufficient for present purposes to observe it and call on it in the analysis of Rotuman.[6]

Another logical possibility is a monosyllabic output *raok*, in which each of *ɑ, o,* and *k* has a mora. By treating *ao* as a heavy diphthong, this candidate skirts the prohibition inherent in LIGHT-DIPH, but it runs afoul of another undominated constraint: Rotuman never permits trimoraic syllables, and indeed actively avoids them. The same can be said, *mutatis mutandis*, for a candidate in which *ɑ* and *o* have moras, but *k* does not; Rotuman codas are always mora-bearing, reflecting the force of another undominated constraint.

This still leaves a class of candidates that respect the unviolated prosodic canons and that do not involve impossible types of unfaithfulness. Some of these candidates are listed below:

(23) Some Seemingly Plausible Incomplete-Phase Candidates

	From /pure/	From /rɑko/
a.	purē	rɑkō
b.	pureʔ	rɑkoʔ
c.	uper	ɑrok
d.	pu.er	rɑ.ok

The forms in (a) and (b) satisfy INC-PH's heaviness requirement by adding weight to the final syllable, either by lengthening the final vowel or by consonantal epenthesis. Since consonantal epenthesis is never met with in Rotuman, it might be ruled out by undominated DEP-C, but vowel lengthening is independently required to account for the limited distribution of long vowels (see section 4.3). The forms in (c) avoid deletion (and vowel-vowel metathesis) by double vowel-consonant metathesis, in a kind of domino effect. Only low-ranking LINEARITY and ONSET are violated. Most serious of all is case (d), where there is a hiatal sequence that is utterly typical of the language as a whole and which spares any other complications. It seems clear that *rɑ.ok* ought to be optimal, as the following tableau shows:

(24) Evaluation of *rɑk* vs. *rɑ.ok*

	rɑk$_1$o$_2$ (Inc. Ph.)	MAX	LINEARITY	ONSET
a.	.rɑ.o$_2$k$_1$.		*	*
b.	.rɑk$_1$.	* !		

---

[6]Another difference between *roɑk* and *puer* is that the former has metathesis of non-adjacent segments. This too may be universally prohibited, as proposed by Poser (1982). Yet another possibility, afforded by Smolensky's (1995) proposed *local constriant conjunction*, is to construct a power hierarchy of LINEARITY, with LINEARITY^3 > LINEARITY^2 > MAX > LINEARITY^1. Then only local metathesis is permitted in Rotuman to avoid MAX violation

This issue is of some significance, since the explanation for the impossibility of *ra.ok* greatly expands the interest of Rotuman for the theory of Prosodic Morphology. The matter is addressed at length in sections 4 and 5.

Apart from these seemingly problematic candidates, we have a reasonably thorough account of the deletion and metathesis patterns. The analysis does not address the umlauting cases like *mose/mös*. Because these examples involve vowel sequences that cannot be accommodated under LIGHT-DIPH, they are predicted to show deletion rather than metathesis. Certainly, *mös* exhibits a kind of deletion, but with a twist: the erstwhile penult is fronted. In fact, umlaut is coalescence in Rotuman, and the fronting is a faithfulness effect. The details of this analysis are presented below in section 5.3.

3.3 Summary

We now have several core elements of the analysis in hand. The constraint INC-PH demands that incomplete-phase stems emerge with a final heavy syllable (a monosyllabic foot). Vowel sequences that obey LIGHT-DIPH are preserved metathetically, showing that LINEARITY is low-ranking — it is sacrificed to spare violation of MAX, under the core ranking of Rotuman, MAX ≻ LINEARITY. But the undominated prosodic constraints of Rotuman ensure that any diphthong in a closed syllable is light, and so the sonority requirement LIGHT-DIPH bars metathesis for many other vowel sequences. When metathesis is not an option, the result is deletion or umlaut.

The results achieved depend crucially on the Optimality-Theoretic conception of faithfulness: it is regulated by violable constraints, ranked among constraints on output targets. (Compare the derivational view of faithfulness, which is simply inheritance of the representation from previous derivational stages. I return to this point in section 3.4.) Moreover, the core ranking, MAX ≻ LINEARITY, hinges on the Correspondence approach to faithfulness. Faithfulness through correspondence can deal sensibly with competing candidates that differ in effects as diverse as metathesis, deletion, and coalescence (the subject of section 5.3).

Another interesting point that emerges from the discussion above is the *prosodic inhomogeneity* of Rotuman. Syllables are invariably light (C)V, except finally in incomplete-phase stems, where they are always heavy. This pattern principally emerges from the ranking INC-PH ≻ SYLL=µ, so that all syllables are obliged to be light, except at the right edge of a form in the incomplete phase. Inhomogeneities like this one are an important argument for Optimality Theory, as Prince (1993) argues. In rule-based or parametric theories, a language either is or is not limited to (C)V syllables. OT does not demand such typological strictness; it makes perfect sense, as in Rotuman, to say that (C)V syllables are obligate except under particular morpho-phonological conditions, which are precisely defined by a higher-ranking constraint. This "non-uniformity" thesis, to use Prince's term, is a direct consequence of the OT idea that a grammar is a hierarchy of violable constraints.

The analysis proposed here also bears on the theory of the template in Prosodic Morphology. In earlier work (e.g., McCarthy & Prince 1986 et seq.), a template is conceived of as a prosodic requirement imposed on an *entire* stem (or affix, in reduplicative morphology). When less than the entire stem is subject to the templatic requirement, as in the Arabic broken plural, prosodic circumscription is called on to limit the scope of the template.

In contrast, INC-PH is a restriction on only a portion of the stem, not the whole stem. Incomplete-phase stems are guaranteed only to *end* in a heavy syllable/monosyllabic foot; the rest of the stem can consist of nothing or of several syllables, up to whatever the Rotuman lexicon provides. Furthermore, INC-PH accords with the view that templates are emergent consequences of independently necessary constraints, rather than morphology-specific entities.[7] As I noted in section 3.2, INC-PH is identical, except for the morphological restriction to incomplete-phase stems, with purely phonological constraints observed in other languages, which neutralize final weight distinctions in stems generally or in all words.

Finally, this analysis provides an account of one of the more puzzling features of Rotuman prosody, the non-structure-preserving character of incomplete-phase syllables. Long vowels aside, only (C)V syllables occur in the complete phase and in non-final syllables of the incomplete phase.[8] But final syllables of the incomplete phase must be heavy, (C)VC and (C)VV. This morphologically-based disjuncture in prosodic possibilities emerges straightforwardly from the violation, through domination, of SYLL=μ. This constraint crucially dominates ONSET and appropriate faithfulness constraints, so it is routinely observed in the language as a whole. But stem-finally in the incomplete phase, INC-PH suppresses SYLL=μ, demanding weight instead. In this way, a (C)V language can allow — even require — CVV or CVC syllables in a particular position of a particular morphological category.

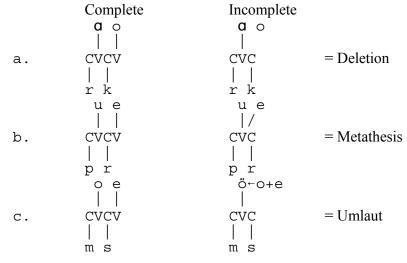## 3.4 Discussion of Previous Analyses

The analysis proposed here owes a very substantial debt to the first prosodic analysis of Rotuman, independently developed by Saito (1981), van der Hulst (1983), and Besnier (1987), henceforth S-H-B. This earlier account represents an important advance in our understanding of this language, because it unites the various incomplete-phase alternations under a single structural operation: deletion of a V-slot. (There are differences of detail among the three authors, but these are inconsequential in the current context.) The idea is that /...VCV/ words lose the final V-slot in the incomplete phase, and the resulting stray vowel melodeme is deleted (25a), reassociated to form a diphthong (25b), or absorbed via vowel coalescence (25c). Moreover, under the assumption that vowels

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[7]This is dubbed "Generalized Template Theory" in McCarthy & Prince (1994b). See also McCarthy & Prince (1990b, 1993a, 1994a), Itô & Mester (1992), Itô, Kitagawa, & Mester (1995), Moore (1995), Steriade (1988), Urbanczyk (1994, 1995, 1996).

[8]Loan-words with clusters are arguably given an *ad hoc* analysis as compounds: *kampanē* would be /kɑmɑ–pɑnē/, while *tisempa* would be /tiseme+pɑ/ (see Blevins 1994).

and consonants are arrayed on separate tiers, the metathesis effect involves no actual re-ordering, but comes "for free" as a repair of the stray melodeme:

(25) Phase Difference in /...VCV/ Words According to S-H-B

```
              Complete              Incomplete
               ɑ  o                  ɑ  o
               |  |                  |
     a.        CVCV                  CVC            = Deletion
               |  |                  |  |
               r  k                  r  k
                 u  e                  u  e
                 |  |                  | /
     b.        CVCV                  CVC            = Metathesis
               |  |                  |  |
               p  r                  p  r
                 o  e                  ö←o+e
                 |  |                  |
     c.        CVCV                  CVC            = Umlaut
               |  |                  |  |
               m  s                  m  s
```
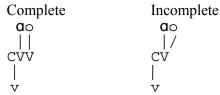
Below, I discuss some of the successes and failures of S-H-B, dealing first with the process relating the two phases, and then turning to the idea that consonants and vowels are segregated on separate tiers.

It should be clear from these structures and the brief explanation just given that S-H-B anticipate many aspects of the overall approach taken here. They see the complex alternations of Rotuman in a unified way: there is *one* difference between phases (loss of a V-slot), and the various surface effects result from accommodation to this difference. Ideally, the accommodations are seen as automatic consequences of reparsing the same underlying melody with fewer skeletal positions to work from.

There are difficulties, however. In (25b), we see that S-H-B posit a light diphthong in metathetic examples. Apart from the difference between moraic and CV theory, this structure is identical to (8a). But the S-H-B analysis must posit the same light-diphthong structure for the incomplete phase of /...VV/ words:

(26) Phase Difference in /...VV/ Words According to S-H-B

```
          Complete            Incomplete
            ɑo                   ɑo
            ||                   | /
           CVV                  CV
            |                    |
            v                    v
```

For S-H-B, this structure is a result of having a uniform operation to make the incomplete phase: if you delete a V-slot in *vao*, the result is a light diphthong, the same as in *puer* (25b). Yet this cannot be correct. As I showed in (14), /...VV/ words like *vɑo* can contain *any* vowel combination, while metathetic forms like *puer* are limited to rising sonority sequences, respecting a well-known restriction on light diphthongs. So S-H-B must contend with an unexplained failure of symmetry between the light diphthongs in /...VV/ words and the light diphthongs in metathetic /...VCV/ words. Some fix-up or further condition is required.

For similar reasons, S-H-B encounter problems with words ending in long vowels. In fact, these words make no distinction of phase, since their normal form satisfies INC-PH. But S-H-B predict shortening of final long vowels in the incomplete phase — contrary to what is actually observed.

In summary, though the S-H-B analysis provides a uniform treatment of /...VCV/ words, it does not generalize to /...VV/ and /...Vː/ words. In contrast, the templatic analysis presented in section 3.2 accords with the phonetic details of Churchward's description, and it explains the differences between the metathetic /...VCV/ forms and the diphthongal /...VV/ forms, the absence of phase difference in /...Vː/ forms, and the limitation of heavy syllables to incomplete-phase stems. The S-H-B processual account, though it supplies many important insights, cannot achieve this level of integration into the phonological system of the language.

The reason for the empirical inadequacies and lack of phonological integration of S-H-B lies with its *processual* treatment of the incomplete phase. For S-H-B, the incomplete phase is derived by a process deleting the final V-slot of the complete phase, and this process applies indiscriminately to /...VCV/, /...VV/, and /...Vː/ roots, with undesirable results. In contrast, as Prince & Smolensky (1991, 1993) emphasize, Optimality Theory deals not with processes but with targets — output constraints that characterize some sought-for structural configuration, rather than a procedure for getting there. The constraint INC-PH defines a target (a prosodic template) which is satisfied in various ways, depending on the form of the input and the low-ranking faithfulness constraints formulated in terms of correspondence. This *uniformity of target* coupled with *non-uniformity of repair* is a hallmark of Optimality-Theoretic analysis, distinguishing it from standard processual treatments (as well as another prominent constraint-based model, the Theory of Constraints and Repair Strategies (Paradis 1988ab)).

Nonetheless, it is worth repeating that S-H-B, by conceiving of the phase alternation prosodically, have significantly illuminated the structure of this language. The same cannot be said about the segmental accounts of this phenomenon, in Cairns (1976), Janda (1984), and Hoeksema & Janda (1988). These treatments do not seem to generalize beyond the first-order descriptive categories. Thus, every way in which the phase alternation is realized requires a separate rule. This pertains not only to /...VV/ and /...Vː/ words,[9] but also to each descriptive type of phase difference /...VCV/ words. There must be very many rules sensitive to the morphological category "incomplete phase".

A concrete instance of this line of analysis is Hoeksema & Janda's morphological metathesis rule in (27), which applies to just one phonologically-defined subset of Rotuman words:

(27) Rotuman Metathesis in Hoeksema & Janda (1988) (morphological conditions omitted)

$$/ \ X \begin{bmatrix} V \\ m \text{ high} \end{bmatrix} \ C \ \begin{bmatrix} V \\ n \text{ high} \end{bmatrix} \ / \rightarrow /1\ 2\ 4\ 3/, \text{ where } m > n$$

$$1 \quad 2 \quad \quad 3 \quad \quad 4$$

---

[9] Presumably. The works cited do not mention /...VV/ and /Vː/ words at all.

The condition that the affected vowels must fall in height is stipulated in the morphological process itself. Because it is merely stipulated in the context of a morphological rule, this condition cannot be related to relevant typological regularities, such as the form of light diphthongs and the bimoraic upper-bound on syllable size. Other rules, each with their own stipulations, will be required for the umlaut, deletion, and diphthongization cases. No greater generality is attempted nor, it would seem, possible.

Thus far, I have concentrated only on the process deriving the incomplete phase in S-H-B and elsewhere. But S-H-B make another important assumption (adopted in McCarthy 1986, 1989): Rotuman vowels and consonants are arrayed on separate tiers, extending the proposals about Semitic languages in McCarthy (1979, 1981). By virtue of this representational assumption, S-H-B can treat what appears to be metathesis as an automatic repair. When a vowel melodeme is left stranded by deletion of its associated V-slot, it can reassociate to the preceding syllable. Rotuman C/V tier segregation is criticized by advocates of segmental analyses (Janda 1984, Hoeksema & Janda 1989, Odden 1988, Anderson 1992: 288), who rely instead on a morphological metathesis rule like (27).

With tier segregation, the possibility of metathesis is hard-wired into every phonological representation — in essence, it's a stipulated regularity of the Rotuman lexicon which has overt consequences in the incomplete phase. In Optimality Theory, on the other hand, there are no stipulated regularities in the lexicon; regularities must emerge from the constraints on output forms, possibly augmented with assumptions about language learning (Prince & Smolensky 1993: Chapt. 9). There are several reasons for pursuing this claim in OT: it is presupposed by another claim, that all interlinguistic differences are to be derived from constraint ranking; it is *possible* to obtain the effect of constraints on underlying representation from output constraints; and it is *necessary* to do so, in order to solve the "duplication problem" (on which see Kenstowicz & Kisseberth 1977).

In this conception of OT, it is not possible to hard-wire the possibility of metathesis into lexical entries; all interlinguistic differences come from the ranking of constraints, and metathesis in Rotuman is a consequence of the ranking MAX ≻ LINEARITY. More broadly, OT takes much of the burden of explanation off of representations (e.g., tier segregation) and places it on substantive constraints (e.g., LINEARITY), which are violable under domination. Thus, consonant-vowel tier segregation is completely superfluous in an Optimality-Theoretic analysis of Rotuman, and in fact it is antithetical to fundamental premises of OT.

Suppose, though, that we put these premises of OT aside and, as an intellectual exercise, pursue the idea that Rotuman has tier segregation within an Optimality-Theoretic analysis. The idea, then, is that the Rotuman lexicon consists of tier-segregated forms like $/\{p_1r_2, u_3e_4\}/$,[10] which Gen is free to operate on. Given this as input, high-ranking SYLL=μ (11) will force the syllabically most harmonic output $p_1u_3r_2e_4$. When INC-PH is active, though, the same input will be analyzed as $p_1u_3e_4r_2$. In this analysis there is no technical violation of LINEARITY, and so there is no literal metathesis. Undominated INC-PH forces the analysis *puer*. When INC-PH is irrelevant,

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[10]Recall that the numerical values of the indices play no role in the theory; they're just a convenient way of labeling input-output correspondent pairs.

in complete-phase forms, then *pure* is the result. This assumption about the form of the lexicon, combined with the prosodic constraints, seems to do the work of LINEARITY and LINEARITY-violation. Then LINEARITY would undergo a kind of apotheosis, becoming a "hard" constraint. (Moreover, there is now a structural rather than substantive account of the non-optimality of forms like **roak* for *rak* from /{rk, ɑo}/ (see p. 15) — vowel-vowel metathesis is impossible because all vowels are on the same tier.)

However attractive this metathesis-less account may appear on superficial inspection, it is fatally flawed. For one thing, it cannot represent the lexical contrast between /CVV/ and /VCV/. Words like *usi* 'bush sp.' and *sui* 'bone' (and 27 other minimal pairs among the disyllables alone) will receive identical lexical representations as /{s, ui}/. For another, this analysis cannot deal in a sensible way with the deletion alternations, such as *rako*/*rak* or *fẹpi*/*fẹp* 'to be slow'. Since consonants and vowels are unordered in the input, why are the incomplete-phase forms *rak* and *fẹp* rather than **rok* and **fip*?[11] To make the matter more concrete, observe that *fẹp* and **fip* are equally unfaithful to the presumptive input /{fp, ei}/, so at best they are tied as outputs. At worst, **fip* is wrongly judged as optimal, since it has a less marked vowel than *fẹp*. (See section 5.2 for the relevant vocalic markedness constraint.) To put the matter differently, if the input is the tier-segregated expression /{fp, ei}/, then *fẹp* and **fip* are wrongly judged to be, at best, equally faithful outputs. One might appeal to some constraint other than faithfulness — for instance, left-to-right association of vowels — to favor *fẹp* over **fip*, but then it's an accident that the vowel preserved in *fẹp* happens to be the same vowel that occurs between *f* and *p* in the corresponding complete phase *fẹpi*. No superficial technical fix is appropriate, because the problem derives directly from the core assumption of tier segregation theory.

Perhaps a way to rescue tier segregation would be to combine it with underlying specification of the skeleton. In this way, the lexical entries are identical to the complete-phase forms in (25) and (26). This obviously solves the problem of representing the contrast between /CVV/ and /VCV/. It also solves the problem of *fẹp* versus **fip*. In the lexical form /fepi/, the *e* is linked to a V slot between *f* and *p*. Because it preserves that linkage, *fẹp* is more faithful to the lexical form than **fip* is. But what is this faithfulness constraint, which favors the output in which the order of linked elements is the same as in the input? It's nothing but a version of LINEARITY, though it is disguised by the more complex representational assumptions. So tier segregation has not eliminated the need for a LINEARITY constraint or for violation of LINEARITY in metathetic forms. I conclude, then, that tier segregation is superfluous.

More broadly, the failure of tier segregation in Rotuman accords with the Optimality-Theoretic imperative to derive linguistic properties from output constraints rather than restrictions on the input. Analogously, it supports the diminished or nonexistent role for underspecification in OT analyses (Prince & Smolensky 1993: Chapt.9, Itô, Mester, & Padgett 1995, McCarthy & Prince 1995). Tier segregation in Rotuman is a type of underspecification; it is underspecification of predictable linear-order relations between consonants

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[11]Thanks to Moira Yip for pointing this out.

and vowels (McCarthy 1989). Just as in featural underspecification, the "underspecified" input /{pr, ue}/ demands that the lexicon account for something that is properly in the purview of output constraints. Rather than some peculiarity of the input, it is the ranking MAX ≻ LINEARITY, formulated under Correspondence Theory, that is responsible for the metathetic alternations.

4. Prosodic Faithfulness

4.1 Introduction

When the forms related through correspondence both have prosodic structure, then we can meaningfully speak of constraints demanding prosodic faithfulness. All aspects of prosodic structure — foot, syllable, or mora — are potentially involved in faithfulness relations of this type. In Rotuman, faithfulness to metrical feet is an important element of the phonology. It can be observed in two circumstances, discussed below: in the complete→incomplete mapping, where it yields an effect akin to prosodic circumscription in operational theories (section 4.2); and in the lexical→surface mapping, where it accounts for the restricted distribution of long vowels in the language (section 4.3). More broadly, prosodic faithfulness constraints lead to a general cross-linguistic theory of circumscriptional effects, pursued in McCarthy (1996) and independently by Itô, Kitagawa, & Mester (1995), and to a general theory of lexical exceptions to stress, pursued in Alderete (1996) and Pater (1995b).

Before examining this material, though, there are details of formulation to be considered. Following an implementational decision by McCarthy & Prince (1995), I assume that correspondence is a relation from segment to segment only. Therefore, any aspects of prosodic faithfulness must be mediated by the segments bearing the prosodic roles. From this perspective, some typical prosodic faithfulness constraints are these:

(28) HEAD-MATCH
   If α is the prosodic head of the word and αℜβ, then β is the prosodic head of the word.

(29) ANCHOR-{L,R}-FT
   If α is at the left/right edge of a foot and αℜβ, then β is at the left/right edge of a foot.

I assume that any vocoid in the main-stressed nucleus is a prosodic head of the word. Thus, any pair of representations that satisfy HEAD-MATCH will have a correspondence relation between their main-stressed segments. Any pair of representations that satisfy ANCHOR-FT will have a correspondence relation between segments standing at a designated foot edge. The formulation and name of the constraint follow proposals about reduplicative anchoring and alignment of morphological and prosodic categories within Correspondence Theory (McCarthy & Prince 1994b, 1995).

Correspondence is essential to the formulation of these constraints, and so analyses incorporating them provide evidence in support of Correspondence Theory. As we will see below, conceptions of prosodic faithfulness that do not rest on correspondence cannot deal with the empirical material discussed. Of course, details of formulation remain; at the end of this section, we will briefly consider the possibility that prosodic constituents themselves also stand in correspondence to one another, subject to constraints like MAX-FT. But

first we will examine the application of the prosodic faithfulness constraints (28) and (29) in the phonology of Rotuman.

4.2 Prosodic Circumscription

Section 3.2 introduced some plausible but failed candidates for the incomplete phase of metathesizing and deleting roots. These candidates are repeated immediately below; anticipating the subsequent analysis, I also show the expected stress and foot-structure of these words, in conformity with undominated constraints:[12]

(30)   Metathesizing Form   Deleting Form
      Com. Phase   Inc. Phase   Com. Phase   Inc Phase
      {púre}   {púer}   {ráko}   {rák}
   a.   *pu{ré}   *ra{kó}
   b.   *pu{ré?}   *ra{kó?}
   c.   *u{pér}   *a{rók}
   d.   *pu.{ér}   *ra.{ók}

The analysis as developed in section 3.2 will not rule out any of these candidates. Some can plausibly be excluded by recognizing additional high-ranking constraints, such as DEP-C, which bars consonant epenthesis (b). But candidates like (d) present unique challenges. They have the structure in (31), which fully satisfies INC-PH:

(31) Structure of *ra.ok

```
      σ    σ
      |   /\
      μ   μ μ
      |   | |
      r   a o k
```

Unlike the actual output form *rak*, this candidate preserves every input segment, obeying MAX. It does so by violating both LINEARITY and ONSET, but irrelevantly, since we independently have the ranking MAX > LINEARITY, ONSET (see p. 7 and tableau (18) for the arguments). To put the matter differently, *rak* suffers from deletion, which is strongly avoided because MAX is high-ranking, while *ra.ok* has only metathesis and an onsetless syllable, both of which are favored outcomes, because they run afoul of only low-ranking constraints. Therefore, under the language-particular ranking of constraints in Rotuman, *ra.ok* is more faithful than *rak*.

But consider the *prosodic* structure of *ra.{ók} versus {rák} in relation to the related complete-phase form {ráko}. The foot structure of *ra.{ók} is very different from the foot structure of {rá.ko}, while the actual output {rák} is a much better match to the foot structure of {rá.ko}. The same difference can be seen with the broader range of examples considered in (32):

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[12]As I argued in section 3.1, the Rotuman main-stress foot is a moraic trochee, consisting of a heavy syllable or two lights, aligned at the right edge of the word. There is no report of secondary stress; I therefore make the assumption (which is inessential to my argument) that all syllables except those in the main-stress foot are unfooted, parsed directly by PrWd.

(32) Role of Metrical Structure in Determining Incomplete Phase

	Complete Phase	Incomplete Phase
a.	{rɑ́.ko}	{rɑ́k}
		vs. *rɑ.{ók}
		*rɑ{kő}
		*rɑ{kóʔ}
		*ɑ{rók}
b.	{púre}	{púer}
		vs. *pu.{ér}
		*pu{rɛ̋}
		*pu{réʔ}
		*u{pér}
c.	he{léʔu}	he{léʔ}
		vs. *he.le.{úʔ}
		*he.le.{ʔŭ}
		*he.le.{ʔúʔ}
		*he.e.{lúʔ}
d.	se{sévɑ}	se{séɑv}
		vs. *se.se.{ɑ́v}
		*se.se.{vɑ̋}
		*se.se.{vɑ́ʔ}
		*se.e.{sɑ́v}
e.	{mó.se}	{mós}
		vs. *mo.{és}
		*mo.{sɛ̋}
		*mo.{séʔ}
		*o.{més}

To show the generality of this result, I've included in (32) all of the failed candidates from (30) and some additional root types (polysyllables and an umlauting root). In every case, the footing of the complete phase more closely resembles the footing of the actually observed incomplete phase than any other candidate.

Of course, equivocations like "more closely resembles" aren't the stuff from which grammars are made, so greater precision is necessary. There is a requirement of structural homology between the incomplete phase and the complete phase. To make sense of this requirement, we need to posit a correspondence relation between the complete-phase form and the incomplete-phase form — that is, there is a correspondence relation ℜ from the complete phase to the incomplete phase, just as there is a relation from the input to the output. (On "output-output" relations of this type, see Benua 1995 and section 5 below.) Using this correspondence relation, we can express the structural homology requirement as HEAD-MATCH (28). For the case at hand, the relation ℜ in this constraint stands for the correspondence relation between the output complete phase, with its metrical structure, and the output incomplete phase, also with its metrical structure.[13]

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[13]Could the *lexical form* have prosodic structure, obviating the need for a correspondence relation between the complete phase and the incomplete phase? This will not succeed, as I show in section 5.2.

Using indexation to indicate correspondent elements, we can go on to apply this constraint to the examples, beginning with the deletion cases (32a). Since the vowel α occupies the stressed nucleus in complete-phase *{rá₂ko₄}*, only the actual output form *{rá₂k}* satisfies HEAD-MATCH. Compare the failed candidates:

(33) Violations of HEAD-MATCH (28) in Failed Candidates for {rɑ́₂k}

      a. *rɑ₂.{ó₄k}
      b. *rɑ₂{kŏ₄}
      c. *rɑ₂{kó₄ʔ}
      d. *ɑ₂{ró₄k}

All of these forms satisfy INC-PH, but they do so in a way that "shifts" the stress from the correspondent of a_2 to the correspondent of o_4. HEAD-MATCH demands that the complete-phase prosodic head have a correspondent in the incomplete phase that is also a prosodic head, yet none of these failed candidates satisfy that requirement.

The failed candidates for *pu₂re₄/pu₂e₄r* (32b) are disposed of likewise, with one small clarification. In *puer*, the nucleus, and hence the prosodic head, consists of the entire light diphthong *ue*. This situation satisfies HEAD-MATCH, which does not demand symmetric identity of prosodic heads — it is enough that the head of the complete phase have a correspondent that is also head in the incomplete phase. Similar considerations apply to examples like *vá₂.o₃/va͡₂o₃*, in which the prosodic head of the incomplete phase is also a diphthong.

The polysyllables (32c, d) are unremarkable; they work just like their disyllabic counterparts. This brings us finally to umlauting forms like *mo₂se₄/mö₂,₄s*; as the dual subscripts on *ö* indicate, I analyze these forms with coalescence in the incomplete phase (Saito 1981, van der Hulst 1983, Besnier 1987). The analysis of coalescing umlaut can be found in section 5.3. For now, it is sufficient to observe that a coalesced segment stands in correspondence with two segments of the related form. Since one of those is a prosodic head, the product of coalesence must also be a prosodic head, if HEAD-MATCH is to be obeyed. In *mö₂,₄s*, this is indeed the case, but not in any of the failed candidates in (32e).

Of course, if HEAD-MATCH is to have any of these salubrious effects, it must be properly ranked. In fact, it is undominated. Crucially, it compels violation of MAX, in order to exclude otherwise plausible results in (32) like *rɑ.ok or *hele.uʔ:

(34) HEAD-MATCH ≫ MAX

{rɑ́₂.ko₄} he.{lé₄.ʔu₆}	HEAD-MATCH	MAX
a. ☞ {rɑ́₂ k} ☞ he.{lé₄ʔ}		*
b. rɑ́₂.{ó₄k} he.le₄.{ú₆ʔ}	* !	

The forms in (a) display the required relation between the prosody of the complete phase and the prosody of the incomplete phase: the correspondent of the prosodic head is also a prosodic head. In the failed candidates, by

contrast, headship is skewed between different correspondent segments. This is a type of unfaithfulness, but it differs from more familiar faithfulness effects in two respects: it is faithfulness to an aspect of prosodic structure, headship, rather than segmentism; and it is unfaithfulness to the related complete-phase form, rather than unfaithfulness to the lexical representation. Faithfulness to prosodic structure is the topic of the remainder of this section; faithfulness between morphologically related forms is discussed in section 5.

A few details remain, some trivial, some more interesting. A relatively unimportant detail involves the implicit assumption that the basic constraints responsible for the Rotuman stress system are undominated. (See Prince & Smolensky 1993 and McCarthy & Prince 1994b for the general type of such constraints.) Every prosodic word of the language has a moraic trochee aligned at the right edge. Thus, candidates like *{rá}.ok* or *{he.lé}.uʔ*, though they satisfy HEAD-MATCH, do so at the expense of violating undominated constraints on foot form and/or alignment. It is unnecessary to consider them further.

A more significant issue concerns the statement of the prosodic faithfulness constraint — why demand correspondence of stressed nuclei, rather than other kinds of prosodic identity? Two possibilities come to mind: correspondence of segments foot edges (=ANCHOR-FT (29)), rather than foot heads (=HEAD-MATCH (28)); and general-purpose faithfulness to *all* aspects of foot structure, minimally violated.

The first possibility is promising, with interesting consequences for other languages (see McCarthy (1996) and section 4.3 below), but it is not entirely successful in dealing with Rotuman. Some examples are:

(35) ANCHOR-L-FT (29) Applied

$\{r_1$á.ko$\}$	⇌	$\{r_1$ák$\}$
$\{p_1$ú.re$\}$	⇌	$\{p_1$úer$\}$
he.$\{l_1$é.ʔu$\}$	⇌	he.$\{l_1$éʔ$\}$
$\{m_1$ó.se$\}$	⇌	$\{m_1$ós$\}$

As the examples show, this constraint is obeyed by all of the actual output forms. It is also violated, as it should be, by many of the failed candidates in (32). Nonetheless, doubly-metathetic forms like *$a\{r_1$ók$\}$ manage to obey ANCHOR-L-FT. Since these forms are in fact ungrammatical, and since no other constraint is available to rule them out (because they otherwise incur violations of only low-ranking ONSET and LINEARITY),[14] it is clear that HEAD-MATCH, rather than ANCHOR-L-FT, is the responsible constraint in Rotuman. Still, the idea of anchoring corresponding foot-edges has useful applications, discussed below.

Though HEAD-MATCH and ANCHOR-FT differ from one another, the differences between them are relatively insignificant — both depend on Correspondence Theory for their formulation, and both are stated in terms of segments standing in correspondence. A quite distinct alternative, with no ties to Correspondence Theory, is a very general metrical faithfulness constraint, rather than one that's specific to particular positions or edges. This constraint would be a kind of broadly-characterized "PROS-FAITH".[15] A constraint of such

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[14]Observe too that *$arok$ is entirely possible under C/V tier segregation, emphasizing the point made in section 3.4 (see p. 22) that even a theory with segregation requires some LINEARITY-like constraint to rule out excessively unfaithful candidates.

[15]Various versions of such a constraint, set within the PARSE/FILL model, can be found in Buckley (1994), Inkelas (1994), and Kenstowicz (1994).

generality would demand exact identity of all aspects of prosodic structure between the complete phase and the incomplete phase: location of segments in metrical structure, the nature of the structure itself, and prominence relationships.

Undifferentiated PROS-FAITH will not succeed. Identity of feet between the phases is not perfect, but only certain kinds of imperfections are permitted and others are banned outright. For example, it is clear that the footing of *{rák}* is different from *{ráko}*, but could one somehow explain why it violates PROS-FAITH less than *ra.{ók}* or *ra.{kŏ́}* do? Such fine-grained measurement of degree of violation will probably elude even the most diligent investigator. Amorphous foot faithfulness, then, is of little use for constructing real grammars, despite its utility as a first-order intuition about how to approach such problems.

Constraints like HEAD-MATCH and ANCHOR-FT form (part of) a theory of prosodic faithfulness. As we have seen, this is a a straightforward undertaking in Correspondence Theory. By requiring correspondent segments to have identical prosodic roles, these constraints enforce full or partial identity of prosodic structure. In contrast with Correspondence Theory, though, the PARSE/FILL theory of faithfulness in Prince & Smolensky (1991, 1993) does not readily incorporate prosodic faithfulness effects, particularly ranked effects of *partial* faithfulness, as in Rotuman. (In this respect, PARSE/FILL encounters much the same problem as undifferentiated PROS-FAITH.) It is by no means clear how to achieve the relevant contrasts in Rotuman within this model. For instance, one cannot sensibly say that *{rák}* "parses" the role of *a* as prosodic head, while *ra.{ók}* "fails to parse" that role. Thus, it seems clear that a PARSE/FILL conception of prosodic faithfulness would require developing various notions like non-parsing of a foot-node in favor of alternative parsings of its dependents, cancelled associational links, and so on. (See Kenstowicz 1994 for some developments along these lines.)

We now have a fairly complete understanding of the role of metrical structure as a determinant of the Rotuman phase alternation. The complete phase and incomplete phase stand in correspondence, and so the incomplete phase must be faithful to the output form of the complete phase. The relevant faithfulness constraint is HEAD-MATCH, which demands a kind of prosodic faithfulness, correspondence of stressed nuclei. It crucially dominates MAX, to favor deletion over other alternatives.

This relation of prosodic faithfulness between the phases is similar in effect, though not in implementation, to prosodic circumscription (McCarthy & Prince 1990a). Prosodic circumscription is set within an operational model of phonology. Central to prosodic circumscription is a parsing function $\Phi(C, E)$ which returns the designated prosodic constituent C that sits at the edge E of the base B. The function Φ induces a factoring on the base B, dividing it into two parts: one is the *kernel* $B{:}\Phi$, the part that satisfies the constraint (C,E); the other is the *residue* B/Φ, the complement of the kernel within B. Assuming an operator "*" that gives the relation holding between the two factors (normally left- or right-concatenation), the following identity holds:

(36) Factoring of B by Φ
    $B = B{:}\Phi * B/\Phi$

In *positive* prosodic circumscription, the B:Φ factor serves as the base for the morphological operation. Let O(X) be a morphological or phonological operation defined on a base X. Then O:Φ — the same operation, but conditioned by positive circumscription of (C, E) — is defined in the following way:

(37) Definition of Operation Applying under Positive Prosodic Circumscription
   O:Φ(B) = O(B:Φ) * B/Φ

That is, to apply O to B under positive prosodic circumscription is to apply O to B:Φ, concatenating the result with B/Φ in the same way ("*") that the kernel B:Φ concatenates with the residue B/Φ in the base B. In this way, the operation O:Φ inherits everything that linguistic theory tells us about O, except its domain of application.

In a rule-based circumscriptional analysis of Rotuman, the final foot of the complete phase would be circumscribed and mapped onto a heavy-syllable template. Formally, the surface form of the complete phase[16] is prosodically circumscribed by Φ(Foot, Right). The morphological operation O applied to the circumscribed base is mapping to a monosyllabic foot template. The full derivation of an incomplete-phase form proceeds as follows:

(38) Circumscriptional Derivation in Rotuman
   a. Underlying Form /seseva/
   b. Pass through phonology, yielding *se{sé.va}*.
   c. Prosodic circumscription by O:Φ(Ft, Right), where O = "map to heavy syllable"
      i.   O:Φ(*se{sé.va}*)   =   O(*se{sé.va}*:Φ) * *se{sé.va}*/Φ
      ii.   =   O(*{sé.va}*) * *se*
      iii.   =   *{seav}* * *se*
      iv.   =   *se{seav}*

In (i–ii), we see the separation of the base into the Φ-delimited portion *seva* and the residue *se*. The Φ-delimited string is mapped onto a monosyllabic foot template (iii), and the form is re-assembled (iv) by attaching the residue in the position where it originated.

The weight of evidence goes against the operational theory of prosodic circumscription and in favor of prosodic faithfulness under correspondence theory. I will mention two considerations here, both of which are pursued at greater length in McCarthy (1996).

This circumscriptional derivation is inherently serial: a complete-phase stem is constructed, its final foot is extracted, and the extracted segmental string is mapped onto a heavy-syllable template. As a consequence of this serial orientation, the circumscriptional approach does not see Rotuman as a situation of faithfulness at all. To put the issue differently, it's purely an accident that Rotuman both *circumscribes* a foot and *maps to* a foot-sized template. The morphological operation O could just as well have involved deletion of the circumscribed string or mapping to a light-syllable (therefore sub-foot) template. In the serial derivation of standard circumscription theory, there is no connection between the circumscriptional target and the morphological operation applied to that target, and so any resemblance between them is claimed to be coincidental. Such a

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[16]The base of prosodic circumscription in Rotuman must be the surface complete-phase stem, not the underlying root, because Φ returns the foot standing at the right edge of the stem. Many similar cases are discussed in McCarthy & Prince (1990a); the most strongly analogous come from Ulwa and Samoan, in which a (derived) foot is circumscribed and then affixed to.

coincidence is extremely unlikely; across languages, the circumscribed constituent and the templatic target show this kind of similarity to one another.

In contrast, the Optimality-Theoretic approach developed above sees the relation between the complete phase and the incomplete phase as one of faithfulness itself. The circumscribed constituent and the templatic target are both feet because the constraint HEAD-MATCH demands coincidence of foot heads. Literal *constraints* on faithfulness are antithetical to serialism, because under serialism, all aspects of faithfulness are left up to the "inheritance" of the representation from one stage of the derivation to the other.

There is another factor militating against the circumscriptional approach. Positive prosodic circumscription, as in Rotuman (37, 38), has a symmetric counterpart called negative prosodic circumscription, defined as follows (McCarthy & Prince 1990a):

(39) Definition of Operation Applying Under Negative Prosodic Circumscription
$$O/\Phi \ (B) = B{:}\Phi * O(B/\Phi)$$

This is essentially extrametricality. To apply O to B under extrametricality of the Φ-named constituent is just to apply O to B/Φ, concatenating the result with $B{:}\Phi$ in the same way that the residue B/Φ concatenates with the kernel $B{:}\Phi$ in the original base B.

Research in Optimality Theory has yielded superior alternatives to negative prosodic circumscription (and, more broadly, extrametricality). In particular, cases analyzed as infixation via negative circumscription — *-um-* infixation in Tagalog and reduplicative infixation in Timugon Murut, Pangasinan, and other languages — are best understood in terms of the interaction of affixal alignment constraints with the syllabic-structural constraints ONSET and NO-CODA (Prince & Smolensky 1991, 1993; McCarthy & Prince 1993ab). This OT approach has yielded new typological insights about infixation that cannot be obtained with negative circumscription.

With the effective demise of negative prosodic circumscription, positive prosodic circumscription is theoretically isolated and therefore open to elimination with no potential loss of explanation. In contrast, the treatment of circumscriptional phenomena via prosodic identity constraints is strongly connected, through Correspondence Theory, with the fundamental linguistic notion of faithfulness. Specifically, constraints of exactly the same type are arguably responsible for prosodic faithfulness effects in the relation between lexical and surface forms, in systems with lexically exceptional prosody. Rotuman is such a system, and we now turn to establishing this connection.

4.3 Prosodic Faithfulness and Lexical Prosody

Thus far, the discussion of "prosodic faithfulness" has dealt with the relation between two surface forms, the complete phase and the incomplete phase of Rotuman. No cases of literal faithfulness have been mentioned — that is, there have been no cases where a surface (output) form is prosodically faithful to the underlying (lexical)

representation. The goal of this section is to show that constraints like ANCHOR-FT and HEAD-MATCH, set within Correspondence Theory, are responsible for faithfulness to lexical form, just as they are responsible for circumscriptional effects.

Rotuman provides a simple and clear example of how prosody in the lexicon affects the surface representation through constraints on correspondent segments. Blevins (1994) observes that Rotuman long vowels occur only finally, and then only in native monosyllables (*rī*, *rē*) or borrowed polysyllables (*sikā* 'cigar', *hanē* 'honey'). As I noted earlier (page 10), Blevins's explanation for the restricted distribution of long vowels rests on Foot Binarity, which prohibits monomoraic feet. A footed monomoraic root *rí violates Foot Binarity; the long vowel of *rī* obeys it. Thus, obligate length in (C)V monosyllables is a word-minimality effect of a familiar type (Prince 1980; Broselow 1982; McCarthy & Prince 1986, 1990ab, 1991a). And if loans like *sikā* are represented lexically with an exceptional final stress (/siká/), then the surface vowel length is also a response to Foot Binarity.[17]

Let us examine the polysyllables more closely, developing the formal details of the analysis. As background, we require a constraint demanding faithfulness to underlying quantitative distinctions. Under the assumption that correspondence is a relation between segments, this constraint will demand identity of quantity between correspondent segments, along the lines proposed in Urbanczyk (1994, 1996):[18]

(40) WT-IDENT

If $\alpha\Re\beta$

and α is monomoraic, then β is monomoraic. (No lengthening.)
and α is bimoraic, then β is bimoraic. (No shortening.)

Most probably the "no lengthening" and "no shortening" provisions are distinct constraints — it is a straightforward matter to sever these two clauses from one another in separate (and therefore separately rankable) constraints.

Rotuman does not have a contrast in segmental quantity that is independent of a difference in stress. This means that WT-IDENT must be ranked below some constraint that militates against long segments. In Rotuman, WT-IDENT is dominated by SYLL=μ, the high-ranking (encapsulated) constraint that guarantees the overall (C)V syllable structure of the language. This ranking ensures that lexical long vowels will not in general be faithfully analyzed at the surface, as the following tableau shows:

(41) SYLL=μ > WT-IDENT

/pā₂tɑ/		SYLL=μ	WT-IDENT
a.	☞ pɑ₂tɑ		*
b.	pā₂tɑ	* !	

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[17]On the proper treatment of exceptions to stress, see among others Hayes (1980), Selkirk (1984), Halle & Vergnaud (1987), Idsardi (1992), Hammond (1995), Rosenthall (1994), Pater (1994), Inkelas (1994), Buckley (1994), and Alderete (1996).

[18]Urbanczyk proposes a version of this constraint to account for quantitative transfer in reduplication (on which, see Levin 1983, Clements 1985a, and McCarthy & Prince 1988).

This example is hypothetical; it shows that a lexical long vowel does not receive a faithful analysis at the surface. Thus, there can be no visible lexical contrast in vowel length, because the effects of such a contrast will always be wiped out by this constraint interaction (cf. Prince & Smolensky 1993, McCarthy & Prince 1995, Kirchner 1995).

Nonetheless, violation of SYLL=µ can be compelled by higher-ranking constraints. We have seen that INC-PH is one such constraint. Another is FT-BIN, which ensures that a monomoraic input like /ri/ cannot faithfully be analyzed as a binary foot. Since all content words[19] must be stressed, we are assured of the following result:

(42) FT-BIN ≻ SYLL=µ ≻ WT-IDENT

/ri$_2$/	FT-BIN	SYLL=µ	WT-IDENT
a. ☞ { rī$_2$ }		*	*
b. { ri$_2$ }	* !		

Form (b) posits a monomoraic foot, with fatal consequences for well-formedness. Form (a) achieves bimoraicity by lengthening the vowel, yielding a heavy syllable (violating SYLL=µ) that is unfaithful to the lexical short vowel (violating WT-IDENT). It's easy to see that a long-voweled input /rī/ would yield the same surface result, emphasizing the irrelevance of underlying vowel length contrasts to the outcome, so long as the faithfulness constraint WT-IDENT is low-ranking. In this way, we capture in formal Optimality-Theoretic terms one aspect of Blevins's analysis: the limitation of vowel length to (C)V monosyllables for word-minimality reasons.[20]

A typical polysyllable like /pure/ will satisfy FT-BIN, SYLL=µ, and WT-IDENT without further ado. But, any word with a lexical foot on the final syllable will have to undergo lengthening to satisfy FT-BIN. This is what Blevins proposes for exceptional loans like *sikā*. If the lexically marked final stress is to be faithfully maintained in the output, then unfaithfulness to underlying vowel length is required:

(43) FT-BIN ≻ SYLL=µ ≻ WT-IDENT, with polysyllabic input

/si{ká$_4$}/	FT-BIN	SYLL=µ	WT-IDENT
a. ☞ si { kā́$_4$ }		*	*
b. si { ká$_2$ }	* !		

As the tableau shows, I assume with many previous analysts that lexical stress is represented by a lexical *foot*, parsing the final syllable. The candidates compared here are both faithful to this underlying foot. In (b), faithfulness is achieved at the expense of FT-BIN, with the usual fatal effect. In (a), the lexical foot is preserved through vowel lengthening, violating the two low-ranking constraints. Observe that the long-voweled *and* end-

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[19]But not function words. See Selkirk (1993) for an account of this difference.

[20]To complete the analysis, it's necessary to exclude outputs like *riʔ* or *riɑ*, in which satisfaction of FT-BIN is achieved by epenthesis. This shows, as has been assumed throughout, that the anti-epenthesis constraint DEP is high-ranking in Rotuman.

stressed lexical form /si{kɑ̌}/ will yield the same result. This establishes a near-exact parallel with the native monomoraic roots.

But what about the possibility of unfaithfulness to the lexically specified prosody? The failed candidate *{sík₃ɑ₄} obeys all three constraints in (43) at the price of being unfaithful to the lexical foot. Its defect is that it fatally violates a prosodic faithfulness constraint — either HEAD-MATCH or ANCHOR-L-FT will do.[21] Thus, HEAD-MATCH (or ANCHOR-L-FT) must dominate SYLL=μ (and WT-IDENT), forcing a heavy final syllable in the output to remain faithful to the underlying foot.

(44) FT-BIN, HEAD-MATCH ＞ SYLL=μ ＞ WT-IDENT, with polysyllabic input

/si{kɑ́₄}/	HEAD-MATCH	SYLL=μ	WT-IDENT
a. ☞ si { kɑ̌₄ }		*	*
b. { síkɑ₄ }	* !		

This is indeed a case of prosodic faithfulness in the lexical/surface relation, mediated by segmental correspondence.[22] In fact, faithfulness to metrical prosody — to foot structure — is achieved at the expense of faithfulness to moraic prosody — segmental quantity.

These are the essential constraint interactions, but they do not complete the analysis. A fundamental tenet of Optimality Theory is *richness of the base*: the lexicon consists of anything, in the sense that there are no language-particular constraints on lexical forms. The grammar — the system of ranked constraints — must yield only well-formed outputs in spite of this richness in the input.[23] For the reasons for this, see Prince & Smolensky (1993) and the discussion of C/V tier segregation above, in section 3.4. (Cf. also Stampe 1972.)

We have already seen two concrete instances of richness of the base with respect to the analysis of stress and quantity in Rotuman. As I showed in (42), the constraint hierarchy motivated here will map all (C)V monosyllabic inputs onto CVː outputs, regardless of whether there is length in the input. Thus, a rich base that includes /ri/, /rī/, and even /{rí}/ or /{rǐ}/ will contain only the output {rǐ}. Similarly, as I showed in (43, 44), the various inputs /si{ká}/ and /si{kǎ}/ must yield surface si{kǎ}, given the ranking that has been motivated.

But richness of the base entails a further commitment. In the cases discussed thus far, either no lexical foot is present (in which case a disyllabic foot results in the complete phase) or a lexical monosyllabic foot is present on the final syllable (in which case a final monosyllabic foot results, because HEAD-MATCH is high ranking). But richness of the base means that we cannot assume that lexical feet are present only on final

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[21]Observe that *{sík₃ɑ₄} obeys ANCHOR-R-FT, so that constraint is of no use in determining the outcome.

[22]In this context, the prosodic faithfulness constraints are analogous to proposals made in some operational approaches. HEAD-MATCH can be compared to the treatment of exceptional stress in Halle & Vergnaud (1987), while ANCHOR-L-FT abstractly resembles the theory of exceptional stress in Idsardi (1992).

[23]See Inkelas (1994: Section 8.3) for recent emphasis on this point, in the same context (the analysis of exceptions).

syllables or that lexical vowel length is subject to a similar convenient limitation. Rather, we must derive the distributional limitations on stress and vowel length from the grammar itself, but showing that *any* input, no matter how constructed, yields an output that is consistent with these observed distributional limitations.

In fact, the system that has already been presented does exactly that. Consider first the possibilities presented by representing vowel length lexically. Hypothetical lexical forms like /tōkiri/, /tokīri/, or /tokirī/ will all map onto *tokíri*, with no vowel length whatsoever. This result follows from the ranking SYLL=μ ≻ WT-IDENT, which ensures that preservation of lexical vowel length, regardless of its position, will always fail in the face of the basic (C)V syllable structure of Rotuman:

(45) Irrelevance of Lexical Length Because of SYLL=μ ≻ WT-IDENT

/tō₂kiri/		SYLL=μ	WT-IDENT
a.	☞ to₂kiri		*
b.	tō₂kiri	* !	

With this much in hand, we have begun to account for the limited distribution of long vowels; one potential source of non-final long vowels — lexical specification of length — has been eliminated.

Now consider the possibilities presented by representing feet lexically. As I have previously noted, all feet observed in this language are moraic trochees which parse the final syllable (if heavy) or the last two syllables (if light). This fact indicates that two metrical constraints are undominated in Rotuman, FT-FORM (Prince & Smolensky 1993) and ALIGN-FT-RIGHT (McCarthy & Prince 1993b). A foot lexically specified on the final syllable can be faithfully maintained at the surface and still satisfy these undomianted constraints. By FT-BIN, also undominated, a stressed final vowel must lengthen so hypothetical /toki{rí}/ yields *toki{rî́}* (43, 44). Another type of lexically specified foot that will receive faithful treatment is one that conforms without further ado to the default pattern of the language, as defined by FT-FORM and ALIGN-FT-RIGHT. Thus, /to{kíri}/ and /tokiri/ will both surface as *to{kíri}*, thereby satisfying all relevant constraints. This result shows that the presence or absence of lexical foot structure in the modal vocabulary has no effect on the outcome — an expected consequence of richness of the base.

Other logically possible inputs will not receive a faithful analysis, and in this lies the explanation for why vowel length is possible only in the final syllable and stress is possible only on one of the last two syllables. One way a skeptic might hope to create a non-final long vowel is through the input /to{kí}ri/, with a monosyllabic non-final foot. But the output **to{kî́}ri* fails on foot-alignment: all feet in Rotuman are right-justified in the prosodic word, as required by undominated ALIGN-FT-RIGHT. In general, then no lexical foot will survive unchanged unless its right edge coincides with the right edge of the prosodic word, effectively limiting feet to the last two syllables.

This observation leads to a ranking argument. Consider a lexical form like hypothetical /{tóki}ri/, which can either be faithfully analyzed as *{tóki}ri* or unfaithfully as *to{kíri}* — but only the latter is in fact possible. It is apparent that *{tóki}ri* is faithful to the underlying foot structure, obeying HEAD-MATCH. By comparison, *to{kíri}* is prosodically unfaithful to the input /{tóki}ri/, but it has a properly aligned foot, right-justified within the prosodic word, as required by ALIGN-FT-RIGHT. This contrast shows that HEAD-MATCH is dominated by ALIGN-FT-RIGHT, as the following argument certifies formally:
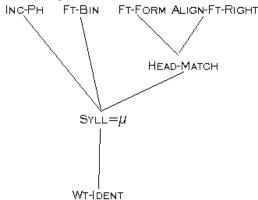
(46) ALIGN-FT-RIGHT ≻ HEAD-MATCH

/{tó$_2$ki}ri/		ALIGN-FT-RIGHT	HEAD-MATCH
a.	☞ to$_2${kíri}		*
b.	{tó$_2$ki}ri	* !	

With this result in hand, we can see that any lexically specified foot that does not include the ultima will receive unfaithful treatment. In itself, this is nearly sufficient to account for the fact that stresses are observed only on the last two syllables in Rotuman. A final detail: mappings like /{tókiri}/ → *{tókiri}* must be excluded by a prohibition on ternary feet. (This is a "hard" universal in the Hayes/McCarthy-Prince foot theory.)

Thus far, I have shown that underlying long vowels outside the ultima will surface as short, and lexical stresses outside the penult or ultima will be ignored in the surface form. These are two significant steps toward showing that the analysis winnows a rich base down to the observed distributional limitations on length and stress in Rotuman. Just a few refinements remain. For one thing, we must establish that combining lexical specifications of length and stress does not provide a way of circumventing the distributional regularities. It is clear that inputs like /{tô}kiri/, /to{kî}ri/, or even /to{kîri}/ cannot receive faithful treatment in the output for the same reason that simpler inputs like /tokīri/ or /{to}kiri/ cannot: they obey the lower-ranking faithfulness constraints HEAD-MATCH and/or WT-IDENT at the expense of violating higher-ranking ALIGN-FT-RIGHT or SYLL=μ (cf. (45), (46)). For another, we need to show that final stress is impossible without final weight, so forms like *tokirí* are ruled out. This result follows in part from undominated FT-BIN, as shown in (43), but inputs like /to{kirí}/ must also be considered. The ill-formedness of the /to{kirí}/ → *to{kirí}* mapping shows, not surprisingly, that trochaic FT-FORM is top-ranked in Rotuman, crucially dominating HEAD-MATCH.

This completes the picture of the distribution of length and stress in Rotuman. The relevant portions of the constraint hiearchy are excerpted in (47):

(47) Constraint Hierarchy Relevant to Length and Stress

INC-PH   FT-BIN   FT-FORM ALIGN-FT-RIGHT

HEAD-MATCH

SYLL=μ

WT-IDENT

Bottom-ranking of WT-IDENT means that lexical specifications of vowel length are irrelevant to the outcome — the presence or absence of vowel length is totally predictable from stress and position. In particular, domination of WT-IDENT by the antagonistic constraint SYLL=μ ensures that short vowels are the norm, except when specific conditions compel long vowels. Those conditions are defined precisely by the higher-ranking constraints. One, FT-BIN, militates against degenerate feet, compelling lengthening. Another, HEAD-MATCH, requires preservation of lexical stress information, so inputs like /si{ká}/ receive faithful treatment in the output. But HEAD-MATCH is itself dominated by constraints on foot form and foot alignment, which effectively limit its scope of operation to the final syllable. In this way, the limited distribution of vowel length follows from the limited distribution of stress, as proposed by Blevins (1994). And the limited distribution of stress follows from the interaction between the prosodic faithfulness constraint HEAD-MATCH and the independently required principles of stress theory, such as FT-FORM and ALIGN-FT-RIGHT. The lexicon can contain anything; these constraints, ranked as indicated, exercise rigid control over the surface outcomes.

In the preceding section, I argued that only a correspondence-based theory of prosodic faithfulness using specific constraints like HEAD-MATCH is sufficiently subtle to account for the details of circumscriptional effects. Undifferentiated PROS-FAITH, whether conceived of under correspondence or PARSE/FILL, is too blunt an instrument to achieve the requisite effects. The same point can be made with respect to prosodic faithfulness in the lexical/surface relation. Consider again the hierarchy (47). Two constraints on prosodic faithfulness, HEAD-MATCH and WT-IDENT, must be distinguished from one another because SYLL=μ stands between them in the ranking. (Separate ranking is a *sine qua non* for separate constraints in OT.) This shows that prosodic faithfulness is not an undifferentiated whole. To put the matter more concretely, *si{kã}* must be assessed as more faithful than *{síka}* from the input /si{ká}/ — exactly as demanded by HEAD-MATCH > WT-IDENT.

An even more compelling instance of this sort of reasoning can be constructed on the basis of Inkelas's (1994) comprehensive analysis of exceptional stress in Turkish. She argues that the fundamental pattern is this: stress is trochaic, falling catalectically on the final syllable, unless there is a morpheme bearing a lexical trochee somewhere in the word, in which case the lexical foot prevails. If there are several lexical feet, the leftmost one

wins. The morphemes which require lexical feet come in two types: (48a) those with a fixed stress on a non-final syllable; and (48b) those that assign stress to the final syllable of the immediately preceding stem.

(48) Turkish Exceptional Stress — Morpheme Taxonomy
    a. Polysyllabic morphemes with fixed stress on non-final syllable

-Íyor	'Progressive'
-ÍnjE	'when'
ab.lú.ka	'blockade'
šev.ró.1e	'Chevrolet'
Kas.tá.mo.nu	place name
pénalti	'penalty kick'

    b. Mono- and poly-syllabic pre-stressing morphemes

´-mE	'Negative'
´-(y)In	'2 plural imperative'
´-leyin	'adverbial'
´-jEsInE	'adverbial'

To account for these two morpheme types, Inkelas proposes that trochaic feet[24] are present lexically on a disyllabic sequence within a morpheme of class (a) or on the initial syllable of a class (b) morpheme (the foot head is segmentally empty):

(49) Turkish Lexical Feet (Inkelas 1994)

```
  a.     Ft             Ft            Ft
        /\            /  \          /  \
      -Íyor        ablúka        pénalti


  b.   Ft
      /  \
     Δ−mE
```

Faithfulness to these lexical feet is responsible for the two types of observed exceptional stress behavior.

Inkelas assumes that faithfulness is mediated by an undifferentiated PARSE constraint for feet; beyond that she does not consider the details of prosodic faithfulness in Turkish. But the details are of more than academic interest. Under assumed richness of the base, an Optimality-Theoretic grammar of Turkish must correctly dispose of morphemes that are represented lexically with a structure that is the the mirror-image of (49b), in which the head of a lexically-specified foot is filled but the non-head syllable is empty:

(50) End-Stressed Lexical Foot

```
          Ft
         /\
      pata Δ
```

When it is word-final, this type of morpheme would be indistinguishable from the normal catalectic pattern. But under suffixation, such a morpheme would display its fixed final stress: *patá-lar*. In fact, no such morphemes

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[24]Because of richness of the base, lexical feet are not limited to trochees. It is, however, a straightforward matter to ensure that lexical iambs will never be faithfully analyzed at the surface, if FT-FORM dominates the relevant prosodic faithfulness constraint, as shown for Rotuman (p. 35).

exist in Turkish, indicating that hypothetical morphemes like (50) do *not* receive faithful treatment at the surface.[25]

These considerations lead to the following conclusion: the high-ranking prosodic faithfulness constraint in Turkish must support the fixed-stress and pre-stress structures in (49) but not the end-stress structure in (50). An undifferentiated prosodic faithfulness constraint cannot make subtle distinctions like this. But correspondence-based prosodic faithfulness is capable of fine-grained discrimination. To wit, high-ranking ANCHOR-R-FT ((29) = "If α is at the right edge of a foot and αℜβ, then β is at the right edge of a foot") will enforce faithfulness to the structures in (49) but not (50), since in (50) there is no segment α sitting at the right edge of the foot. Its mirror-image counterpart, ANCHOR-L-FT, is low-ranking, though; it must be dominated by the constraints responsible for default word-final stress to ensure unfaithful treatment for (50). (For the same reason, HEAD-MATCH is low-ranked.) The overall ranking, then, is one in which ANCHOR-R-FT ≻ "Stress" ≻ ANCHOR-L-FT, where "Stress" stands for the constraints responsible for the default pattern of catalectic final stress. With this ranking, morphemes with foot-final segmental anchors will retain their lexical stress, but morphemes without foot-final segmental anchors will not. This is exactly the distribution observed in Turkish, as shown by the (49)/(50) contrast. More broadly, this result emphasizes the point developed throughout this section: that prosodic faithfulness constraints must make fine distinctions, and Correspondence Theory provides the means for them to do so.

4.4 Summary

The goal of this section has been to review the phenomenon of prosodic faithfulness. Correspondence Theory provides tools to regulate identity of prosodic structures, through correspondence of the segments in those structures. Constraints requiring correspondence of segments standing in prosodic heads (and non-heads) and at the edges of prosodic constituents have been proposed. I have argued that prosodic faithfulness without correspondence does not permit sufficient differentiation of types of unfaithfulness, and so it is unable to deal in an exact way with the types of faithfulness effects observed in Rotuman (and elsewhere).

When the correspondence relation goes from lexical to surface form, the identity constraints produce the effect of classical faithfulness, but to prosodic rather than segmental structures. This yields an elementary theory of faithfulness to lexical foot structure, exemplified here with an analysis of exceptional stress and length in Rotuman.

When the correspondence relation goes from stem to stem, the effect of identity constraints mimics many of the properties of positive prosodic circumscription in operational theories. It was shown that the

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[25]Inkelas recognizes this difficulty and proposes an account of the impossibility of fixed final stress in roots based on the phonology of a root stratum, but, as she notes (fn. 23), this explanation does not generalize to suffixes. In contrast, the analysis proposed here accounts for both roots and suffixes.

complete/incomplete phase relation in Rotuman has this character. (Other cases are discussed in McCarthy 1996.)

Because it generalizes over input/output, stem/stem, and other phonological relations, Correspondence Theory unites these two effects of faithfulness or identity. And because it generalizes over prosodic, segmental, and featural structure, Correspondence Theory unites them both with the analysis of deletion, metathesis, coalescence, and harmony phenomena like those discussed in sections 3 and 5. Thus, a desirable degree of abstraction and generality is achieved in the overall approach.

Further developments along these general lines appear promising. One thread is taken up in the work of Alderete (1995), who proposes the following constraint:

(51) HEAD-DEP (Alderete 1995)
    If β is a prosodic head in S_2, then $\alpha \Re \beta$.

That is, any prosodic head in the output must have a correspondent in the input — it cannot be epenthetic. Properly integrated into a grammar through ranking, this constraint is responsible for many of the ways in which epenthetic vowels are invisible to stress. With straightforward extensions to similar constraints, it can also account for the well-known immunity of stressed vowels to general reduction processes and the overall greater faithfulness of analysis in stressed syllables, as proposed by Selkirk (1994ab) and Beckman (1995, forthcoming).

Another thread involves an alternative way of using correspondence to characterize foot faithfulness. As formulated in (28) and (29), HEAD-MATCH and ANCHOR-FT refer to segments as correspondent elements, with prosodic structure functioning as a kind of role that segments fulfill, a role in which correspondent segments ought to match. Indeed, the analysis of Turkish crucially relied on this point: where there is no input segment standing in the relevant prosodic role, as in (50), there is no faithfulness effect.

Suppose, though, that prosodic constituents themselves stand in correspondence, just as segments do. We would then have constraints like MAX-FT, demanding that every input foot have an output correspondent. This theory also requires constraints on faithfulness to prosody/segment association; a lexically-specified foot cannot be moved to different syllables without exacting some cost in terms of faithfulness.

The two approaches to prosodic faithfulness under Correspondence Theory differ in the degree of independence they provide to prosody. If segments alone stand in correspondence, then there can be no prosodic faithfulness absent the segments that stand in the prosodic role. But if prosodic constituents also stand in correspondence, then they can have a life of their own in the faithfulness universe, persisting even when the original segments are gone. Thus, persistence under deletion, to use the term from autosegmental phonology (Goldsmith 1976), is decisive between these two approaches. This is a matter best left for another paper, but the evidence seems at first glance inconsistent: compensatory lengthening phenomena provide compelling evidence of moraic persistence under segmental deletion, but comparable cases involving foot structure have never been

securely established.[26] Either way, though, Correspondence Theory is central to the characterization of prosodic faithfulness.

5. Stem-to-Stem Correspondence

5.1 Introduction

As originally conceived, faithfulness is an identity relation between underlying and surface forms (Prince & Smolensky 1993). Correspondence Theory extends the scope of faithfulness considerably, permitting the comparison of one surface form with another. Two types of surface/surface correspondence have been explored in detail: the intra-word relation between base and reduplicant (McCarthy & Prince 1993a, 1994b, 1995; Urbanczyk 1994, 1995, 1996) and the inter-word relation between full and truncated form (Benua 1995). This is a crucial point of difference from the PARSE/FILL model, which relies on the assumption that an unprosodized (lexical) input is related to a fully prosodized output (see section 2 above).[27]

Corrrespondence between surface strings leads to surface identity in the face of other constraints that are at best indifferent to surface identity and at worst antithetical to it. In reduplicative morphology, segments of the base and the copy are in correspondence with one another. High-ranking constraints on this correspondence relation — that is, constraints on faithfulness of reduplication — are responsible for the phenomena traditionally called "overapplication" and "underapplication". (See McCarthy & Prince 1995 for references.) For example, harmony in Madurese spreads nasality rightward from a nasal consonant, yielding nasalized vocoids, which are not permitted in other contexts. This process is observed to overapply, affecting the prefixed reduplicant even in the absence of direct phonological motivation (Stevens 1968, 1985, McCarthy & Prince 1995): *ỹãt–nẽỹãt* 'intentions'.

Schematically, the model required for reduplicative overapplication and other effects is something like the following, where the arrows indicate the various correspondence relations:

(52) Correspondence in Reduplicative Structure (McCarthy & Prince 1995)

$$\text{Lexical:} \quad /\text{Af}_{\text{RED}} + \text{neat}/$$
$$\Downarrow$$
$$\text{Surface:} \quad \tilde{y}\tilde{a}t \leftrightharpoons n\tilde{e}\tilde{y}\tilde{a}t$$

Each arrow stands for a distinct correspondence relation $\Re$. There are separate faithfulness constraints governing each of these correspondence relations — e.g., a distinct MAX-LS for lexical-surface correspondence and MAX-BR for base-reduplicant correspondence. Crucial to the analysis of overapplication is the faithfulness constraint IDENT-BR(nasal), which requires base and reduplicant segments to agree in their specification for [nasal]. It dominates the constraints responsible for the limited distribution of nasalized vocoids, favoring identity of reduplicant-base correspondents over phonological regularity.

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[26]The nearest analogues are stress-shift under syncope cases, like Bedouin Arabic (Al-Mozainy, Bley-Vroman, & McCarthy 1985). For a reanalysis of this case, see McCarthy (1993b).

[27]For further examination of these differences in the context of reduplicative correspondence, see McCarthy & Prince (1995: 270–2).

Benua (1995, forthcoming) extends this model to over- and underapplication in truncating morphology. For example, English prohibits *æ* before tautosyllabic *ɹ*: *car* is [kɑɹ], never [kæɹ]. Yet the truncated nickname derived from *Larry* [læɹi] is unexpectedly *Lar'* [læɹ]. If the truncationally-related *surface words Larry* and *Lar'* stand in correspondence with one another, just as reduplicant and base do within a single word, then this phenomenon can be understood in just the same way as reduplicative over- and underapplication. The relevant correspondence relations are shown in the following schema:

(53) Correspondence in Morphological Truncation (Benua 1995, forthcoming)

Lexical: /læɹi/
                 ⇓
Surface: læɹi ⇒ læɹ

Identity over correspondence between base and truncated form, IDENT-BT, must dominate the constraint that prohibits tautosyllabic *æɹ*.[28] The connection with reduplicative overapplication is clear, as is the generality of correspondence, which subsumes these various types of linguistic relatedness of strings.

Under Benua's proposal, Correspondence Theory has been extended from relations within a single derivation (faithfulness *per se*) or a single word (reduplicative copying) to relations between surface forms within a paradigm. Through this intra-paradigmatic correspondence, phonological effects on one word may be duplicated in the other, even if the requisite phonological conditions are not met. Benua further argues that stem-stem correspondence generalizes to phenomena that have been attributed to phonological cycles or levels. (See also Buckley 1995, Kager 1995, and Pater 1995b.) After all, the descriptive effect of cyclicity is much the same as overapplication in Madurese or underapplication in English truncation: the word [[X]+Afx] "inherits" the phonology of free-standing [X]. Under Correspondence Theory, this can be interpreted to mean that there is a correspondence relation between the output forms of the word X and the word X+Afx, just as there is a relation *nẽỹãt* and *ỹãt* in Madurese or between *Larry* and *Lar'* in English. In this way, correspondence provides a formal theory applicable to traditional conceptions of paradigm uniformity (see, e.g., Bybee 1985) and more recent developments along these lines, such as Burzio (1994ab), Flemming & Kenstowicz (1995), Kenstowicz (1995), Kraska-Szlenk (1995), and Orgun (1994).

Correspondence of output forms, as in reduplicative or truncational morphology, is appropriate for the Rotuman phases too. Below, I will present evidence for the following correspondence relations, which closely parallel (53):

(54) Correspondence in the Phase Relation

Lexical: /rako/
                            ⇓
Surface: {rɑ́.ko} ⇒ {rɑ́k}

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[28]One form has priority: *Larry* determines the phonology of *Lar'*, and not vice-versa. That is, surface [læɹi] stands to surface [læɹ] just as lexical /læɹi/ stands to surface [læɹi]. In reduplicative correspondence, the base can determine the phonology of the reduplicant (e.g., Madurese), but the reduplicant can also determine the phonology of the base (e.g., Tagalog /paN+RED+putul/ → *pamumutul*). See Benua (1995, forthcoming) for discussion.

Section 5.2 reviews this evidence, which comes from both prosody and segmental phonology. Following that, section 5.3 analyzes the umlauting pattern of phase alternation, redeeming the promissory note pledged in section 3.2. We will see that umlaut is also best understood within the correspondence model (54).

5.2 Prosodic and Segmental Evidence for the Phase Relation

Like reduplication, truncation, and "cyclic" effects, prosodic circumscription also involves a relation between output forms. Working in an operational theory, Broselow & McCarthy (1983) propose that reduplication in Samoan involves prefixation to the main-stress foot: *a{lófa} → a–lo–{lófa}*. This derivation requires that the base word *alofa* be in its surface form, since it must already have been provided with metrical structure when reduplication takes place. Most cases of positive prosodic circumscription discussed by McCarthy & Prince (1990a) are analyzed in this way too (see section 4.2 and McCarthy 1996). For example, the Arabic broken plural is derived from the singular stem, rather than directly from the consonantal root, since derived properties of the singular stem determine the form of the plural, which is formed from the singular by way of the circumscription operation.[29]

In section 4.2 above, I argued that the incomplete phase is subject to a kind of prosodic circumscription, interpreted as prosodic faithfulness of the incomplete phase to the complete phase. Prosodic faithfulness accounts for the similarity in foot structure between complete phase *{ráko}* and incomplete phase *{rák}* in the face of what would be otherwise more appealing candidates like *ra{ók}*. This result rests on the assumption that the correspondence relation $\Re$ maps the *surface* form of the complete phase onto the surface form of the incomplete phase, just as the reduplicative correspondence relation maps the surface form of the base onto the reduplicant in (52). Prosodic faithfulness makes sense here only if the two forms standing in correspondence each have prosodic structure; in the case of Rotuman, this means that the incomplete phase is faithful to another *surface* form, as (54) entails, since only surface forms reliably have prosodic structure.

To escape the consequences of this argument, could we insist that the *lexical* form is endowed with prosodic structure, seeing HEAD-MAX as a constraint on the lexical/surface relation (i.e., conventional faithfulness)? I've already shown that some prosodic structure is present in the lexicon of Rotuman, to account for exceptional stress (section 4.3). So why not assume that all words have lexical prosody, deriving both *{ráko}* and *{rák}* directly from underlying /{ráko}/?

The standard (pre-OT) objection to this line of analysis is that prosodic structure isn't contrastive, exceptional stress aside, and non-contrastive information should not be present in the lexicon. But in Optimality Theory contrastiveness is a property of the interaction between faithfulness and phonological markedness, rather than a stipulation about the lexicon. (See Kirchner 1995 for discussion of this point.) More specifically, under richness of the base (section 4.3 above), there is no way to ensure that *all* words will be provided with prosodic

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[29]The proposals about reduplication in Steriade (1988) should also be mentioned in this regard, as well as the analysis of Modern Hebrew morphology in Bat-El (1994). Within OT, Pierrehumbert's (1993) work on alignment to prosodic heads is also quite relevant.

structure in the lexicon. Simply to be predictable, any allegedly predictable property, like Rotuman foot structure, must be derivable from bare representations as well as from representations with the correct structure or even the wrong structure. These considerations mean that we cannot rely on the lexical representation to have the requisite prosodic structure. Instead, it's necessary to establish a correspondence relation between the output forms of the complete and incomplete phases, as in (54), since only output forms are reliably provided with prosody.

Rotuman segmental phonology also provides rich evidence for the correspondence relation between surface forms in (54). The evidence comes from several processes that affect the penultimate vowel under the influence of the final vowel. Even when the triggering final vowel is absent, because top-ranked INC-PH dominates MAX (22b), the penultimate vowel still shows the effects of the process.

One such process is raising of mid vowels before a final high vowel. The raising is indicated here by the IPA diacritic (see Appendix A on the details of Churchward's transcription):

(55) Mid Vowel Raising

	Com. Ph.	Inc. Ph.	
/...eCi/	fẹpi	fẹp	'to be slow'
/...eCu/	sẹru	sẹr	'to comb'
/...oCi/	họti	hö̧t	'to embark'
/...oCu/	lọʔu	lọʔ	'to bend at an angle'

A skeptic might see this process as a kind of hyper-phoneticization, intruding into a domain where phonological theory should not go. This is incorrect; the alternation is truly phonological. Phonologiziation is proven by the fact that the raised mid vowel is found even in the incomplete phase, where the triggering vowel is absent. In structuralist terms, one would actually have to say that there is a phonemic contrast between ẹ and e or between ọ and o.

A related process (see the analysis below) is the change of /ɑ/ to ɒ before a final high vowel:

(56) /ɑ/ Becomes ɒ (before final high vowel)

	Com. Ph.	Inc. Ph.	
/...ɑCu/	hɒŋu	hɒŋ	'to awaken'
/...ɑCi/	tɒfi	taf	'to sweep'

In the form with final /i/, the incomplete phase shows the umlauted version of ɒ , a low front vowel a̱. Umlaut aside, the facts are the same as with mid-vowel raising: the incomplete phase has the same derived vowel contrast as the complete phase.

The vowel /ɑ/ is also affected by following /e/, where it fronts and raises to æ:

(57) /ɑ/ Fronting

	Com. Ph.	Inc. Ph.	
/...ɑCe/	læče	læč	'coral'

As in the previous cases, the effects of this process are observed in both phases, though the triggering vowel is absent in the incomplete phase.

There is one more alternation. When /ɑ/ is followed by /o/ across a laryngeal consonant, it is backed. I will indicate the result with the IPA backing diacritic:

(58) Glottal Backing[30]

	Com. Ph.	Inc. Ph.	
/...ɑʔo/	fɑ̱ʔo	fɑ̱ʔ	'nail'
	hanɑ̱ʔo	hanɑ̱ʔ	'steal'
/...ɑho/	mɑ̱ho	mɑ̱h	'to become cold'

This is a subtle difference, and also might seem hyperphoneticized, but again observe that there is a classical phonemic ɑ in the incomplete-phase forms, as a result of loss of conditioning final vowel. For a minimal pair, compare *mɑ̱h* 'become cold' with *mah* 'carrying weight', which is the incomplete phase of /mɑhɑ/.

There's one striking feature of all these alternations: the vowel of the incomplete phase takes on all of the *derived* properties of the corresponding complete-phase vowel, even though the triggering vowel is absent in the incomplete phase. This consistent finding can be rationalized in terms of (54). The incomplete phase is derived from the complete phase, in the sense that there is a correspondence relation between the two. Identity of correspondent elements (expressed formally by featural IDENT constraints) ensures that the incomplete-phase vowels will be the same as their correspondents in the complete phase. It does not matter that the vowels that trigger the alternation are deleted in the incomplete phase — identity of correspondents is sufficient. This, then, is a type of overapplication, closely parallel to the truncational and cyclic cases analyzed by Benua.

These considerations are rather abstract; to make them concrete, let us examine one process in detail, beginning with "normal application" in the complete phase and then turning to "overapplication" in the incomplete phase. Arguably, the alternations in (55) and (56) reflect the same process, [ATR] harmony. The premises that underlie this claim are these:

- The raised mid vowels *ẹ, ọ,* and *ọ̈* are [+ATR]; their unraised counterparts *e* and *o* are [−ATR].
- The low vowel *ɑ* is [−ATR], and its [+ATR] counterpart is *ɒ*. This is exactly the nature of the [ATR] contrast in the Kalenjin dialects Nandi-Kipsigis-Elgeyo and Päkot (Hall et al. 1973/4).[31]
- The high vowels are [+ATR], in conformity with a known cross-linguistic relation (Halle & Stevens 1969:212; Archangeli & Pulleyblank 1994a).

The [ATR] harmony is this: a mid or low vowel before a high vowel takes on the high vowel's [+ATR] value. Descriptively, then, [ATR] harmony in Rotuman has the following properties:

(i) High vowels are always [+ATR].

(iii) Mid and low vowels are [−ATR] by default.

(iii) But mid and low vowels are [+ATR] in a [+ATR] context — i.e., in the penult before a [+ATR] (=[+high]) ultima.

We take each of these points in turn.

High vowels are redundantly [+ATR]. Therefore, the "grounded condition" (Archangeli & Pulleyblank 1994a) relating [ATR] and [+high] must be top-ranked, crucially dominating an antagonistic faithfulness constraint such as IDENT(ATR).

(59) [ATR] & [+high] Redundancy
    a. ATR/HI (Archangeli & Pulleyblank 1994a: 176)
        [+high] ⊃ [+ATR]
    b. IDENT(ATR)
        Correspondent segments in lexical and surface form have identical values for [ATR]. I.e., if α is [ξATR] and αℜβ, then β is [ξATR].
    c. ATR/HI ≻ IDENT(ATR)

/fepɪ/ −A −A	ATR/HI	IDENT(ATR)
a. ☞ fe̦pi +A+A		*
b. fepɪ −A −A	* !	

The *underlying* [ATR] value of the high vowel has no effect on the outcome, because the faithfulness constraint is low-ranked To make this point, I've arbitrarily assumed a lexical representation with a [−ATR] high vowel. Thus, no lexical contrast in the [ATR] value of high vowels could survive to the surface. That is the sense in which the value of [ATR] is redundant in high vowels.[32]

Point (ii), default [−ATR] in mid and low vowels, devolves from a nearly identical ranking argument. The same faithfulness constraint is this time dominated by a constraint expressing another implicational relation between height and [ATR] value:

(60) [ATR] & [−high] Default
    a. RTR/NON-HI [33]
        [−high] ⊃ [−ATR]
    b. RTR/NON-HI ≻ IDENT(ATR)

/ se̦vɒ/ 'left-handed' +A +A	RTR/NON-HI	IDENT(ATR)
a. ☞ sevɑ −A −A		**
b. se̦vɒ +A +A	** !	

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[32] See McCarthy & Prince (1995: 279–281) and cf. Kirchner (1995), and Itô, Mester, & Padgett (1995).

[33] Archangeli & Pulleyblank (1994a: 174–5), who deny the existence of this constraint, nevertheless cite work indicating that "tongue root advancement varies with tongue height, with greater advancement in high vowels than in mid, and greater advancement in mid vowels than in low".

Again, to make the point that the lexical value of [ATR] has no effect on the outcome, I've arbitrarily assumed a lexical form whose vowels have the "wrong" value.

High vowels are always [+ATR], so ATR/HI is undominated. But non-high vowels are [+ATR] under duress, in the context demanding harmony. This proves that RTR/NON-HI is crucially dominated by the constraint responsible for the harmony process. Full development of a theory of harmony is obviously inappropriate in this context;[34] therefore, I will assume without discussion that Universal Grammar includes a constraint SPR(+ATR) which provides the necessary impetus for harmony. The force of this constraint can be seen in the following tableau, which formalizes the ranking argument just made:

(61) SPR(ATR) ≻ RTR/NON-HI

/fepi/ /hɑŋu/ −A +A	SPR(+ATR)	RTR/NON-HI	IDENT(ATR)
a. ☞ fẹpi ☞ hɔŋu +A +A		*	*
b. fẹpi hɑŋu −A +A	*!		

Because the [ATR] faithfulness constraint is bottom-ranked, the same results are obtained even if the lexical forms are /fepɪ/ and /hɑŋʊ/, with [−ATR] final high vowels.

One last ranking argument is necessary to complete the picture. Obedience to *both* SPR(+ATR) and RTR/NON-HI is possible by avoiding [+ATR] high vowels entirely — that is, forms like *fepɪ* or *hɑŋʊ* obey SPR(+ATR) because they have no [+ATR] to spread. This can be understood as as a conflict between ATR/HI and RTR/NON-HI. Since high vowels are always [+ATR], the resolution of the conflict is obvious:

(62) ATR/HIGH ≻ RTR/NON-HIGH

/fepɪ/ −A −A	ATR/HI	RTR/NON-HI
a. ☞ fẹpi +A +A		*
b. fepɪ −A −A	*!	

This completes the picture of [ATR] redundancy and harmony in Rotuman. The full hierarchy of constraints is as follows:[35]

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[34]For various proposals about the proper treatment of vowel harmony in OT, see Akinlabi (1994, 1995), Archangeli & Pulleyblank (1994a), Beckman (1995, forthcoming), Selkirk (1994ab), Cole & Kisseberth (1995), and Kirchner (1993).

[35]A fuller account would include undominated IDENT(high) and IDENT(low), to ensure that vowel height is immutable in the face of the height/ATR grounded conditions.

(63) Rotuman [ATR] Phonology — Ranking Summary

  SPR(+ATR), ATR/HI ≻ RTR/NON-HI ≻ IDENT(ATR)

Top-ranked SPR(ATR) forces harmony at the expense of imposing a dispreferred [+ATR] value on non-high vowels. At the same expense, the preference for [+ATR] high vowels is also supported. There is no effect whatsoever of faithfulness to [ATR] values in the input, so lexical contrasts in [ATR] are insupportable.

  Thus far, we've only looked at the relation between the lexical form and the complete phase, but the model (54) also posits a correspondence relation between the complete phase, in its output form, and the incomplete phase. In effect, the incomplete phase owes allegiance, through faithfulness, to the *surface* complete phase. Concretely, this faithfulness effect shows up in the [+ATR] non-high vowels of *fẹp* and *hɒŋ*, which violate RTR/NON-HI in order to ensure that the incomplete phase is identical, [ATR]-wise, to the complete phase.

  Proceeding more formally, we have here evidence that distinct correspondence relations are subject to distinct faithfulness constraints — exactly as in the reduplicative material of McCarthy & Prince (1995) or the truncational material of Benua (1995). In the ranking summary (63), the low-ranking faithfulness constraint governs the correspondence relation between the lexical form and the surface complete phase. Call it IDENT-LS(ATR), to emphasize the role it plays in the system of correspondence relations. But there is a parallel constraint on the complete/incomplete correspondence relation, IDENT-CI(ATR). These two constraints are distinct, because they are ranked differently, as the following tableau proves:

(64) IDENT-CI(ATR) ≻ RTR/NON-HI

fẹpi + Inc. Ph.		IDENT-CI(ATR)	RTR/NON-HI
a.	☞ fẹp		*
b.	fep	* !	

Here, we see that IDENT-CI(ATR) crucially dominates RTR/NON-HI. But RTR/NON-HI itself dominates IDENT-LS(ATR), as shown by the tableau (60b). Thus, we have the full ranking IDENT-CI(ATR) ≻ RTR/NON-HI ≻ IDENT-LS(ATR), which shows that the two faithfulness constraints are indeed separate. In this way, the distribution of [ATR] is fully predictable or allophonic in complete-phase forms, where only LS faithfulness is at stake, but it is unpredictable or phonemic in incomplete-phase forms, where only CI faithfulness is relevant. Effectively, [ATR] harmony "overapplies" in incomplete-phase forms like *fẹp* and *hɒŋ*. This result exactly parallels the treatment of nasal harmony in Madurese reduplication (McCarthy & Prince 1995) or of vowel length in Icelandic truncation (Benua 1995).

  This argument confirms two points, First, it shows formally what I observed informally at the outset of this section: the incomplete phase must be derived from the *surface* form of the complete phase, rather than from the underlying lexical form. Even with respect to fully automatic allophonic alternations, the incomplete phase

takes on derived properties of the complete phase. This "overapplication" yields vowels in the incomplete phase that would otherwise be unexpected, given the rest of the phonology of the language. Indeed, it produces derived phonemic contrasts where there are no lexical contrasts.[36] Second, the argument confirms the claim that distinct correspondence relations are regulated by separate constraints. Lexical specifications for [ATR] are irrelevant, because IDENT-LS is low-ranking, but the surface [ATR] value of the complete phase is carried over to the incomplete phase, because IDENT-CI is top-ranked.

In summary, Correspondence Theory provides an integrated picture of the segmental and prosodic phonology of the incomplete phase. With respect to its vocalism and its foot structure, the incomplete phase is faithful to the complete phase, rather than the lexical form, strongly supporting the correspondence-based model in (54).

5.3 Phase Alternation by Umlaut

Umlaut is the only type of phase alternation in Rotuman that was not analyzed in section 3, though it was suggested there — following Saito (1981), van der Hulst (1983), and Besnier (1987)[37] — that umlaut is a type of coalescence. The goal now is to make good on this idea by understanding umlaut in the context of the correspondence model (54).

As a preliminary, it is appropriate to recall where the analysis of Rotuman phase alternations stands, especially in the context of (54). The core of the phonology of phase depends the following ranking, repeated from (21):

(65) Core Ranking for Rotuman Phase Alternation
    HEAD-MATCH, INC-PH > MAX > LINEARITY

Top-ranked INC-PH demands a final heavy syllable in incomplete-phase stems, and HEAD-MATCH relates that final heavy syllable to the metrical structure of the complete phase. These constraints are visibly active through domination of two faithfulness constraints. As has now been made clear, these faithfulness constraints pertain to the correspondence relation between the complete phase and the incomplete phase — i.e, they are CI

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[36]There's a possible objection to this line of argument. We know that phonological alternations can be opaque, in the sense that the triggering conditions are absent at the surface. For example, Tiberian Hebrew spirantization affects post-vocalic stops, even when the conditioning vowel has been deleted: /katabū/ → $k\bar{a}\theta\beta\bar{u}$ 'they wrote'. Since any phonological theory must give an account of effects of this type, why not recruit the same mechanism in Rotuman, so that the raising, fronting, and backing processes take place regardless of whether the triggering vowel is present on the surface or not?

We need a concrete theory of opacity in which to work this out argument. In most previous OT research (Prince & Smolensky 1991, 1993), this type of phonological opacity has been analyzed under the assumption that literal deletion does not occur, so the triggering segment is still present, though not phonologically realized, in the output form. Under Correspondence Theory, this type of analysis is not available, since there *is* literal deletion. But there is a natural extension of Correspondence Theory to situations of opacity, in which a phonological constraint may refer not just to the surface configuration but also to the configuration of input correspondent elements (McCarthy 1995). Then SPR-[ATR] would be stated something like this:

(i) If a vowel *or its input correspondent* is followed by [+ATR], it too is [+ATR].
Significantly, this sort of approach won't work for Rotuman. The problem is that the [ATR] alternations in non-high vowels depend crucially on [+ATR] in high vowels, which is itself predictable, and therefore not reliably present in the input, under richness of the base. (I am indebted to Diana Archangeli for pointing this out to me.)

[37]As well as the straw man in Cairns (1976).

constraints. The ranking between the two constraints —MAX ≻ LINEARITY — expresses one of the more salient facts about Rotuman: metathesis is preferred to deletion whenever the final vowel cannot remain *in situ*.

Faithfulness-wise, umlaut stands between metathesis and deletion among the responses to INC-PH-violation. Umlaut is observed only in cases where metathesis is ruled out by high-ranking LIGHT-DIPH; hence, it's only possible with vowel sequences of equal or falling sonority. Umlaut is also limited to vowel sequences with the order back+front. The basic data are as follows:

(66) Umlaut in the Incomplete Phase

a.	/...aCi/	tɒfi	taf	'to sweep'
b.	/...oCi/	ho̱ti	hö̱t	'to embark'
c.	/...oCe/	mose	mös	'to sleep'
d.	/...uCi/	futi	füt	'to pull'
cf. e.	/...uCe/	pure	puer	'to rule'
cf. f.	/...ɑCe/	læče	læč	'coral'

These forms also show the effects of additional phonological processes, discussed in the preceding section. Observe that the umlauting examples (a–d) end in front vowels, but the triggering vowel is absent in the incomplete phase, where umlaut happens. Thus, umlaut is not found in the complete-phase forms of these words nor in examples like (e), where the front vowel is preserved (by metathesis). A slightly different process, which occurs even in the complete phase, is the fronting of /a/ before /e/, seen in example (f).

There are two possible ways of understanding coalescence under Correspondence Theory, and I will briefly explore each of them. One way rests on the assumption that segments alone are the units of correspondence, and all aspects of featural faithfulness are mediated through them. This is consistent with the view adopted above (especially sections 4 and 5.2) and it is applied to other coalescence systems in Gnanadesikan (1995), Lamontagne & Rice (1995), McCarthy & Prince (1995), and Pater (1995a).

Under this segmentally-based view of coalescence, Rotuman umlaut satisfies MAX, because every input segment has a correspondent in the output. But it does so at the expense of violating UNIFORMITY, which prohibits two or more input segments from sharing an output correspondent. A further feature of Rotuman phonology is that coalescence outputs also violate LINEARITY, since the two vowels that coalesce are not adjacent in the corresponding complete phase: complete-phase $fu_1t_2i_3$ stands in correspondence with incomplete-phase $fü_{1,3}t_2$. For the full suite of umlauting examples, the picture is this:

(67) Correspondence in Words with Umlaut

Complete Phase	Incomplete Phase
$fu_1t_2i_3$	$fü_{1,3}t_2$
$ho̱_1t_2i_3$	$hö̱_{1,3}t_2$
$mo_1s_2e_3$	$mö_{1,3}s_2$
$tɒ_1f_2i_3$	$ta_{1,3}f_2$

The umlauted vowel has dual allegiances — it strives to be faithful to the featural composition of both its correspondents. The result is coalescence, a merger of the features of both correspondent vowels, taking [–back] from the second of them.[38]

Since coalescence spares a MAX violation, we require the ranking in (68); part of it is new (MAX ≻ UNIFORMITY) and part of it confirms the result previously established in section 3.2 (MAX ≻ LINEARITY — see (18)):

(68) MAX ≻ UNIFORMITY, LINEARITY

$fu_1t_2i_3$ (Inc. Ph.)	MAX	UNIFORMITY	LINEARITY
a. ☞ $fü_{1,3}t_2$		*	*
b. fu_1t_2	* !		

With MAX standing at the top of this hierarchy, deletion is the least favored option. Ranked below MAX are the two constraints violated in Rotuman coalescence, the anti-coalescence constraint itself and LINEARITY. This tableau shows that, because of the circumstances obtaining in Rotuman, coalescence is really a special case of metathesis, since all instances of coalescence also involve CV→VC reordering. This means that UNIFORMITY and LINEARITY can't be ranked with respect to one another; apart from transitivity of ranking, the basis of ranking is conflict, and no conflict is possible when violation of one constraint entails violation of another.

Without further ado, this constraint hierarchy accounts also for the *lack* of coalescence in forms like *puer* (cf. *pure*) or $\widehat{?oi}$ (cf. *?o.i*) 'to scrape or grate'. In *puer*, coalescence to *pür would involve unmotivated violation of UNIFORMITY, with no improvement on LINEARITY. By contrast, in coalescent cases like *füt,* the prosodic-structural constraint LIGHT-DIPH rules out the metathetic, non-coalescent candidate *fuit, which has a monomoraic vowel sequence that does not rise in sonority. As for /...VV/ words like $\widehat{?oi},$ LIGHT-DIPH is irrelevant (see section 3), so there is no danger of MAX violation and hence no reason to violate UNIFORMITY.

To sum up, the core ranking responsible for the phase alternation is as follows:

(69) Core Ranking for Rotuman Phase Alternation (Final Version)

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[38]Cairns (1976) entertains but rejects a coalescence analysis of Rotuman. His grounds: a cross-linguistic survey of coalescence processes yields no other cases in which front rounded vowels are the result of coalescence (p. 281). Hoeksema & Janda (1988: 228–9) cite this finding in discarding later incarnations of the coalescence analysis (such as those in Saito 1981 and McCarthy 1986). It should be noted, however, that neither Cairns nor Hoeksema & Janda present a theory from which this typological claim follows; the typological observation alone is taken to be sufficient. (Compare de Haas 1988 for a theory of coalescence that entails no such result.)

The value of typological observations without a supporting theory is very limited. Furthermore, in the case at hand, the possibility of a sampling error is high: front rounded vowels are rare, and coalescence is rare, so the conjunction of the two ought to be rare as well, and a scarcity of examples is not too surprising. In any case, there is a case of umlauting coalescence besides Rotuman. According to H.-S. Sohn (1987), Korean has a process of vowel coalescence that produces front rounded vowels in free variation with vocoid sequences:

(i) Korean Coalescence

kwemul ~ kömul	'monster'	p'yocok ~ p'öcok	'sharp'
wekuk ~ ökuk	'foreign country'	weka ~ öka	'grandparent'
wisəŋ ~ üsəŋ	'hypocrisy'	wi ~ ü	'above'
wihəm ~ ühəm	'danger'		

The forms 'monster' and 'foreign country' show that the process involved must be coalescence, not diphthongization, since a contrast is neutralized.

HEAD-MATCH, INC-PH > MAX > LINEARITY, UNIFORMITY

When INC-PH demands a final heavy syllable from a ...VCV input, the incomplete phase cannot be fully faithful to the form of the complete phase. The minimally unfaithful result is metathesis, which violates only low-ranking LINEARITY. Coalescence, which produces umlauted vowels, is next in degree of unfaithfulness, since it violates both of the low-ranking constraints, LINEARITY and UNIFORMITY. When neither metathesis nor umlaut is an option, because of other high-ranking constraints, deletion is the last resort, violating MAX. Through correspondence, we now have a reasonably complete account of the variety of ways in which the phase alternations differ from one another in Rotuman.

The featural consequences of coalescence have still not been discussed, though. The exact featural outcome of coalescence must be defined; why *hoti → höt* and not *hüt, *hɤt, or *hɨt? And coalescence must be prevented, in favor of deletion, in cases /tiʔu/ → *tiʔ, *tüʔ*. Accounting for these observations requires an apparatus of ranked IDENT constraints, which select among the conflicting featural allegiances of the coalescent segments or block coalescence entirely when the conflicts are irresolvable under ranking. I will not pursue these final details here, because there are ample precedents in the literature on coalescence under Correspondence Theory, particularly Gnanadesikan (1995), McCarthy & Prince (1995), and Pater (1995). Rather, I will continue by looking at an alternative approach, which offers a very different take on Rotuman umlaut.[39]

As Correspondence Theory is implemented above and in McCarthy & Prince (1995), the correspondence relation goes from segment to segment *only*, and featural faithfulness is mediated by IDENT constraints, which refer to correspondent segments. Suppose, though, that the correspondence relation goes from feature to feature as well as from segment to segment, a possibility that is entertained *passim* in McCarthy & Prince (1995) and supported directly by Lombardi (1995). In this alternative, it makes sense to formulate constraints demanding faithfulness to particular features independently of the segments that bear them. Such a constraint is MAX(–back): "every instance of [–back] in S_1 has a correspondent in S_2". When MAX(–back) is high ranking, it will require that [–back] persist even in the face of deletion of the segment that originally bore it — just as in Rotuman. From this perspective, Rotuman coalescence is faithfulness to the particular feature-value [–back], because of high-ranking MAX(–back). Faithfulness to [–back] compels absorption of it by a segment that was not its original sponsor. Conceptually, this is a kind of feature-level rather than segment-level coalescence, somewhat reminiscent of the treatment of coalescence in Lamontagne & Rice (1995). [40]

At an abstract level, this feature-based approach is not too different from the segmental one sketched immediately above, because both accounts assess the various responses to INC-PH in terms of relative faithfulness, preserving a result that was emphasized in sections 3.2 and 3.4. Either way, full deletion of a

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segment is the worst, faithfulness-wise; intermediate is coalescence; best of all is metathesis. Observe how the constraints rank the relevant candidates from *pure*:

(70) Ranked Incomplete-Phase Candidates Under Alternative Approaches

		Segmental Correspondence	Segmental & Featural Correspondence
Least faithful	*pur*	Violates MAX	Violates MAX, MAX(–back)[41]
Intermediate	*pür*	Violates UNIFORMITY, LINEARITY	Violates MAX
Most Faithful	*puer*	Violates LINEARITY	Violates LINEARITY

Given the ranking MAX > LINEARITY, which lies at the core of Rotuman prosodic morphology (18), both approaches yield the correct faithfulness ranking of these candidates. Less faithful candidates violate higher-ranking constraints than more faithful ones, or they violate a superset of the constraints violated by the more faithful ones.

With suitable development, the feature-based account deals straightforwardly with the details of coalescence in Rotuman. That *hoti* becomes *höt* and not **hüt*, **hɤt*, or **hɨt* shows that preservation of *only* [–back] is favored by high-ranking MAX(–back) — other featural MAX constraints are low-ranking. And it is unremarkable that /tiʔu/ shows no coalescence, surfacing as *tiʔ* rather than **tüʔ*, since in this case MAX(–back) is simply not at stake.

For completeness, it should be noted that implementing segmental and featural correspondence requires additional theoretical development. Feature-specific MAX and DEP constraints are necessary, of course, to replace the IDENT constraints of the segments-only correspondence theory. But faithfulness has other obligations: features are normally bound to the segments that bear them in the input, and they are not free to gain or lose autosegmental links without exacting some cost in faithfulness, under duress from higher-ranked constraints. In correspondence-theoretic terms, linkage-faithfulness constraints like the following are required as well (φ_x are features, ς_y are segments, subscript *i* stands for input, and subscript *o* stands for output):[42]

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[41]See Lombardi (1995) where this sort of dual segmental and featural MAX violation plays a crucial role in explaining a typological observation.

[42]As stated, the constraints require features to stay put except in cases of segmental deletion or epenthesis, when the antecedent conditions "$\varsigma_i \Re \varsigma_o$" would not be met. Different formulations of these constraints can be constructed by distributing the clauses "$\varphi_i \Re \varphi_o$" and "$\varsigma_i \Re \varsigma_o$" differently in the antecedent and consequent. Presumably UG countenances only one formulation as correct, but empirical differences are subtle and hard to come by.

Constraints with the intended force of MAX(feature), DEP(feature), NO-FLOP, and NO-SPREAD are not uncommon in the OT literature. Formalization has been problematic, however. The PARSE/FILL model provides a close analogue for MAX(feature), but not for the other three constraint-types. FILL(feature), understood literally, assumes that the phonological output contains an empty position standing for each added feature, but no such positions play a role in any theory of featural representation known to me. (The class nodes of feature geometry (Clements 1985b) are not what's required, since it is not generally the case that an otherwise empty class node is created every time a feature is added to a segment.) Worse yet, PARSE(link) and FILL(link), analogues to NO-FLOP and NO-SPREAD, make no formal sense at all — no version of autosegmental theory reifies links in this way, nor does any version provide unfilled "link-positions" that FILL(link) would violate.

(71) NO-FLOP(φ) (under featural correspondence)

    If

           φ_i is linked to ς_i,

           $\varphi_i \Re \varphi_o$, and

           $\varsigma_i \Re \varsigma_o$

    then

           φ_o is linked to ς_o.

           "The feature φ does not lose its original segmental linkage."

(72) NO-SPREAD(φ) (under featural correspondence)

    If

           φ_o is linked to ς_o,

           $\varphi_i \Re \varphi_o$, and

           $\varsigma_i \Re \varsigma_o$

    then

           φ_i is linked to ς_i.

           "The feature φ does not acquire new segmental linkages."

Constraints of this type are clearly necessary, since otherwise it would be possible for features to move from one segment to another willy-nilly, without any cost in faithfulness — in which case /tɪp/ would inexorably change to *pɪt*, in every language, if UG includes a constraint favoring coronal codas. Of course, NO-FLOP and NO-SPREAD are violable under domination by higher-ranking constraints, which motivate phenomena of delinking or spreading.

      This review of two approaches to Rotuman umlaut brings us to a final point. Umlaut is "non-structure-preserving", since it yields the front rounded vowels *ü*, *ö*, and *ǫ̈* and the [+ATR] low front vowel a̲, none of which occurs in complete-phase words. The phonological inventory of a language is determined by interaction between segmental markedness constraints and featural faithfulness constraints (Prince & Smolensky 1993: Chapt. 9). In general, if *F dominates Faith(F), then the F-containing structure will not be part of the inventory. For example, to account for the absence of front rounded vowels in the complete phase of Rotuman, the featural markedness constraint *UMLAUT ([–back] ⊃ [–round]) must dominate a relevant featural faithfulness constraint Faith(–back) (which stands for IDENT(–back) or MAX(–back), depending what model of correspondence is adopted). But these same constraints are also involved in compelling coalescence, since coalescence is also an effect of featural faithfulness, as I just argued. There is a seeming contradiction here: to limit the vocalic inventory in the complete phase, we require *UMLAUT ≫ Faith(–back), but to force umlaut in the incomplete phase, we require Faith(–back) ≫ *UMLAUT. This is what it means, concretely, to say that umlaut in Rotuman is "non-structure-preserving".

      The solution to this apparent paradox is to be sought in the model (54), which distinguishes between two types of correspondence relations: lexical form ⇒ surface complete phase and surface complete phase ⇒ surface incomplete phase. (See section 5.2, page 46 for a parallel argument based on the phonology of [ATR] in Rotuman.) There are separately rankable faithfulness constraints on each correspondence relation. The distribution of front rounded vowels in Rotuman motivates the following ranking:

(73) Faith-CI(–back) > *UMLAUT > Faith-LS(–back)

The markedness constraint *UMLAUT is active in governing the lexical ⇒ surface relation, because it dominates Faith-LS(–back). But the same constraint is inactive in the complete ⇒ incomplete relation, because it is dominated by Faith-CI(–back). This top-ranked constraint is also responsible for coalescence itself, preserving lexical [–back] in the face of deletion or absorption of the segment that bore it. Because the CI constraint is ranked differently from is LS counterpart, coalescence is indeed "non-structure-preserving".

5.4 Summary

In this section, I have presented evidence in support of the model of phase relations in (54), based upon proposals in Benua (1995, forthcoming) and McCarthy & Prince (1994b, 1995). Evidence has been adduced from a variety of sources, including prosody, segmental identity between the two phases, and segmental *non-identity* between the phases (non-structure-preserving umlaut). This model shows that the incomplete phase is related through correspondence to the complete phase, which is itself related to the lexical form of the word. Separately rankable faithfulness constraints are imposed on each of these correspondence relations. Furthermore, derived properties of the complete phase may determine, directly or indirectly, the form of the incomplete phase. The broad convergence of the Rotuman evidence on this model provides strong support for it.

In connection with the analysis of Rotuman umlaut, I have also sketched a view of featural correspondence, in which features and segments receive partly independent treatment by faithfulness constraints. Umlaut is preservation of [–back] in the face of deletion of the sponsoring segment — "persistence under deletion" in autosegmental terminology (Goldsmith 1976).[43] Full development of this view of featural faithfulness within Correspondence Theory is a project for another article, but here I have pointed out one consequence, complementing proposals by Lombardi (1995). I have also suggested how linkage faithfulness might be realized under correspondence, through the constraints NO-FLOP (71) and NO-SPREAD (72).

6. Conclusion

Through this article, I have examined matters of faithfulness and identity, focusing on the phonology and prosodic morphology of Rotuman. I have argued in support of Correspondence Theory, which extends the original Optimality-Theoretic conception of faithfulness in various ways:

- •Faithfulness constraints regulate types of alternations (metathesis, coalescence) which have not previously been considered. In Rotuman, the core ranking of constraints on correspondent segments leads to metathesis or coalescence in preference to deletion.

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[43] Jill Beckman has pointed out to me that persistence under deletion effects are subject to significant substantive limitations. Persistence has been observed with tone, of course, with nasality (e.g., French), and with palatalization (e.g., Lardil, Irish (Ní Chiosáin 1991) , and, effectively, Rotuman), but not with other features. To my knowledge, no explanation for this asymmetry has been offered in the feature-geometric or other literature.

- Faithfulness constraints regulate differences in prosodic structure as well as in segmental analysis. This subsumes both faithfulness to lexical prosody and phenomena previously attributed to prosodic circumscription.
- Faithfulness constraints regulate relations between surface forms, as well as relations between lexical and surface forms.

Apart from these principal themes, I have presented arguments and results about featural and segmental correspondence, about the character of templates in Prosodic Morphology, about differences between substantive and formal restrictions on grammars, and about the superiority of Optimality Theory over operational approaches.

Appendix A: Interpretation of Churchward's Transcription

Churchward (1940) has a highly idiosyncratic system of transcription, and it has been necessary to clarify and interpret some of his usages. Prosodic matters were dealt with in section 3.1; this Appendix gives the segmental details.

I have adopted *č* as the symbol for what Churchward (1940: 64) writes as *j*, which "is similar to the English *ch*, as in 'church,' but differs from it in exactly the same way as Rotuman *t* differs from English *t*: see par. 9. The resulting sound seems, to the English ear, to be between *ch* and *ts*." In par. 9, he says, "Rotuman *t* is strictly dental, as in Fijian, the tip of the tongue being pressed against the back of the top teeth.".

Churchward does not use a special transcription for the distinction between the "broad" and "narrow" mid vowels, which I transcribe as *e* vs. *ẹ*, etc., and which I interpret as [–ATR] and [+ATR], respectively. Nonetheless, he is careful to document the distinction (pp. 78–9): narrow *e* "as its name implies, is a little narrower than the ordinary R[otuman] *e*. It is, perhaps, about half-way between *e* as in 'pet' and *i* as in 'pit'...But it is still essentially an *e*-sound, and is not always easy to distinguish from normal *e*." Churchward also observes (p. 167) that one of the two previous writing systems he sought to replace, that of the Catholic missions, does distinguish the narrow and broad *o*, though not *e* or *ö*.

The vowel I transcribe as *æ* is, in Churchward's system, *ä*. "This vowel is a little narrower than *a* in 'cat,' tending, therefore, towards the sound in 'pet'." (P. 77.)

Churchward transcribes the complete and incomplete phases of /tɑfi/ (see (56)) as *tạfi* and *tạ̇f*, respectively. In the former, "the vowel is a little wider than *o* in 'odd' or 'cot'..." (p. 76); i.e., it is a little wider than IPA *ɒ*, the vowel in the Received Pronunciation of *odd* or *cot*. Its umlauted counterpart in *tạ̇f* is described as "just a little wider than *a* in 'cat'... It is nearer to this sound than any other English vowel, but differs from it in being a trifle longer ... and containing just a suggestion of the sound of *u* in 'cut' or 'but'. (This last sound is, of course, not a *u*-sound at all, but is a slight modification of the sound of *a* in 'calm', shortened.)" (P. 79.) I take this vowel to be IPA a, lower and slightly more central than *æ*.

Appendix B: Churchward's Rules for the Use of the Phases

Churchward (1940: 88ff.) presents and exemplifies six principles for the use of the two phases. I will quote his rules directly, with appropriate examples added from elsewhere in the text. To clarify the morphology of the examples, I have italicized any stem that is in the incomplete phase:[44]

"FIRST RULE

> Except before certain suffixes, and in a few other cases, each element or component part of a composite word, other than the last, is used in its inc. phase, no matter what may be the phase of the whole word. (The phase of the word as a whole is shown, of course, by the phase of its last element.)"

	Phase of "Whole Word" (determined by syntactic context)		
	Com. Ph.	Inc. Ph.	
/mɑkɑ+sulu/	*m*ɑ*k*sulu	*m*ɑ*ksul*	'dark'
/fino+ŋɑro/	*fion*ŋɑro	*fionŋ*ɑ*r*	'will (of a chief)'

For further exemplification, see (?).

"SECOND RULE

> A word is used in its inc. phase when it qualifies or defines the word or group of words that follows, or (except in a few special cases) when it is qualified or defined by it."

/sivɑ riri?i/	*si*ɑ*v* riri?i	'fans:inc little:com = the little fans'
/?orisɑ sivɑ/	*?oris* sivɑ	'their:inc fans:com = their fans'
/?orisa sivɑ riri?i/	*?oris si*ɑ*v* riri?i	'their:inc fans:inc little:com = their little fans'
/sivɑ ne tore/	*si*ɑ*v* ne tore	'fans:inc that remain:com = the fans that are left'
/sivɑ riri?i ne tore/	*si*ɑ*v riri?* ne tore	'fans:inc little:inc that remain:com = the little fans that are left'

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[44]In poetry, every stem (including stems covered by the "First Rule") appears in the complete phase, "except when the requirements of metre or assonance call for the use of a shorter form" (Churchward 1940: 100–101).

"THIRD RULE

In most cases—

(a) If no defining word or group follows, a noun or verb is used in its com. phase when definite, but in its inc. phase when indefinite."

/fɑmori ʔeɑ/   fɑmori ʔeɑ   'people:com say:com = the people say'
/fɑmori ʔeɑ/   *fɑmör ʔeɑ*   'people:inc say:com = some people say'

"(b) If a defining word or group follows, the definiteness or indefiniteness of a noun, cardinal pron., or verb, shows itself (unless prevented by some other factor) in the phase of the defining word or in that of the last word of the defining group."

/ʔepɑ folu/   *ʔeɑp* folu   'mats:inc three:com = the three mats'
/ʔepɑ folu/   *ʔeɑp fol*   'mats:inc three:inc = some three mats'

In verb phrases, the definiteness distinction leads to contrasts like the following:

/leʔe-tɑ tɑe RED-tuki-me/   *leʔet* tæe tuktukime   'person-sing:inc there knock-toward:com = There is someone knocking'

/leʔe-tɑ RED-tuk-me/   *leʔet tuktukim*   'person=sing:inc knock-toward:inc = Someone is knocking'

"FOURTH RULE

In some cases the use of the com. phase indicates positiveness, finality, or emphasis, or (in questions) the desire to be positive or certain."

/ʔe fɑp-ʔɑŋɑ/   ʔe fɑpʔɑŋɑ   'in three-days'-time:com = in three days' time'
/ʔe fɑp-ʔɑŋɑ/   ʔe *fɑpʔɑŋ*   'in three-days'-time:inc = in three days' time, did you say?'

"FIFTH RULE

In the case of verbs ending in a pron. suffix, the com. phase usually expresses the force of the completive tense."

/iɑ čoni-enɑ/   iɑ čonienɑ   'he/she/it flee-3sg:com = she has (already) fled'
/fā-tɑ čoni-enɑ/   *fā*tɑ *čonien*   'man-sing:com flee-3sg:inc = the man fled'

SIXTH RULE

The cardinal prons. and *seiɑ,* except as they come under the control of the foregoing rules, are treated as follows:

(a) Immediately after the preps. *ʔe* and *se* the normal usage is the com. phase, sometimes embellished with *-ŋ.*

(b) In all other positions the inc. phase is used.

References

Akinlabi, Akinbiyi. 1994. Featural alignment. Ms., Rutgers University. [To appear in *Journal of Linguistics.*]

Akinlabi, Akinbiyi. 1995. Kalabari vowel harmony. Ms., Rutgers University.

Alderete, John. 1995. Faithfulness to prosodic heads. Ms., University of Massachusetts, Amherst.

Alderete, John. 1996. Prosodic faithfulness in Cupeño. Ms., University of Massachusetts, Amherst.

Al-Mozainy, Hamza Q., Robert Bley-Vroman, & John McCarthy. 1985. Stress shift and metrical structure. *Linguistic Inquiry* 16, 135–144.

Anderson, Stephen R. 1992. *A-Morphous Morphology*. Cambridge: Cambridge University Press.

Anttila, Raimo. 1989. *Historical and Comparative Linguistics*. 2nd revised edition. Amsterdam: Benjamins.

Archangeli, Diana & Douglas Pulleyblank. 1994a. *Grounded Phonology*. Ms., University of Arizona and University of British Columbia.

Archangeli, Diana & Douglas Pulleyblank. 1994b. Kinande vowel harmony: domains, grounded conditions, and one-sided alignment. Ms., University of Arizona and University of British Columbia.

Bat-El, Outi. 1994. Stem modification and cluster transfer in Modern Hebrew. *Natural Language and Linguistic Theory* 12, 571–598.

Beckman, Jill. 1995. Shona height harmony: Markedness and positional identity. In Jill Beckman et al., eds. 1995.

Beckman, Jill. Forthcoming. *Harmony and Positional Faithfulness*. Doctoral dissertation, University of Massachusetts, Amherst.

Beckman, Jill, Laura Walsh Dickey, & Suzanne Urbanczyk, eds. 1995. *University of Massachusetts Occasional Papers in Linguistics* 18: Papers in Optimality Theory. Amherst, MA: Graduate Linguistic Student Association.

Benua, Laura. 1995. Identity effects in morphological truncation. In Jill Beckman et al., eds. 1995.

Benua, Laura. Forthcoming *Phonological Relations Between Words*. Doctoral dissertation, University of Massachusetts, Amherst.

Besnier, Niko. 1987. An autosegmental approach to metathesis in Rotuman. *Lingua* 73, 201–223.

Biggs, Bruce G. 1959. Rotuman vowels and their history. *Te Reo* 2, 24–26.

Biggs, Bruce G. 1965. Direct and indirect inheritance in Rotuman. *Lingua* 14, 383–445.

Blevins [Levin], Juliette. 1994. The bimoraic foot in Rotuman phonology and morphology. *Oceanic Linguistics* 33.

Broselow, Ellen. 1982. On predicting the interaction of stress and epenthesis. *Glossa* 16, 115–132.

Broselow, Ellen & John McCarthy. 1983. A theory of internal reduplication. *The Linguistic Review*, 3, 25–88.

Buckley, Eugene. 1994. Alignment in Manam stress. Ms., University of Pennsylvania.

Buckley, Eugene. 1995. Cyclicity as correspondence. Handout from Tilburg 'Derivational Residue' conference. ROA-93c.

Burzio, Luigi. 1994a. *Principles of English Stress*. Cambridge: Cambridge University Press.

Burzio, Luigi. 1994b. Anti-allomorphy. Handout of talk presented at "Going Romance 1994", Utrecht.

Bybee, Joan. 1985. *Morphology: a study of the relation between meaning and form*. Amsterdam: John Benjamins.

Cairns, Charles E. 1976. Universal properties of umlaut and vowel coalescence rules: Implications for Rotuman phonology. In Alphonse Juilland, ed., *Linguistic Studies Offered to Joseph Greenberg*. Vol. 2 (Phonology). 271–283. Saratoga, CA: Anma Libri.

Chomsky, Noam & Morris Halle. 1968 *The Sound Pattern of English*. New York: Harper & Row.

Churchward, C. M. 1940. *Rotuman Grammar and Dictionary*. Sydney: Australasia Medical Publishing Co. [Repr. New York: AMS Press, 1978.]

Clements, G. N. 1985a. The problem of transfer in nonlinear morphology. *Cornell Working Papers in Linguistics*, 7, 38–73.

Clements, G. N. 1985b. The geometry of phonological features. *Phonology* 2, 225–252.

Cole, Jennifer & Charles Kisseberth. 1995. Nasal harmony in Optimal Domains Theory. Cognitive Science Technical Report UIUC-BI-CS-95-02 (Language Series). Beckman Institute, University of Illinois.

Flemming, Edward & Michael Kenstowicz. 1995. Base-identity and uniform exponence: Alternatives to cyclicity. Ms., MIT.

Gafos, Adamantios. 1995. On the proper characterization of 'nonconcatenative' languages. Ms., Johns Hopkins University. ROA-106.

Gnanadesikan, Amalia. 1995. Markedness and faithfulness constraints in child phonology. Ms., University of Massachusetts, Amherst.

Goldsmith, John. 1976. *Autosegmental Phonology*. Doctoral dissertation, MIT.

Haas, Willem Gerrit de. 1988. *A Formal Theory of Vowel Coalescence: A Case Study of Ancient Greek.* Doctoral dissertation, Catholic University of Nijmegen.

Hall, Beatrice L., R. M. R. Hall, Martin D. Pam, Amy Myers, Stephen A. Antell, & Godfrey K. Cherono. 1973/4. African vowel harmony systems from the vantage point of Kalenjin. *Afriku und Übersee* 57, 241–267.

Halle, Morris & Kenneth Stevens. 1969. On the feature "Advanced Tongue Root". *Quarterly Progress Report* of the Research Laboratory of Electronics, MIT, 94, 209–215.

Halle, Morris & Jean-Roger Vergnaud. 1987 *An Essay on Stress*. Cambridge, MA: MIT Press.

Halle, Morris & Valdis Zeps. 1966. A survey of Latvian morphophonemics. *Quarterly Progress Report of the Research Laboratory of Electronics*, MIT, 83, 104–113.

Hammond, Michael. 1995. There is no lexicon. Ms., University of Arizona, Tucson.

Haudricourt, A.-G. 1958a. L'accent d'agencement en mélanésien de Rotuma. *Bulletin de la Société de Linguistique de Paris* 53, 16–17.

Haudricourt, A.-G. 1958b. La phonologie des voyelles en rotumien (Océanie). *Bulletin de la Société de Linguistique de Paris* 53, 268–272.

Hayes, Bruce. 1980. *A Metrical Theory of Stress Rules*. Doctoral dissertation, MIT. Distributed by the Indiana University Linguistics Club. New York: Garland, 1985.

Hayes, Bruce. 1987. A revised parametric metrical theory. In J. McDonough and B. Plunkett, eds., *Proceedings of NELS 17*. Amherst, MA: Graduate Linguistic Student Association, University of Massachusetts, Amherst.

Hayes, Bruce. 1994. *Metrical Stress Theory: Principles and Case Studies*. Chicago: University of Chicago Press.

Hoeksema, Jack and Richard D. Janda. 1988 Implications of process-morphology for categorial grammar. In Richard Oehrle, Emmon Bach, and Deirdre Wheeler, eds., *Categorial Grammars and Natural Language Structures*. 199f. Dordrecht: D. Reidel.

Hulst, Harry van der. 1983. Rotuman umlaut. Ms., University of Leiden.

Hume, Elizabeth. 1994. Metathesis and Optimality Theory. Handout from Phonology/Phonetics Group, Ohio State University, 9 November, 1994.

Hume, Elizabeth. 1995. Beyond linear order: Prosodic constraints and C/V metathesis. *Proceedings of FLSM 6*. Bloomington: Indiana University Linguistics Club.

Idsardi, William. 1992. *The Computation of Prosody*. Doctoral dissertation, MIT.

Inkelas, Sharon. 1994. Exceptional stress-attracting suffixes in Turkish: representations vs. the grammar. To appear in René Kager, Harry van der Hulst, and Wim Zonneveld, eds., *The Prosody Morphology Interface*.

Itô, Junko. 1989. A prosodic theory of epenthesis. *Natural Language and Linguistic Theory*, 7, 217–260.

Itô, Junko & Armin Mester. 1992. Weak layering and word binarity. Ms., University of California, Santa Cruz.

Itô, Junko, Yoshihisa Kitagawa, & R. Armin Mester. 1995. Prosodic faithfulness and correspondence: Evidence from a Japanese argot. To appear in *Journal of East Asian Linguistics*.

Itô, Junko, Ralf-Armin Mester, & Jaye Padgett. 1995. Licensing and underspecification in Optimality Theory. *Linguistic Inquiry* 26, 571–614.

Janda, Richard D. 1984 Why morphological metathesis rules are rare: On the possibility of historical explanation in linguistics. In Claudia Brugman and M. Macaulay, eds., *Proceedings of the Tenth Annual Meeting of the Berkeley Linguistics Society*. 87–103. Berkeley: Berkeley Linguistics Society.

Kager, René. 1995. Surface opacity of metrical structure in Optimality Theory. Handout from Tilburg 'Derivational Residue' conference. ROA-93a.

Kawasaki, Noriko. 1990. Cooccurrence restrictions on consonants in some Polynesian languages. In Greg Lamontagne and Alison Taub, eds., *University of Massachusetts Occasional Papers* 13. Amherst, MA: Graduate Linguistics Student Association.

Kaye, Jonathan. 1983. On the syllable structure of certain West African languages. In D. L. Goyvaerts, ed., *African Linguistics — Essays in Memory of M. W. K. Semikenke*. Amsterdam: Benjamins.

Kaye, Jonathan and Jean Lowenstamm . 1984 De la syllabicité. In F. Dell, D. Hirst and J.-R. Vergnaud, eds., *Forme sonore du language: structure des représentations en phonologie*. 123–159. Paris: Hermann.

Kenstowicz, Michael. 1994. Cyclic vs. noncyclic constraint evaluation. *MIT Working Papers in Linguistics* 21. Pp. 11–42.

Kenstowicz, Michael. 1995. Base-identity and uniform exponence: Alternatives to cyclicity. Ms., MIT.

Kenstowicz, Michael & Charles Kisseberth. 1977. *Topics in Phonological Theory*. New York: Academic Press.

Keyser, S. Jay. 1975. Metathesis and Old English phonology. *Linguistic Inquiry* 6, 377–411.

Kirchner, Robert. 1993. Turkish vowel disharmony in Optimality Theory. Handout from talk presented at Rutgers Optimality Workshop I, Rutgers University, New Brunswick, N.J.

Kirchner, Robert. 1995. Contrastiveness is an epiphenomenon of constraint ranking. Forthcoming in Berkeley Linguistics Society Proceedings.

Kraska-Szlenk, Iwona. 1995. *The Phonology of Stress in Polish*. Doctoral dissertation, University of Illinois.

Krupa, Viktor. 1966. The phonemic structure of bi-vocalic morphemic forms in Oceanic languages. *Journal of the Polynesian Society* 75, 458–497.

Lamontagne, Greg & Keren Rice. 1995 A correspondence account of coalescence. In Jill Beckman et al., eds. 1995.

Levin [Blevins], Juliette. 1983. Reduplication and prosodic structure. Ms., MIT.

Lombardi, Linda. 1995. Why Place and Voice are different: Constraint interactions and feature faithfulness in Optimality Theory. Ms., University of Maryland, College Park. ROA-105.

McCarthy, John. 1979. *Formal Problems in Semitic Phonology and Morphology*. Doctoral dissertation, MIT.

McCarthy, John. 1981. A prosodic theory of nonconcatenative morphology. *Linguistic Inquiry* 12, 373–418.

McCarthy, John. 1986. OCP effects: Gemination and antigemination. *Linguistic Inquiry* 17, 207–263.

McCarthy, John. 1989. Linear order in phonological representation. *Linguistic Inquiry* 20, 71–99.

McCarthy, John. 1993a. A case of surface constraint violation. *Canadian Journal of Linguistics* 38, 169-195. [Special issue edited by Carole Paradis and Darlene LaCharité.]

McCarthy, John. 1993b. The parallel advantage: containment, consistency, and alignment. Handout from talk presented at Rutgers Optimality Workshop I, Rutgers University, New Brunswick, N.J.

McCarthy, John. 1995. Remarks on phonological opacity in Optimality Theory. To appear in Jacqueline Lecarme, Jean Lowenstamm, and Ur Shlonsky, eds., *Studies in Afroasiatic Grammar*, Holland Academic Graphics.

McCarthy, John. 1996. Faithfulness and prosodic circumscription. Ms., University of Massachusetts, Amherst.

McCarthy, John & Alan Prince . 1986. Prosodic morphology. Ms., University of Massachusetts, Amherst, and Brandeis University, Waltham, Mass.

McCarthy, John and Alan Prince. 1988. Quantitative transfer in reduplicative and templatic morphology. In *Linguistics in the Morning Calm* 2, ed. Linguistic Society of Korea, 3–35. Seoul: Hanshin Publishing Co.

McCarthy, John and Alan Prince . 1990a. Foot and word in Prosodic Morphology: The Arabic broken plural. *Natural Language and Linguistic Theory* 8:209–282.

McCarthy, John and Alan Prince . 1990b. Prosodic Morphology and templatic morphology. In *Perspectives on Arabic Linguistics: Papers from the Second Symposium*, ed. M. Eid and J. McCarthy, 1–54. Amsterdam: Benjamins, Amsterdam.

McCarthy, John and Alan Prince . 1991a. Prosodic minimality. Handout from talk presented at University of Illinois Conference *The Organization of Phonology*.

McCarthy, John and Alan Prince. 1991b. Linguistics 240: Prosodic Morphology. Lectures and handouts from. 1991 LSA Linguistic Institute Course, University of California, Santa Cruz.

McCarthy, John & Alan Prince. 1993. *Prosodic Morphology I: Constraint Interaction and Satisfaction*. Ms., University of Massachusetts, Amherst, and Rutgers University. To appear, MIT Press.

McCarthy, John & Alan Prince . 1993b. Generalized alignment. In Geert Booij & Jaap van Marle (eds.), *Yearbook of Morphology 1993*. Dordrecht: Kluwer. 79-153.

McCarthy, John & Alan Prince . 1994a. The emergence of the unmarked: Optimality in Prosodic Morphology. In Mercè Gonzàlez (ed.), *Proceedings of the North East Linguistic Society 24*. Amherst, MA: Graduate Linguistic Student Association. 333–379.

McCarthy, John & Alan Prince. 1994b. Two lectures on Prosodic Morphology (Utrecht, 1994). Lecture transcripts and handouts, deposited on Rutgers Optimality Archive.

McCarthy, John & Alan Prince. 1995. Faithfulness and reduplicative identity. In Jill Beckman et al., eds. 1995 249–384. Also to appear in René Kager, Harry van der Hulst, and Wim Zonneveld, eds., *The Prosody Morphology Interface*.

Mester, Ralf-Armin. 1986. *Studies in Tier Structure*. Ph.D. Dissertation, University of Massachusetts, Amherst.

Mester, Ralf-Armin. 1990. Patterns of truncation. *Linguistic Inquiry*, 21, 478–485.

Milner, George B. 1971. Fijian and Rotuman. In Thomas A. Sebeok, ed., *Current Trends in Linguistics* 8. The Hague: Mouton.

Moore, Deanna. 1995. Reduplication and optimization of prosodic structure. Ms., University of Massachusetts, Amherst.

Ní Chiosáin, Máire. 1991. Topics in the phonology of Irish. Doctoral dissertation, University of Massachusetts, Amherst.

Odden, David. 1988. Antiantigemination and the OCP. *Linguistic Inquiry* 19, 451–75.

Orgun, C. Orhan. 1994. Monotonic cyclicity and Optimality Theory. In Mercè Gonzàlez (ed. *Proceedings of the 24th Annual Meeting of the North-East Linguistic Society*. Amherst, MA: Graduate Linguistic Student Association. Pp. 461–474.

Orgun, Cemil Orhan. 1995. Correspondence and identity constraints in two-level Optimality Theory. WCCFL Proceedings.

Paradis, Carole. 1988a. On constraints and repair strategies. *The Linguistic Review* 6, 71-97.

Paradis, Carole. 1988b. Towards a theory of constraint violations. *McGill Working Papers in Linguistics* 5, 1-44.

Pater, Joe. 1994. Against the underlying specification of an "exceptional" English stress pattern. In *Proceedings of the Conference on Contrast in Phonology*, *Toronto Working Papers in Linguistics* 13, 95-121.

Pater, Joe. 1995. Austronesian nasal substitution and other NC effects. To appear in René Kager, Harry van der Hulst, and Wim Zonneveld, eds., *The Prosody Morphology Interface*.

Pater, Joe. 1995. On the nonuniformity of weight-to-stress and stress preservation effects in English. Ms., McGill University. ROA-107.

Pierrehumbert, Janet. 1993. Alignment and prosodic heads. ESCOL Proceedings.

Piggott, G. L. 1991. Apocope and the licensing of empty-headed syllables. *The Linguistic Review* 8, 287–318.

Poser, William. 1982. Phonological representations and action-at-a-distance. In H. van der Hulst and N. Smith (eds.), *The Structure of Phonological Representations* vol. 2 (pp. 121– 158). Dordrecht: Foris.

Prince, Alan. 1980. A metrical theory for Estonian quantity. *Linguistic Inquiry*, 11, 511–562.

Prince, Alan. 1993. Minimal violation. Handout of talk presented at ROW-1, October 22–24, 1993.

Prince, Alan & Paul Smolensky. 1991. Linguistics 247: Notes on connectionism and harmony theory in linguistics. In *Technical Report CU-CS-533-91*. Department of Computer Science, University of Colorado, Boulder, Colorado.

Prince, Alan & Paul Smolensky. 1993. *Optimality theory: constraint interaction in generative grammar*. To appear, MIT Press. TR-2, Rutgers University Cognitive Science Center.

Rosenthall, Samuel. 1994. *Vowel/Glide Alternations in a Theory of Constraint Interaction*. Doctoral dissertation, University of Massachusetts, Amherst.

Saito, Mamoru. 1981 A preliminary account of the Rotuman vowel system. Ms., MIT.

Selkirk, Elisabeth. 1984. *Phonology and Syntax: The Relation between Sound and Structure*. Cambridge, MA: MIT Press.

Selkirk, Elisabeth. 1993. The prosodic structure of functional elements: affixes, clitics, and words. Ms., University of Massachusetts, Amherst. To appear in J. Morgan and K. Demuth (eds. *Signal to syntax: bootstrapping from speech to grammar in early acquisition*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Selkirk, Elisabeth. 1994a. Positional licensing as positional (conditional Parse vs. Align(F;Gcat). Class notes from Linguistics 730, University of Massachusetts, Amherst. Fall, 1994.

Selkirk, Elisabeth. 1994b. The constraint question for feature structure: a review of some answers. Class notes from Linguistics 730, University of Massachusetts, Amherst. Fall, 1994.

Sherer, Tim. 1994. *Prosodic Phonotactics*. Doctoral dissertation, University of Massachusetts, Amherst.

Smolensky, Paul. 1995. On the structure of the constraint component Con of UG. Handout of talk at UCLA, 4/7/95. ROA-86.

Sohn, Hyank-Sook. 1987. On the representation of vowels and diphthongs and their merger in Korean. In Anna Bosch, Barbara Need, and Eric Schiller, eds., *Papers from the 23rd Annual Regional Meeting of the Chicago Linguistic Society*, Part Two: Parasession on Autosegmental and Metrical Phonology. Pp. 307–323. Chicago: Chicago Linguistic Society.

Stampe, David 1972 [1980]. *How I Spent My Summer Vacation [A Dissertation on Natural Phonology]*. Doctoral dissertation, University of Chicago. [New York: Garland.]

Steriade, Donca. 1988. Reduplication and syllable transfer in Sanskrit and elsewhere. *Phonology*, 5, 73–155.

Stevens, Alan M. 1968. *Madurese Phonology and Morphology*. American Oriental Series no. 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. Pp. 232–242. [Also appears in *CUNYForum* 11, 92–102.]

Ultan, Russell. 1978. A typological view of metathesis. In J. Greenberg (ed.), *Universals of Human Language* (pp. 367– 402). Stanford: Stanford University Press.

Urbanczyk, Suzanne. 1994. Double reduplications in parallel. In Jill Beckman et al., eds. 1995. Also to appear in René Kager, Harry van der Hulst, and Wim Zonneveld, eds., *The Prosody Morphology Interface*.

Urbanczyk, Suzanne. 1995. The case of the migrating suffix: Out-of-control in Salish. Ms., University of Massachusetts, Amherst.

Urbanczyk, Suzanne. 1996. *Patterns of Reduplication in Lushootseed*. Doctoral dissertation, University of Massachusetts, Amherst.

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