Phase Alternation in Rotuman in Natural Derivational Phonology

Byung-Gun Lee
Emeritus Professor, Seoul National University
E-mail Address: bgplee@korea.com
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1. Introduction

I will explore "phase" alternation in Rotuman within the framework of Natural Derivational Phonology proposed in Lee (2009a). This work is entirely built on the data adduced and the OT (Optimality Theory) analyses made in McCarthy (1995, 2000). Rotuman words have two phases, "complete" and "incomplete". Various phonological processes conspire to bring forth the surface forms of the words belonging to the single morphological category "incomplete phase". For the works by other writers, see Churchward (1940 [1978]), Haudricourt (1958a, b), Biggs (1959, 1965), Milner (1971), Anttila (1989 [1972]), 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). It will be shown that the analyses in Natural Derivational Phonology alternative to those in OT account for the Rotuman phase alternation adequately.

2. Natural Derivational Phonology[1]

This section will give an outline of Natural Derivational Phonology. In Natural Derivational Phonology a constraint pair (C-pair) and an unpaired deriving markedness constraint (unpaired constraint) perform phonological derivation. A C-pair consists of a dominating markedness constraint M and the dominated faithfulness constraint F in the form of M » F. It is satisfied provided that the markedness constraint is satisfied and at the same time its paired faithfulness constraint is violated. Constraints may apply singly or multiply to any candidate (underlying or not), resulting in serial derivation.[2] The natural ranking of universal ranking principles (URP's) determines the ranking of

[1] The readers who have read Lee (2009a) may skip this section.
[2] 'Constraint' will be used interchangeably with 'unpaired constraint', 'markedness constraint' of a C-pair and 'C-pair'.

constraints. Evaluation constraints (E-constraints), which may be ranked, evaluate the outputs of constraints. Only the candidates derived by the qualified constraints except the underlying candidate are presented in a tableau of Natural Derivational Phonology. Natural Derivational Phonology may be succinctly summed up as a system in which constraints apply in obedience to the natural ranking of URP's, letting E-constraints evaluate their outputs.

URP's will be introduced below, since they are the fundamentals on which Natural Derivational Phonology is structured. The terms to be employed need to be defined. The constraints whose SD's meet the overlapping structure in the same input candidate are said to stand in an *overlapping* (*O*-) relation, and the constraints whose SD's meet the non-overlapping structures in the same input candidate are said to stand in a *non-overlapping* (*NO*-) relation. Derivatively, constraints can be said to *be O-related* or *NO-related*, to *O-apply* or *NO-apply*, and to *O-derive* or *NO-derive a candidate*.

We are now in a position to introduce URP's:

(1) Apply-M Principle (AMP)
Apply M.

- M represents a constraint. Not only does AMP allow constraints to apply singly but also it allows more than one constraint to apply simultaneously.

(2) Maximal Feeding Principle (MFP)
Apply M_α if and only if M_α M-feeds M_β.
Definition: M_α M-feeds M_β if M_α can derive the candidate with a structure S_{n+1} from the candidate with a structure S_n, where S_n and S_{n+1} are identical except the change(s) to be made by constraint(s), and both S_n and S_{n+1} meet the SD of M_β.

- The constraints to be ranked by the same URP, which is checked by the natural ranking of URP's, are qualified to stand in an M-feeding relation. And once the M-feeding constraint is established, it may apply with other constraints according to the URP that ranks it previous to its establishment.

(3) No Reanalyzing Principle (NRP)[3]

Apply M_N if and only if there is no other M may apply than M_N that is NO-related with itself.

Definition: The neutralization M whose SD is met in S_I is M_N, where S_I = intramorphemic structure, i.e., the structure in the context $\mu_i[\ldots\_\_\_\_\_\ldots]\mu_i$, μ = morpheme.

- The constraint ranked according to NRP is said to be N-ranked.

(4) Allophonic Constraint Principle (ACP)

Apply M_A if and only if there is no other M may apply than M_N, or M_A that is NO-related with itself.

Definition: The allophonic M in whose SD no non-phonetic context other than syllable boundary is specified is M_A.

- Allophonic M may be defined as M that produces an allophonic segment. The constraint ranked according to ACP is said to be A-ranked. The A-ranked constraint applies before the N-ranked constraint when they are O-related. This sequencing of the constraints is inherent in the statements of NRP and ACP themselves though there is no ranking between them.

The natural ranking of URP's introduced above is: NRP, ACP » MFP » AMP. And if a candidate violates an E-constraint crucially, derivation resumes from the nearest correct candidate (in such a way that the same E-constraint is not violated).

3. Preliminary

Rotuman has the morphological "phase" distinction in major-category words, the complete phase and the incomplete phase. The problem is that the structure of the surface final syllable of some incomplete-phase forms is vastly different from that of the corresponding complete-phase forms, though they originate from the same underlying phonological structure.

Examine closely the following examples cited from McCarthy (1995, 2000). They

[3] Neutralization M's are those which do not yield an allophonic segment.

form the core of the discussion that will follow. The parentheses delimit the stress-foot of bimoraic trochee. The vowel sequences connected with the ligature in (b) and (d) are respectively light diphthongs and heavy diphthongs. And the mid vowels indicated by the IPA diacritic are [+ATR] (e.g., *o̝* in *ho̝ti* in (c)).

(5) Phase Alternation

	Complete	Incomplete	
a. ‘Deletion’ of the Final Vowel			
/rako/:	(rako)	(rak)	‘to imitate’
/tokiri/:	to(kiri)	to(kir)	‘to roll’
/sulu/:	(sulu)	(sul)	‘coconut-spathe’
/tiʔu/:	(tiʔu)	(tiʔ)	‘big’
b. Metathesis and Light Diphthongization			
/iʔa/:	(iʔa)	(i͡aʔ)	‘fish’
/seseva/:	se(seva)	se(se͡av)	‘erroneous’
/tiko/:	(tiko)	(ti͡ok)	‘flesh’
/parofita/:	paro(fita)	paro(fi͡at)	‘prophet’
/hosa/:	(hosa)	(ho͡as)	‘flower’
/pure/:	(pure)	(pu͡er)	‘to rule’
c. Umlaut			
/mose/:	(mose)	(mös)	‘to sleep’
/hoti/:	(ho̝ti)	(hö̝t)	‘to embark’
/futi/:	(futi)	(füt)	‘to pull’
d. Heavy Diphthongization			
/pupui/:	pu(pui)	pu(pu͡i)	‘floor’
/keu/:	(keu)	(ke͡u)	‘to push’
/lelei/:	le(lei)	le(le͡i)	‘good’
/joseua/:	jose(ua)	jose(u͡a)	‘Joshua’
e. Forms with a Final Long Vowel			
/rī/:	(rī)	(rī)	‘house’
/rē/:	(rē)	(rē)	‘to do’
/hanē/:	ha(nē)	ha(nē)	‘honey’
/sikā/:	si(kā)	si(kā)	‘cigar’

As Blevins (1994) observes, all feet must be syllabically or moraically binary. The feet of the complete-phase forms in (a-d) are syllabically binary and those of the corresponding incomplete-phase forms are moraically binary. And the feet of both the complete-phase forms and the incomplete-phase forms in (e) are moraically binary. This means that every foot is moraically binary whether it occurs in complete-phase forms or in incomplete-phase forms.

According to McCarthy (1995), the foot of the incomplete-phase forms consists of a short (monomoraic) vowel and a moraic coda in (5a, c). It consists of a monomoraic diphthong (light diphthong) and a moraic coda in (5b), while it has a heavy diphthong with the second vocoid assigned its own mora in (5d). And it has a bimoraic monosyllable of a long vowel in (5e). All the incomplete-phase forms have a two-mora foot in the final syllable. McCarthy (1995) expresses this regularity in the following alignment constraint:

(6) INC-PH

Align (Stem]$_{\text{INC-PH}}$, R, [σ]$_{\text{FT}}$, R)

"Every incomplete-phase stem ends in monosyllabic foot (or heavy syllable)."

The discussion in this paper will be focused on the realization of the monosyllabic foot in the incomplete-phase forms, namely, on hitting the target set by the constraint INC-PH.

4. 'Deletion' of the Final Vowel

The surface incomplete-phase form *(rak)* in (5a), for instance, is realized through the serial derivation /rako/ → raok → raϕk → [(raϕk)]. For the first step the C-pair *CV_{μ}**]**$_{\text{INCPH}}$ (META) » LIN is necessary. It metathesizes the structure CV_{μ}**]**$_{\text{INCPH}}$ to the structure $V_{\mu}C$]$_{\text{INCPH}}$. The vowel in the SD of META must be short to leave the word-final long vowel of the incomplete-phase forms in (5e) unscathed. For the second step the C-pair *[μ**μ**μ]$_{\sigma}$ » MAX (μ) is necessary,[4] and it deletes the second mora of the three-mora syllable. This C-pair is formulated on the ground that coda consonant is assigned a mora. It is assumed that the deletion of the mora of a monomoraic vowel entails the concomitant deletion of the vowel. For the last step the unpaired constraint ASSFT is required. This constraint is in charge of the foot formation of both complete-phase forms and incomplete-phase forms. It assigns a non-iterative bimoraic foot, starting

[4] The target in the SD of the markedness constraint in a C-pair is bold-faced in order to indicate definitely to which element in the input the dominated faithfulness constraint must be faithful.

from the right end of a word.[5] According to Lee (2009b), ASSFT is ranked after the unpaired constraint BRACKET ERASURE (BE) by default, which is also ranked after all the constraints applicable by default.[6]

With the constraints established we may construct the tableau for the (5a) forms. In a tableau candidates are arranged in the order of their derivation. The underlying candidate is numbered *0*, the candidate derived from it is numbered *1*, and so on.

(7) Tableau for the (5a) Forms

	META » LIN	$*[\mu\mu\mu]_\sigma$ » MAX (μ)	ASSFT
a. /rako]$_{\text{CPH}}$/			
1. → (rako)]$_{\text{CPH}}$			√
b. /rako]$_{\text{INCPH}}$/			
1. ra$_\mu$o$_\mu$k$_\mu$]$_{\text{INCPH}}$	√		
2. ra$_\mu$ϕk$_\mu$]$_{\text{INCPH}}$		√	
3. → (ra$_\mu$ϕk$_\mu$)]$_{\text{INCPH}}$			√
c. /tokiri]$_{\text{CPH}}$/			
1. → to(kiri)]$_{\text{CPH}}$			√
d. /tokiri]$_{\text{INCPH}}$/			
1. toki$_\mu$i$_\mu$r$_\mu$]$_{\text{INCPH}}$	√		
2. toki$_\mu$ϕr$_\mu$]$_{\text{INCPH}}$		√	
3. → to(ki$_\mu$ϕr$_\mu$)]$_{\text{INCPH}}$			√

In (a, c), only ASSFT operates in deriving the surface form of the complete-phase form. In (b, d), AMP-ranked META derives [1], overriding ASSFT. In deriving [2] N-ranked $*[\mu\mu\mu]_\sigma$ applies to the intramorphemic structure, overriding ASSFT. The surface form is derived by ASSFT.

The incomplete-phase forms in (5a) might be claimed to be derived simply by deleting the word-final vowel without employing META (and $*[\mu\mu\mu]_\sigma$). META is nevertheless independently necessary for the incomplete-phase forms in (5b). Therefore it is desirable to make it apply to all the incomplete-phase forms that end in the structure CV$_\mu$]$_{\text{INCPH}}$. It would be complex to state an alternative constraint that exempts from the process of metathesis the incomplete-phase forms in (5a) that end in the same underlying structure CV$_\mu$]$_{\text{INCPH}}$ as those in (5b). Moreover, META not only feeds

5 It is assumed that trochaic stress is assigned at the same time when ASSFT applies.
6 BE will not be considered.

*[μμμ]$_\sigma$ for the incomplete phase forms in (5a) but also indirectly feeds it for the incomplete phase forms in (5b-c). META and *[μμμ]$_\sigma$ are free-ride constraints as regards the incomplete-phase forms in (5a).

5. Metathesis and Light Diphthongization

A C-pair is required for the incomplete-phase forms in (5b) besides the constraints established already. On the basis of the typological generalization that monomoraic or light diphthongs are limited to those which rise in sonority (Kaye 1983, Kaye & Lowenstamn 1984, Rosenthall 1994), McCarthy (1995) establishes the constraint LIGHT-DIPH. This constraint says that light diphthongs must rise in sonority. (The vowel sequence connected with the ligature of the incomplete-phase forms in (5b) is licit light diphthongs.) In Natural Derivational Phonology LIGHT-DIPH is split into a C-pair and an E-constraint on it. The C-pair *VV (DIPH) » IDENT (voc) changes the second vowel of the vowel sequence VV to a glide in the context _____C$_0$]$_{\text{INCPH}}$ whether the sequence rises in sonority or not. DIPH is ranked according to AMP due to its non-phonetic context though it yields allophonic diphthongs. And the E-constraint SONCON (for sonority contour) on it says that the diphthong in the context _____ C must rise in sonority.

The surface incomplete-phase form *($\widehat{i_\mu a}$ʔ$_\mu$)]$_{INCPH}$* in (5b), for instance, is realized through the serial derivation /iʔa]$_{\text{INCPH}}$/ → iaʔ]$_{\text{INCPH}}$ → $\widehat{i_\mu a_\mu}$ʔ$_\mu$]$_{\text{INCPH}}$ → $\widehat{i_\mu a}$ʔ$_\mu$]$_{\text{INCPH}}$ → [($\widehat{i_\mu a}$ʔ$_\mu$)]$_{\text{INCPH}}$]. The C-pair DIPH » IDENT (voc) derives the third candidate.

Thanks to the constraint DIPH and the E-constraint SONCON on it we can construct the following tableau. Subtableau (e) (for a form in (5d)) is constructed to exemplify that the incomplete-phase forms other than those in (5b) may undergo DIPH. And subtableau (7b) is reconstructed as subtableau (f) to show how the E-constraint SONCON operates.

(8) Tableau for the (5b) Forms (N = N-ranked)

	SONCON	META	DIPH	*[μμμ]$_\sigma$	ASSFT
a. /iʔa]$_{\text{CPH}}$/					
1. → (iʔa)]$_{\text{CPH}}$					√
b. /iʔa]$_{\text{INCPH}}$/					
1. i$_\mu$a$_\mu$ʔ$_\mu$]$_{\text{INCPH}}$		√			
2. $\widehat{i_\mu a_\mu}$ʔ$_\mu$]$_{\text{INCPH}}$			√	N	
3. $\widehat{i_\mu a}$ʔ$_\mu$]$_{\text{INCPH}}$				√	

4. → ($\widehat{i_{\mu}a}$ʔ$_{\mu}$)]$_{\text{INCPH}}$					√
c. /saseva]$_{\text{CPH}}$/					
1. → sa(seva)]$_{\text{CPH}}$					√
d. /saseva]$_{\text{INCPH}}$/					
1. sase$_{\mu}$a$_{\mu}$v$_{\mu}$]$_{\text{INCPH}}$		√			
2. sas$\widehat{e_{\mu}a}_{\mu}$v$_{\mu}$]$_{\text{INCPH}}$			√	N	
3. sas$\widehat{e_{\mu}a}$v$_{\mu}$]$_{\text{INCPH}}$				√	
4. → sa(s$\widehat{e_{\mu}a}$v$_{\mu}$)]$_{\text{INCPH}}$					√
e. /lelei]$_{\text{INCPH}}$/					
1. lel$\widehat{e_{\mu}i}_{\mu}$]$_{\text{INCPH}}$			√		
2. → le(l$\widehat{e_{\mu}i}_{\mu}$)]$_{\text{INCPH}}$					√
f. /rako]$_{\text{INCPH}}$/					
1. ra$_{\mu}$o$_{\mu}$k$_{\mu}$]$_{\text{INCPH}}$		√			
2. r$\widehat{a_{\mu}o}_{\mu}$k$_{\mu}$]$_{\text{INCPH}}$	*		√	N	
3. ra$_{\mu}$ɸk$_{\mu}$]$_{\text{INCPH}}$				√	
4. → (ra$_{\mu}$ɸk$_{\mu}$)]$_{\text{INCPH}}$					√
	SONCON	META	DIPH	*[μμμ]$_{\sigma}$	ASSFT

In (a, c), only ASSFT participates in deriving the surface form of the complete-phase form. In (b, d, f), META derives [1], overriding ASSFT. In (b, d), AMP-ranked DIPH derives [2], overriding N-ranked *[μμμ]$_{\sigma}$ and ASSFT, in accordance with the natural ranking NRP » AMP. N-ranked *[μμμ]$_{\sigma}$ derives [3]. In (e), AMP-ranked DIPH derives [1], overriding ASSFT. It does not violate SONCON though it does not rise in sonority, since the diphthong is not in the context _____ C. In (f), AMP-ranked DIPH derives [2], overriding N-ranked *[μμμ]$_{\sigma}$ and ASSFT, in accordance with the natural ranking NRP » AMP. It violates SONCON, since the sonority of the diphthong does not rise in the context _____ C. N-ranked *[μμμ]$_{\sigma}$ derives [3] from [1], overriding ASSFT. In (b, d-f), ASSFT derives the surface form. What is true of subtableau (f) is also applicable to subtableau (7d).

Two things are to be noted in the tableau above. The N-ranked constraint *[μμμ]$_{\sigma}$ that may apply in the intramorphemic environment is overridden by the AMP-ranked constraint DIPH in accordance with the natural ranking NRP » AMP. And in (f) *[μμμ]$_{\sigma}$ derives [3] from [1], the nearest correct candidate, in such a way that SONCON is not violated.

6. [ATR] Harmony and Umlaut

According to McCarthy (1995), mid vowels and the low vowel ɑ become [+ATR] before a high vowel across an optional consonant by the process of [ATR] harmony. This is exemplified by the following examples cited from McCarthy. The [+ATR] mid vowels are indicated by the IPA diacritic, and the front low vowel a̲ is the umlauted version of ɐ ([+ATR, +low]).

(9) [ATR] Harmony

	Complete	Incomplete	
a. Mid Vowels Become [+ATR]			
/fepi/:	(fe̝pi)	(fe̝p)	'to be slow'
/loʔu/:	(lo̝ʔu)	(lo̝ʔ)	'to bend at an angle'
/seru/:	(se̝ru)	(se̝r)	'to comb'
b. /ɑ/ ([-ATR, +low]) Becomes ɐ			
/tɑfi/:	(tɐfi)	(ta̲f)	'to sweep'
/hɑŋu/:	(hɐŋu)	(hɐŋ)	'to awaken'

Mid vowels and the low vowel ɑ become [+ATR] under the influence of the following [+ATR] high vowel. The allophonic markedness constraint [ATR] HARMONY (ATR-H) which constitutes a C-pair with the faithfulness constraint IDENT (ATR) spreads [+ATR] to the preceding mid or low vowel with an optional C intervening.

The newly established constraint ATR-H to be A-ranked takes part in constructing the tableau for the (9) forms. (The derivation of *(ta̲f)* will be given later.)

(10) Tableau for the (9) Forms (A = A-ranked)

	SONCON	META	DIPH	ATR-H	$*[\mu\mu\mu]_\sigma$	ASSFT
a. /fepi]$_{\text{CPH}}$/						
1. fe̝pi]$_{\text{CPH}}$				√		
2. → (fe̝pi)]$_{\text{CPH}}$						√
b. /fepi]$_{\text{INCPH}}$/						
1. fe$_\mu$i$_\mu$p$_\mu$]$_{\text{INCPH}}$		√		A		
2. f$\overset{\frown}{\text{e}_\mu\text{i}_\mu}p_\mu$]$_{\text{INCPH}}$	*		√	A	N	
3. fe̝$_\mu$i$_\mu$p$_\mu$]$_{\text{INCPH}}$				√	N	
4. fe̝$_\mu$ϕp$_\mu$]$_{\text{INCPH}}$					√	
5. → (fe̝$_\mu$ϕp$_\mu$)]$_{\text{INCPH}}$						√

c. /hɑŋu]$_{\text{CPH}}$/						
1. hɐŋu]$_{\text{CPH}}$				√		
2. → (hɐŋu)]$_{\text{CPH}}$						√
d. /hɑŋu]$_{\text{INCPH}}$/						
1. hɑ$_{\mu}$u$_{\mu}$ŋ]$_{\text{INCPH}}$		√		A		
2. hɑ$_{\mu}$u͡$_{\mu}$ŋ$_{\mu}$]$_{\text{INCPH}}$	*		√	A	N	
3. hɐ$_{\mu}$u$_{\mu}$ŋ$_{\mu}$]$_{\text{INCPH}}$				√	N	
4. hɐ$_{\mu}$ɸŋ$_{\mu}$]$_{\text{INCPH}}$					√	
5. → (hɐ$_{\mu}$ɸŋ$_{\mu}$)]$_{\text{INCPH}}$						√
	SONCON	META	DIPH	ATR-H	*[μμμ]$_{\sigma}$	ASSFT

In (a, c), A-ranked ATR-H derives [1], overriding ASSFT. In (b, d), AMP-ranked META derives [1], overriding A-ranked ATR-H and ASSFT, in accordance with the natural ranking ACP » AMP. AMP-ranked DIPH derives [2], overriding N-ranked *[μμμ]$_{\sigma}$, A-ranked ATR-H, and ASSFT, in accordance with the natural ranking NRP, ACP » AMP. It violates SONCON, since the sonority of the diphthong does not rise in the context _____ C. A-ranked ATR-H derives [3] from [1], overriding N-ranked *[μμμ]$_{\sigma}$ and ASSFT, in accordance with the natural ranking NRP, ACP. N-ranked *[μμμ]$_{\sigma}$ derives [4], overriding ASSFT. In (a-d), ASSFT derives the surface form.

I will proceed to the incomplete-phase form *(taf)* in (9) and those in (5c). A back vowel is fronted before a front vowel by the process of umlaut. The responsible C-pair is *[**V, +back**][V, -back] C (UMLAUT) » IDENT (back).

With the constraint UMLAUT established we may construct the following tableau. In subtableau (f) the derivation of *(pu$_{\mu}$͡er$_{\mu}$)]$_{INCPH}$* from /pure]$_{\text{INCPH}}$/ in (5b) is given to demonstrate how DIPH and UMLAUT interact.

(11) Tableau for Umlauted Forms (M = M-fed)

	SONCON	META	DIPH	ATR-H	UMLUAT	*[μμμ]$_{\sigma}$	ASSFT
a. /hoti]$_{\text{CPH}}$/							
1. ho̝ti]$_{\text{CPH}}$				√			
2. → (ho̝ti)]$_{\text{CPH}}$							√
b. /hoti]$_{\text{INCPH}}$/							
1. ho$_{\mu}$i$_{\mu}$t$_{\mu}$]$_{\text{INCPH}}$		√		A			
2. ho$_{\mu}$i͡$_{\mu}$t$_{\mu}$]$_{\text{INCPH}}$	*		√	A	A	N	
3. ho̝$_{\mu}$i$_{\mu}$t$_{\mu}$]$_{\text{INCPH}}$				√	M	N	

4. hö̯$_\mu$i$_\mu$t$_\mu$]$_{\text{INCPH}}$					√	N	
5. hö̯$_\mu$ϕt$_\mu$]$_{\text{INCPH}}$						√	
6. → (hö̯$_\mu$ϕt$_\mu$)]$_{\text{INCPH}}$							√
c. /tɑfi]$_{\text{CPH}}$/							
1. tɐfi]$_{\text{CPH}}$				√			
2. → (tɐfi)]$_{\text{CPH}}$							√
d. /tɑfi]$_{\text{INCPH}}$/							
1. tɑ$_\mu$i$_\mu$f$_\mu$]$_{\text{INCPH}}$		√		A			
2. tɑ$_\mu$͡i$_\mu$f$_\mu$]$_{\text{INCPH}}$	*		√	A	A	N	
3. tɐ$_\mu$i$_\mu$f$_\mu$]$_{\text{INCPH}}$				√	M	N	
4. ta̲$_\mu$i$_\mu$f$_\mu$]$_{\text{INCPH}}$					√	N	
5. ta̲$_\mu$ϕf$_\mu$]$_{\text{INCPH}}$						√	
6. → (ta̲$_\mu$ϕf$_\mu$)]$_{\text{INCPH}}$							√
e. /mose]$_{\text{INCPH}}$/							
1. mo$_\mu$e$_\mu$s$_\mu$]$_{\text{INCPH}}$		√					
2. mo$_\mu$͡e$_\mu$s$_\mu$]$_{\text{INCPH}}$	*		√		A	N	
3. mö$_\mu$e$_\mu$s$_\mu$]$_{\text{INCPH}}$					√	N	
4. mö$_\mu$ϕs$_\mu$]$_{\text{INCPH}}$						√	
5. → (mö$_\mu$ϕs$_\mu$)]$_{\text{INCPH}}$							√
f. /pure]$_{\text{INCPH}}$/							
1. pu$_\mu$e$_\mu$r$_\mu$]$_{\text{INCPH}}$		√					
2. pu$_\mu$͡e$_\mu$r$_\mu$]$_{\text{INCPH}}$			√		A	N	
3. pu$_\mu$͡er$_\mu$]$_{\text{INCPH}}$						√	
4. → (pu$_\mu$͡er$_\mu$)]$_{\text{INCPH}}$							√
	SONCON	META	DIPH	ATR-H	UMLUAT	*[μμμ]$_\sigma$	ASSFT

In (a, c), A-ranked ATR-H derives [1], overriding ASSFT. In (b, d), AMP-ranked META derives [1], overriding A-ranked ATR-H and ASSFT, in accordance with the natural ranking ACP » AMP. The SD's of five constraints including ASSFT meet [1], but only AMP-ranked DIPH applies, deriving [2]. It overrides N-ranked *[μμμ]$_\sigma$, A-ranked ATR-H, A-ranked UMLAUT, and ASSFT, in accordance with the natural ranking NRP, ACP » AMP. [2] violates SONCON, since the sonority of the diphthong does not rise in the context _____ C. A-ranked ATR-H derives [3] from [1], overriding N-ranked *[μμμ]$_\sigma$ and ASSFT, and M-feeding A-ranked UMLAUT, in accordance with the natural ranking NRP, ACP » MFP » AMP. ATR-H M-feeds UMLUAT, since it can derive the candidate

$h\underset{\frown}{o}_{\mu}i_{\mu}t_{\mu}]_{INCPH}$ [3] with the structure $\underset{\frown}{o}_{\mu}i_{\mu}t_{\mu}$ from the candidate $ho_{\mu}i_{\mu}t_{\mu}]_{INCPH}$ [1] with the structure $o_{\mu}i_{\mu}t_{\mu}$, where the structure $o_{\mu}i_{\mu}t_{\mu}$ and the structure $\underset{\frown}{o}_{\mu}i_{\mu}t_{\mu}$ are identical except the change to be made by ATR-H (i.e., o → $\underset{\frown}{o}$), and both the structure $o_{\mu}i_{\mu}t_{\mu}$ and the structure $\underset{\frown}{o}_{\mu}i_{\mu}t_{\mu}$ meet the SD of UMLUAT. A-ranked UMLAUT derives [4], overriding N-ranked $*[\mu\mu\mu]_{\sigma}$ and ASSFT, in accordance with the natural ranking NRP, ACP. N-ranked $*[\mu\mu\mu]_{\sigma}$ derives [5], overriding ASSFT. What is true of subtableaux (b, d) is also applicable to subtableau (e) except that ATR-H does not take part. In (f), META derives [1], overriding ASSFT. The SD's of four constraints meet [1], but only AMP-ranked DIPH derives [2], overriding N-ranked $*[\mu\mu\mu]_{\sigma}$, A-ranked UMLUAT, and ASSFT, in accordance with the natural ranking NRP, ACP » AMP. N-ranked $*[\mu\mu\mu]_{\sigma}$ derives [3], overriding ASSFT. In (a-f), ASSFT derives the surface form.

The reason for the M-feeding ranking of the two constraints ATR-H and UMLUAT that are to be A-ranked in deriving [3] in (11b, d) is: Because ACP does not allow the two O-related M_A's to O-apply, they are ranked according to outranked MFP in accordance with the natural ranking ACP » MFP. And it is worth noting that in deriving [2] in (11f) the SD of UMLUAT also meets [1], which may bring forth the wrong candidate $pii_{\mu}e_{\mu}r_{\mu}]_{INCPH}$. But for the natural ranking of the constraints, it would be complex for DIPH to derive [2], overriding UMLUAT that might derive the wrong candidate.

7. Heavy Diphthongization

I will turn to the forms in (5d), which end in /VV/. The following additional examples drawn from McCarthy (2000: 154-155) exhaust the possible vowel combinations. The vowel sequences connected with the ligature in the incomplete-phase forms are heavy diphthongs.

(12) Forms Ending in /VV/

	Complete	Incomplete	
a.	Falling Sonority in the Diphthong		
	(čei)	(če͡i)	'cricket (insect)'
	(tae)	(ta͡e)	'to touch'
	(vau)	(va͡u)	'bamboo'
	(čou)	(čo͡u)	'bottle'
	(ʔoi)	(ʔo͡i)	'to scrape or grate'

b. Rising Sonority in the Diphthong

(fia)	(fi͡a)	‘pouch of a sling’
ka(mia)	ka(mi͡a)	‘dog (< come here)’
(mea)	(me͡a)	‘the temples’
(čua)	(ču͡a)	‘(to have) very serious elephantiasis of testicles’
ŋa(rue)	ŋa(ru͡e)	‘work’

c. Equal Sonority in the Diphthong

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

As is observed, the vowel sequence in the incomplete-phase forms is diphthongized whether the resultant diphthong rises in sonority or it is of equal sonority. Yet we do not have to establish another constraint for the process of this diphthongization. The established C-pair DIPH » IDENT (voc) that applies in the context _____$C_0]_{\mathrm{INCPH}}$ is sufficient. The derived diphthongs are heavy in contrast to those of the forms in (5b).

The following tableau exemplifies how heavy diphthongs are realized:

(13) Tableau for the (5d) and (12) Forms

	DIPH » IDENT (voc)	ASSFT
a. /pupui$]_{\mathrm{CPH}}$/		
1. → pu(pui)$]_{\mathrm{CPH}}$		√
b. /pupui$]_{\mathrm{INCPH}}$/		
1. pupu͡i$]_{\mathrm{INCPH}}$	√	
2. → pu(pu͡i)$]_{\mathrm{INCPH}}$		√
c. /joseua$]_{\mathrm{INCPH}}$/		
1. joseu͡a$]_{\mathrm{INCPH}}$	√	
2. → jose(u͡a)$]_{\mathrm{INCPH}}$		√
d. /čei$]_{\mathrm{INCPH}}$/		
1. če͡i$]_{\mathrm{INCPH}}$	√	
2. → (če͡i)$]_{\mathrm{INCPH}}$		√
e. /fia$]_{\mathrm{INCPH}}$/		
1. fi͡a$]_{\mathrm{INCPH}}$	√	
2. → (fi͡a)$]_{\mathrm{INCPH}}$		√

In (a), only ASSFT takes part in deriving [1]. In (b-e), AMP-ranked DIPH derives [1], overriding ASSFT. ASSFT derives the surface form.

The diphthongs derived by DIPH in the tableau above have nothing to do with the E-constraint SONCON, since they are not followed by a consonant (see (8e)).

8. Forms with a Final Long Vowel

Long vowels occur only in word-final positions: in native monosyllabic words (e.g., /rī/, /rē/) and in borrowed polysyllabic words (e.g., /hanē/, /sikā/). There is no distinction between the two phases when words end in a long vowel: the words of both phases have a monosyllabic heavy foot of a long vowel.

The tableau for the (5e) forms tells the story:

(14) Tableau for the (5e) Forms

	ASSFT
a. /rī]$_{\text{CPH}}$/	
1. → (rī)]$_{\text{CPH}}$	√
b. /rī]$_{\text{INCPH}}$/	
1. → (rī)]$_{\text{INCPH}}$	√
c. /sikā]$_{\text{CPH}}$/	
1. → si(kā)]$_{\text{CPH}}$	√
d. /sikā]$_{\text{INCPH}}$/	
1. → si(kā)]$_{\text{INCPH}}$	√

Only ASSFT is involved in deriving the surface forms in both phases of the words that end in a long vowel.

The words of both phases ending in a long vowel have a monosyllabic heavy foot, which conforms to the generalization that every foot is moraically binary whether it occurs in complete-phase forms or in incomplete-phase forms.

9. Conclusion

Fairly complex alternations are accounted for by six constraints and one E-constraint in compliance with the natural ranking of URP's in Natural Derivational Phonology. By way of conclusion, we may summarize what has been discussed in the following overall tableau:

(15) Overall Tableau

	SONCON	META	DIPH	ATR-H	UMLAUT	*[μμμ]$_{\sigma}$	ASSFT
a. /sulu]$_{\text{INCPH}}$/							
1. su$_{\mu}$u$_{\mu}$l$_{\mu}$]$_{\text{INCPH}}$		√					
2. s$\overset{\frown}{\text{u}_{\mu}\text{u}}_{\mu}l_{\mu}$]$_{\text{INCPH}}$	*		√			N	
3. su$_{\mu}$ϕl$_{\mu}$]$_{\text{INCPH}}$						√	
4. → (su$_{\mu}$ϕl$_{\mu}$)]$_{\text{INCPH}}$							√
b. /tiko]$_{\text{INCPH}}$/							
1. ti$_{\mu}$o$_{\mu}$k$_{\mu}$]$_{\text{INCPH}}$		√					
2. t$\overset{\frown}{\text{i}_{\mu}}o_{\mu}k_{\mu}$]$_{\text{INCPH}}$			√			N	
3. t$\overset{\frown}{\text{i}_{\mu}}ok_{\mu}$]$_{\text{INCPH}}$						√	
4. → (t$\overset{\frown}{\text{i}_{\mu}}ok_{\mu}$)]$_{\text{INCPH}}$							√
c. /futi]$_{\text{INCPH}}$/							
1. fu$_{\mu}$i$_{\mu}$t$_{\mu}$]$_{\text{INCPH}}$		√					
2. f$\overset{\frown}{\text{u}_{\mu}\text{i}}_{\mu}t_{\mu}$]$_{\text{INCPH}}$	*		√		A	N	
3. fü$_{\mu}$i$_{\mu}$t$_{\mu}$]$_{\text{INCPH}}$					√	N	
4. fü$_{\mu}$ϕt$_{\mu}$]$_{\text{INCPH}}$						√	
5. → (fü$_{\mu}$ϕt$_{\mu}$)]$_{\text{INCPH}}$							√
d. /keu]$_{\text{CPH}}$/							
1. → (keu)]$_{\text{CPH}}$							√
e. /keu]$_{\text{INCPH}}$/							
1. k$\overset{\frown}{\text{eu}}$]$_{\text{INCPH}}$			√				
2. → (k$\overset{\frown}{\text{eu}}$)]$_{\text{INCPH}}$							√
f. /rē]$_{\text{CPH}}$/							
1. → (rē)]$_{\text{CPH}}$							√
g. /rē]$_{\text{INCPH}}$/							
1. → (rē)]$_{\text{INCPH}}$							√
h. /seru]$_{\text{INCPH}}$/							
1. se$_{\mu}$u$_{\mu}$r$_{\mu}$]$_{\text{INCPH}}$		√		A			
2. s$\overset{\frown}{\text{e}_{\mu}\text{u}}_{\mu}r_{\mu}$]$_{\text{INCPH}}$	*		√	A		N	
3. se̞$_{\mu}$u$_{\mu}$r$_{\mu}$]$_{\text{INCPH}}$				√		N	
4. se̞$_{\mu}$ϕr$_{\mu}$]$_{\text{INCPH}}$						√	
5. → (se̞$_{\mu}$ϕr$_{\mu}$)]$_{\text{INCPH}}$							√

In (a-c), META derives [1], overriding ASSFT. In (a), AMP-ranked DIPH derives [2], overriding N-ranked *[μμμ]$_σ$ and ASSFT, in accordance with the natural ranking NRP » AMP. It violates SONCON, since the sonority of the diphthong does not rise in the context _____ C. N-ranked *[μμμ]$_σ$ derives [3] from [1]. In (b), AMP-ranked DIPH derives [2] without violating SONCON, overriding N-ranked *[μμμ]$_σ$ and ASSFT, in accordance with the natural ranking NRP » AMP. N-ranked *[μμμ]$_σ$ derives [3], overriding ASSFT. In (c), AMP-ranked DIPH derives [2], overriding N-ranked *[μμμ]$_σ$, A-ranked UMLAUT, and ASSFT, in accordance with the natural ranking NRP, ACP » AMP. It violates SONCON, since the diphthong does not rise in sonority in the context _____C. A-ranked UMLAUT derives [3] from [1], overriding N-ranked *[μμμ]$_σ$ and ASSFT, in accordance with the natural ranking NRP, ACP. N-ranked *[μμμ]$_σ$ derives [4], overriding ASSFT. In (d), only ASSFT applies in deriving the surface form. In (e), AMP-ranked DIPH derives [1], overriding ASSFT. In (f-g), only ASSFT participates in deriving the surface form. In (h), AMP-ranked META derives [1], overriding A-ranked ATR-H and ASSFT, in accordance with the natural ranking ACP » AMP. AMP-ranked DIPH derives [2], overriding N-ranked *[μμμ]$_σ$, A-ranked ATR-H, and ASSFT, in accordance with the natural ranking NRP, ACP » AMP. It violates SONCON, since the diphthong does not rise in sonority in the context _____C. A-ranked ATR-H derives [3] from [1], overriding N-ranked *[μμμ]$_σ$ and ASSFT, in accordance with the natural ranking NRP, ACP. N-ranked *[μμμ]$_σ$ derives [4], overriding ASSFT. In (a-c, e, h), ASSFT derives the surface form.

The overall tableau above clearly and conclusively shows that six constraints combine to bring about a monosyllabic foot of incomplete-phase forms, which is defined by the constraint INC-PH, in Natural Derivational Phonology. Most importantly, the six deriving constraints apply in compliance with the natural ranking of URP's with one of them constrained by an E-constraint. And it is epitomized in subtableaux (11b, d) how the six deriving constraints and one E-constraint are interlocked with each other under the direction of the natural ranking NRP, ACP » MFP » AMP in Natural Derivational Phonology.

I may conclude this paper by remarking that it would be extremely complex to construct the tableau comparable to the overall tableau in OT.

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