Harmonic Serialsim and Natural Derivational Phonology

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1. Introduction

Harmonic Serialism (HS), a derivational version of Optimality Theory (OT) (Prince & Smolensky 1993/2004), will be reviewed on the basis of argument advanced in McCarthy (2010). Basically, HS's GEN, on which HS heavily relies, is asserted to make one change at a time. It will turn out that this property of GEN may engender undesirable consequences. Eventually, the phonological analyses in HS will be reanalyzed within the framework of Natural Derivational Phonology proposed in Lee (2009a).

2. Natural Derivational Phonology

This section will give an outline of Natural Derivational Phonology (NDP). In NDP 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.[1] The natural ranking of universal ranking principles (URP's) determines the ranking of 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 NDP. NDP may be succinctly summed up as a system in which constraints apply in obedience to the natural ranking of URP's, letting E-

[1] 'Constraint' will be used interchangeably with 'unpaired constraint', 'markedness constraint' of a C-pair and 'C-pair'.

constraints evaluate their outputs.

URP's, the constraint on URP's, the derivedness constraint schema and the counterfed constraint schema, which are the fundamentals on which NDP is structured, will be introduced. 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 the fundamentals:

(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.

(3) No Reanalyzing Principle (NRP)[2]

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.

2 Neutralization M's are those which do not yield an allophonic segment.

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

(4) Constraint on URP's (C-on-U)

Apply M_O's individually to the same candidate.

Definitions: 1. M that derives a candidate that violates at least one E-constraint is M_E.

2. O-related M's at least one of which is M_E are M_O's.

• M_O's derive the candidates numbered identically, since they apply to the same input candidate and they are ranked according to the same URP. As a result, the candidates constitute multiple candidate rows (MCR's).

• In the cases of MFP and C-on-U alike, 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 to be M_O's. And once the M-feeding constraint and M_O's are established, they may apply with other constraints according to the URP that ranks them previous to their establishment.

(5) Derivedness Constraint (DC) Schema

Neutralization M must

(a) apply to S_D if its SD is met in S_I, or

(b) apply only to S_D.

Where S_D = the structure derived phonologically.

Condition: S_D can be S_D by a specific M.

(6) Counterfed Constraint (CFC) Schema

M must not apply to (a) S_D or (b) S_D by a specific M.

• The instantiations of M choose (a) by default and they choose (b) on constraint-particular basis, constituting the CFC's on themselves.

The natural ranking of URP's introduced above is: NRP » 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. Arabic

In Arabic the surface form [ʔuktub], for instance, is derived from the underlying representation /ktub/ 'write!' by the constraints responsible for epenthesizing a vowel and a glottal stop. To illustrate the way the surface form is derived in HS, McCarthy (2010) constructs the HS tableaux as in (7) below. It is absolutely essential that HS's GEN be limited to "doing one thing at a time".

(7) Derivation of /ktub/ → [ʔuktub] in HS[3]

Step 1: First pass through GEN → EVAL → GEN … loop

ktub	*COMPLEX-ONSET	ONSET	DEP
a. → uktub		1	1
b. ktub	1W	L	L

Step 2: Second pass through GEN → EVAL → GEN … loop

uktub	*COMPLEX-ONSET	ONSET	DEP
a. → ʔuktub			1
b. uktub		1W	L

Step 3: Third pass through GEN → EVAL → GEN … loop

ʔuktub	*COMPLEX-ONSET	ONSET	DEP
a. → ʔuktub			
b. ʔuktubu			1W

At step 1, the winner [uktub] is selected from the candidate set that includes [ktub], [uktub], [ktubu], [xtub] and so on. At step 2, the winner [uktub] becomes the input, from which GEN yields the candidate set that includes [uktub], [ʔuktub], [uxtub] and so on. The candidate [ʔuktub] is evaluated as the winner. At step 3, the winner [ʔuktub] becomes the input, from which GEN yields the candidate set that includes [ʔuktub], [ʔuktubu] and so on. The candidate [ʔuktub] is selected as the winner once again. Here the winner converges with that at step 2, making the surface form selected.

HS demands that the constraint hierarchy be "invariant across all iterations of the GEN → EVAL → GEN … loop". But the three faithfulness constraints DEP's employed

[3] McCarthy footnotes that OT tableaux usually leave out many losers and the constraints that bring about them.

in the tableaux above cannot be maintained to be "invariant". At step 1 DEP that militates against the insertion of *u* is dominated by *COMPLEX-ONSET, at step 2 DEP that militates against the insertion of ʔ by ONSET, and at step 3 DEP that militates against the insertion of *u* in the word-final position by other markedness constraint than the two constraints.

Furthermore, the derivation of /ktub/ → [ʔuktub] cannot be dealt with in so straightforward a manner as in HS tableaux (7). For instance, at step 1, besides the wrong candidates [ktub], [ktubu] and [xtub] a surprisingly large number of wrong candidates can be presented. And to filter out these wrong candidates a great number of constraints to be ranked extrinsically must be taken advantage of (see Lee 2009a: section 1).

We may now construct the tableau in NDP that will replace the HS tableaux in (7). Utilizing the constraints operating in constructing the HS tableaux, we postulate the two C-pairs *COMPLEX-ONSET » DEP and ONSET » DEP. These C-pairs construct the following alternative tableau:

(8) Tableau for the Derivation of /ktub/ → [ʔuktub] in NDP

/ktub/	*COMPLEX-ONSET » DEP	ONSET » DEP
1. uktub	√	
2. → ʔuktub		√

The C-pair *COMPLEX-ONSET » DEP derives [1], feeding the C-pair ONSET » DEP, and the fed C-pair derives [2]. This conforms to the universal ranking principle AMP.

Makassarese furnishes a case analogous to the Arabic case. In Makassarese, an Austronesian language of South Sulawesi province, Indonesia, the words ending in the coda consonant *s*, *r* or *l* are provided with an epenthetic copy of the preceding vowel, and only the words with the copied vowel can have the glottal stop ʔ added word-finally. Namely, the glottal stop ʔ is added only in the environment *derived* by the constraint responsible for the epenthesis. This is illustrated in the following examples (McCarthy & Prince 1994, McCarthy 2002; see also Aronoff, Basri & Broselow 1987):

(9) ʔ-Addition in Makassarese

a. ʔ-Addition in the *Derived* Environment

/rantas/ → [rántasaʔ] 'dirty'

/tetter/ → [tétténeʔ] 'quick'

/jamal/ → [jámalaʔ] 'naughty'

b. ʔ-Addition Prohibited in the *Non-Derived* Environment
/lompo/ → [lómpo] (*[lómpoʔ]) 'big'

For the forms in (9a) the HS tableaux can be constructed in almost the same way that those in (7) are constructed. CODACOND penalizes the coda consonant *s*, *r* or *l*, and $*V]_{PW}$ the word-final vowel. Besides, the faithfulness constraint DEP is required.

(10) Derivation of /rantas/ → [rántasaʔ] in HS

Step 1: First pass through GEN → EVAL → GEN … loop

rantas	CODACOND	$*V]_{PW}$	DEP
a. → rántasa		1	1
b. rántas	1W	L	L

Step 2: Second pass through GEN → EVAL → GEN … loop

rántasa	CODACOND	$*V]_{PW}$	DEP
a. → rántasaʔ			1
b. rántasa		1W	L

Step 3: Third pass through GEN → EVAL → GEN … loop

rántasaʔ	CODACOND	$*V]_{PW}$	DEP
a. → rántasaʔ			
b. arántasaʔ			1W

We note that the distribution of the integer, W and L is exactly the same as that in tableaux (7). And these HS tableaux derive the expected surface form in a plausible way even though they are defective in the "invariant" requirement of the constraint hierarchy.

Nonetheless, we are very uncertain about what to do in HS when we take into account the form in (9b). It must not undergo $*V]_{PW}$, since the glottal stop ʔ must not be added to the words ending in an underlying (i.e., *non-derived*) vowel.[4]

I will now proceed to construct the tableau for the forms in (9) in NDP (for details see Lee 2009a: section 5). The C-pairs CODACOND » DEP (V) and $*V]_{PW}$ » DEP (ʔ) are

[4] To solve the problem we might rely on an instantiation of the ranking schema for DEE's (i.e., $_{N}M$ » F » $_{O}M$) in comparative markedness theory proposed in McCarty (2002). But it cannot be easily grafted upon the HS theory; furthermore, Lee (2009a: chapter 15) argues that comparative markedness theory is not tenable.

respectively responsible for the processes of vowel epenthesis and ʔ-addition. Moreover, the form in (9b) forces *V]$_{PW}$ to be constrained by the DC on itself. The neutralization constraint *V]$_{PW}$, an instantiation of M in the DC schema, chooses (b) from the DC schema, constituting the DC on itself. The DC on *V]$_{PW}$ demands that *V]$_{PW}$ apply only to derived structure.

With the DC on *V]$_{PW}$ we construct the tableau for the forms in (9) in NDP:

(11) Tableau for ʔ-Addition in Makassarese in NDP

		DC	CODACOND » DEP (V)	*V]$_{PW}$ » DEP (ʔ)
a. /rantas/	1. rántasa		√	
	2. → rántasaʔ			√
b. /lompo/	0. → lómpo			
	1. lómpoʔ	*		√

In (a), CODACOND derives [1], feeding *V]$_{PW}$. Fed *V]$_{PW}$ derives [2]; it does not violate DC, since it applies to the structure derived by CODACOND. This derivation complies with the universal ranking principle AMP. In (b), *V]$_{PW}$ derives [1], but it violates DC, since it applies in the non-derived environment.

The “invariant” requirement of the constraint hierarchy is not met satisfactorily in the HS tableaux in (7). And the comparison between the HS tableaux in (7) and the NDP tableau in (8) may guide our choice. In addition, the Makassarese case further complicates the matter in HS.

4. Cairene Arabic

In Cairene Arabic a short unstressed high vowel in non-final open syllables syncopates in internal and external sandhi. The following data cited from McCarthy (2010) exemplify this:

(12) Cairene Syncope (see also Watson 2002: 70-72)

a. /wiħiʃ-a/ → [ˈwiħ.ʃ-a] ‘bad (f. sg.)’
/xulusˤ-it/ → [ˈxul.sˤ-it] ‘she finished’
/tˤardi kibi:r/ → [ˈtˤar.dik.ˈbi:r] ‘my parcel is big’

b. /ħagar kibi:r/ → [ˈħa.gar.k**i**.ˈbi:r] ‘big stone’

In (a), syncope alters the syllable structure: the onset of the deleted vowel is resyllabified as the coda of the preceding vowel. But in (b), the deletion of the bold-faced *i* would give birth to an impermissible triconsonantal cluster.

McCarthy (2010) argues that syncope must operate simultaneously with resyllabification, since the sequential derivation brings about a ranking paradox. He further argues that unfaithful operations are limited to carrying out a single change at a time, but no limit is set to faithful operations (see also McCarthy 2007). The unfaithful syncope and faithful resyllabification can therefore operate simultaneously in a single step. Consequently, he constructs the HS tableaux for a form in (12a) and the form in (12b) as in (13) and (14) below respectively. If a consonant is unsyllabified, it violates PARSE-SEGMENT. If a consonant is the onset of a degenerate syllable, it violates HEADEDNESS (σ). If a consonant is syllabic, it violates NUC/CONS. And the constraint WEAK < *i* is in charge of syncope (see McCarthy 2007:169-174). Besides, the undominated constraints NO-COMPLEX-CODA and NO-COMPLEX-ONSET are required for the form in (12b).

(13) Syncope in <…, ˈwi.ħi.ʕ-a, ˈwiħ.ʕ-a>

ˈ(wi)$_\sigma$(ħi)$_\sigma$(ʕ-a)$_\sigma$	PRS-SEG	HEAD (σ)	*NUC/CONS	WEAK < *i*	MAX-V
a. → ˈ(wiħ)$_\sigma$(ʕ-a)$_\sigma$					1
b. ˈ(wi)$_\sigma$(ħi)$_\sigma$(ʕ-a)$_\sigma$				1W	L
c. ˈ(wi)$_\sigma$ħ(ʕ-a)$_\sigma$	1W				1
d. ˈ(wi)$_\sigma$(ħ_)$_\sigma$(ʕ-a)$_\sigma$		1W			1
e. ˈ(wi)$_\sigma$(ħ̩)$_\sigma$(ʕ-a)$_\sigma$			1W		1

From the input /ˈ(wi)$_\sigma$(ħi)$_\sigma$(ʕ-a)$_\sigma$/ the candidate set (a, b, c, d, e, …) is derived. The resyllabified candidate ˈ*(wiħ)*$_\sigma$*(ʕ-a)*$_\sigma$ (a) that violates the lowest-ranked MAX-V wins, since the candidates (b-e) are all filtered out by the outranking constraints.

(14) No syncope in <…, ˈħa.gar.ki.ˈbi:r>

ˈ(ħa)$_\sigma$ (gar)$_\sigma$ (ki)$_\sigma$ ˈ(bi:r)$_\sigma$	PRS-SEG	HEAD (σ)	*NUC/CONS	NO-COMP-COD	NO-COMP-ONS	WEAK < *i*	MAX-V
a. → ˈ(ħa)$_\sigma$ (gar)$_\sigma$ (ki)$_\sigma$ ˈ(bi:r)$_\sigma$						1	
b. ˈ(ħa)$_\sigma$ (gar)$_\sigma$ k ˈ(bi:r)$_\sigma$	1W					L	1W
c. ˈ(ħa)$_\sigma$ (gar)$_\sigma$ (k_)$_\sigma$ ˈ(bi:r)$_\sigma$		1W				L	1W
d. ˈ(ħa)$_\sigma$ (gar)$_\sigma$ (k̩)$_\sigma$ ˈ(bi:r)$_\sigma$			1W			L	1W
e. ˈ(ħa)$_\sigma$ (gark)$_\sigma$ ˈ(bi:r)$_\sigma$				1W		L	1W
f. ˈ(ħa)$_\sigma$ (gar)$_\sigma$ ˈ(kbi:r)$_\sigma$					1W	L	1W

From the input /ˈ(ħa)$_\sigma$ (gar)$_\sigma$ (ki)$_\sigma$ ˈ(bi:r)$_\sigma$/ the candidate set (a, b, c, d, e, f, …) is derived. The candidate ˈ*(ħa)$_\sigma$ (gar)$_\sigma$ (ki)$_\sigma$ˈ (bi:r)$_\sigma$* (a) identical to the input wins, since the candidates (b-f) are all filtered out by the undominated constraints that dominate WEAK < *i*, which the optimal candidate vacuously violates. The fact that candidates (e) and (f) violate NO-COMP-CODA and NO-COMP-ONSET respectively explains why the candidate (a) that does not undergo WEAK < *i* wins. In short, the simultaneous application of syncope and resyllabification in a single step guarantees the derivation of the expected surface form.

However, it is quite natural that resyllabification should operate independently after a phonological process has changed syllable structure. Hence, the two constraints responsible for syncope and resyllabification must apply in a sequential fashion.

We may construct the NDP tableau that will replace the HS tableaux in (13-14). In NDP the C-pair WEAK < *i* » MAX (V) and the unpaired constraint RESYLLABIFICATION are required. And the E-constraint *CCC on WEAK < *i* is required to rule out the wrong candidate with three-consonant cluster that WEAK < *i* may yield.

(15) Tableau for the Cairene Syncope in NDP

	*CCC	WEAK < *i* » MAX (V)	RESYLLABIFICATION
a. /wiħiʃ-a/			
1. ˈwiħʃ-a		√	
2. → ˈ(wiħ)$_\sigma$ (ʃ-a)$_\sigma$			√
b. /ħagar kibi:r/			
1. ˈħagar kˈbi:r	*	√	
2. → ˈ(ħa)$_\sigma$ (gar)$_\sigma$ (ki)$_\sigma$ ˈ(bi:r)$_\sigma$			√

In (a), WEAK < *i* derives [1], feeding RESYLLABIFICATION. Fed RESYLLABIFICATION derives [2]. In (b), WEAK < *i* derives [1], which violates the E-constraint *CCC. Hence, RESYLLABIFICATION derives [2] from the underlying representation in such a way that the E-constraint *CCC is not violated. The universal ranking principle AMP directs the constraints to derive the expected surface forms with the aid of an E-constraint.

Yawelmani provides the case almost parallel to that of the Cairene syncope. Examine the following examples (Kenstowicz & Kisseberth 1977, 1979, McCarthy 2008, Lee 2009b):

(16) Final Vowel Deletion in Yawelmani
   a. /taxa:-k'a/ → [taxa-k'] 'bring!'
      /taxa:-mi/ → [taxam] 'having brought'
   b. /xat-k'a/ → [xat-k'a] (*[xat-k']) 'eat!'
      /xat-mi/ → [xat-mi] (*[xat-m]) 'having eaten'

The process that deletes the word-final vowel and the process that shortens the three-mora syllable are responsible for the forms in (a).[5] But the word-final vowel of the forms in (b) must not be deleted, since the deletion would yield the impermissible two-consonant cluster word-finally.

We can construct the HS tableaux almost parallel to those in (13-14) for the forms in (16). The HS tableaux for a form in (16a) will now be constructed; the only difference between this tableau and tableau (13) is that *V]$_{PW}$ takes the place of WEAK < *i*.

(17) Final Vowel Deletion in <…, ta.xa:-k'a, ta.xa-k'>

$(ta)_\sigma(xa:)_\sigma$-$(k'a)_\sigma$	PRS-SEG	HEAD (σ)	*NUC/CONS	*V]$_{PW}$	MAX-V
a. → $(ta)_\sigma(xa{:}k')_\sigma$					1
b. $(ta)_\sigma(xa:)_\sigma$-$(k'a)_\sigma$				1W	L
c. $(ta)_\sigma(xa:)_\sigma$-k'	1W				1
d. $(ta)_\sigma(xa:)_\sigma$-$(k'\_)_\sigma$		1W			1
e. $(ta)_\sigma(xa:)_\sigma$-$(\underset{|}{k}')_\sigma$			1W		1

The candidate set (a, b, c, d, e, …) is derived from the input /$(ta)_\sigma(xa:)_\sigma$-$(k'a)_\sigma$/. The resyllabified candidate *$(ta)_\sigma(xa{:}k')_\sigma$* (a) that violates the lowest-ranked MAX-V wins, since the candidates (b-e) are all ruled out by the outranking constraints.

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[5] The coda consonant is assigned a mora in Yawelmani (see Lee 2009b).

As the three-mora syllable of the winner in (17) must be shortened, the ranking $*[\mu\mu\mu]_\sigma$ » MAX (μ) is required. Consequently, the tableau for step 2, where this ranking participates, must be constructed.

Examine the following additional examples, where the process of vowel shortening interacts with the process for vowel lowering:

(18) a. /mi:k'-hin /→ me:k'-hin → [mek'-hin] (nonfuture) 'swallow'
b. /ʔili:-ʔ/ → [ʔili-ʔ] (future) 'fan'

Besides the ranking $*[\mu\mu\mu]_\sigma$ » MAX (μ), the ranking $*[V_{\mu\mu}$,+high] » IDENT (high) is required for the lowering of the long high vowel. For the form in (a) $*[V_{\mu\mu}$,+high] must apply before $*[\mu\mu\mu]_\sigma$ and for the form in (b) the latter must apply before the former. The problem is how to graft these contradictory rankings on the constraint hierarchy employed in (17).

The situation is complicated even further by such forms as the following: /ʔilk-k'a/ → [ʔilik-k'a] 'sing!'. The SD's of the two NO-related constraints $*V]_{PW}$ and the constraint responsible for *i*-epenthesis meet the underlying representation simultaneously. Confronted with this form, we are at a loss which to apply first, the constraint $*V]_{PW}$ or the constraint responsible for *i*-epenthesis.

Without further argument we may construct the tableau for the cited Yawelmani forms in NDP (see Lee 2009b for details). Besides the C-pairs corresponding to the rankings introduced above, the C-pair $*V]_{PW}$ » MAX (V) is required, and the C-pair $*CC\{C,]_{PW}\}$ » DEP (i) epenthesizes the high vowel *i* in the context C _____ $C\{C,]_{PW}\}$. And the markedness constraint $*CC\{C,]_{PW}\}$ serves as the E-constraint on $*V]_{PW}$ to rule out the wrong outputs that $*V]_{PW}$ may derive.[6]

[6] This E-constraint is reminiscent of the output constraint proposed by Kisseberth (1970), difference being that the latter has blocking effects.

(19) Tableau for the Yawelmani Forms in NDP (N = N-ranked, M = M-fed)

	*CC{C,]PW}	*V]PW	*[$V_{\mu\mu}$,+high]	*[μμμ]σ	*CC{C,]PW}
a. /taxa:-k'a/					
1. taxa:-k'		√			
2. → taxa-k'				√	
b. /xat-k'a/					
0. → xat-k'a					
1. xat-k'	*	√			
c. /ʔilk-k'a/					
1. ʔilik-k'	*	√			√
2. → ʔilik-k'a					√
d. /mi:k'-hin/					
1. me:k'-hin			√	M	
2. → mek'-hin				√	
e. /ʔili:-ʔ/					
1. → ʔili-ʔ			N	√	

In (a), *V]PW derives [1], feeding *[μμμ]σ, and fed *[μμμ]σ derives [2]. In (b), *V]PW derives [1], but it violates the E-constraint *CC{C,]PW}. In (c), *V]PW and *CC{C,]PW} NO-derive [1] according to AMP, but it violates the E-constraint *CC{C,]PW}. *CC{C,]PW} thus derives [2] from the underlying representation. In (d), N-ranked *[$V_{\mu\mu}$, +high] derives [1], M-feeding N-ranked *[μμμ]σ, in accordance with the natural ranking NRP » MFP. *[$V_{\mu\mu}$, +high] M-feeds *[μμμ]σ, since it can derive the candidate *me:k'-hin* with the structure *e:k'* from the candidate /mi:k'-hin/ with the structure *i:k'*, where the structure *i:k'* and the structure *e:k'* are identical except the change to be made by *[$V_{\mu\mu}$, +high] (i.e., i: → e:), and both the structure *i:k'* and the structure *e:k'* meet the SD of *[μμμ]σ. M-fed *[μμμ]σ derives the surface form. In (e), AMP-ranked *[μμμ]σ derives [1], overriding N-ranked *[$V_{\mu\mu}$, +high], in agreement with the natural ranking NRP » AMP.

Subtableaux (19d-e) furnish a good illustration of how the natural rankings of URP's direct the same constraints to operate differently. In subtableau (19d) *[$V_{\mu\mu}$, +high] and *[μμμ]σ that are to be N-ranked are ranked in accordance with the natural ranking NRP » MFP, while in subtableau (19e) N-ranked *[$V_{\mu\mu}$, +high] is overridden by AMP-ranked *[μμμ]σ in accordance with the natural ranking NRP » AMP.

In Cairene Arabic two constraints one of which performs faithful operation must operate simultaneously in a single step despite GEN's basic limitation to "doing one thing at a time" in HS. But it is perfectly natural that even "faithful" RESYLLABIFICATION should operate independently. And we encounter insuperable difficulties in constructing the HS tableaux for the Yawelmani case parallel to the Cairene case. Alternatively, the Yawelmani case is effectively dealt with in the tableau (19) constructed in NDP.

5. Diola Fogny

McCarthy (2010) cites examples from the West African language Diola Fogny to illustrate how HS works. In Diola Fogny a consonant is deleted in the context ______ (#) C. Note that two consonants are deleted in the last form in the following examples:

(20) Consonant Deletion in Diola Fogny

/udʒuk-dʒa/ → [u.dʒu.dʒa] 'if you see'
/let-ku-dʒaw/ → [le.ku.dʒaw] 'they won't go'
/e-rent-rent/ → [e.re.rent] 'it is light'

Let us now look at how McCarthy constructs the tableaux for the derivation of the last form in (20) within the framework of HS:

(21) Derivation of /e-rent-rent/ → [e.re.rent] in Diola Fogny in HS

Step 1: Consonant Deletion

/e-rent-rent/	DEP	PARSE	MAX
a. → $(e)_\sigma$ $(re)_\sigma$ n $(rent)_\sigma$		1	1
b. $(e)_\sigma$ $(re)_\sigma$ nt $(rent)_\sigma$		2W	L
c. $(e)_\sigma$ $(re)_\sigma$ $(nit)_\sigma$ $(rent)_\sigma$	1W	L	L

Step 2: Consonant Deletion

$(e)_\sigma$ $(re)_\sigma$ n $(rent)_\sigma$	DEP	PARSE	MAX
a. → $(e)_\sigma$ $(re)_\sigma$ $(rent)_\sigma$			1
b. $(e)_\sigma$ $(re)_\sigma$ n $(rent)_\sigma$		1W	L
c. $(e)_\sigma$ $(re)_\sigma$ $(ni)_\sigma$ $(rent)_\sigma$	1W	L	L

Step 3: Convergence

(e)$_{\sigma}$ (re)$_{\sigma}$ (rent)$_{\sigma}$	DEP	PARSE	MAX
a. → (e)$_{\sigma}$ (re)$_{\sigma}$ (rent)$_{\sigma}$			
b. (e)$_{\sigma}$ (re)$_{\sigma}$ (ren)$_{\sigma}$			1W

At step 1, the winner [(e)$_{\sigma}$ (re)$_{\sigma}$ n (rent)$_{\sigma}$] is chosen.[7] At step 2, the winner [(e)$_{\sigma}$ (re)$_{\sigma}$ n (rent)$_{\sigma}$] becomes the input, and the winner [(e)$_{\sigma}$ (re)$_{\sigma}$ (rent)$_{\sigma}$] is chosen. At step 3, the winner [(e)$_{\sigma}$ (re)$_{\sigma}$ n (rent)$_{\sigma}$] becomes the input. Here the winner [(e)$_{\sigma}$ (re)$_{\sigma}$ (rent)$_{\sigma}$] converges with that at step 2, making the surface form chosen. As is observed, the derivation of [e.re.rent] from /e-rent-rent/ seems to be impeccable. However, this derivation will be proven to be quite an oversimplified picture of what is really going on.

In order to get a better perspective on the consonant deletion in Diola Fogny I will reproduce what is discussed in Lee (2009c). We must take into account the following enriched data (Sapir 1965, Kiparsky 1973, Kenstowicz 1994). Especially compare the forms in (a) with those in (b-e).

(22) Nasal Consonant Assimilation and Consonant Deletion in Diola Fogny

a. Nasal Consonant Assimilation

/ni-maŋ-RED/ → [ni-mam-maŋ] ‘I want’
/pan-ji-maɲj/ → [paɲ-ji-maɲj] ‘you (pl.) will know’
/najum#tɔ/ → [najun#tɔ] ‘he stopped there’

b. Nasal Consonant Deletion

/na-laɲ-RED/ → [na-laϕ-laɲ] ‘he returned’
/na-yɔkɛn-RED/ → [na-yɔkɛϕ-yɔkɛn] ‘he tires’
/na-waɲ-a:m-RED/ → [na-waɲ-a:ϕ-waɲ] ‘he cultivated for me’

c. Non-Nasal Consonant Deletion

/ujuk-ja/ → [ujuϕ-ja] ‘if you see’
/lɛt-ku-jaw/ → [lɛϕ-ku-jaw] ‘they won’t go’
/kutɛb#sinaŋas/ → [kutɛϕ#sinaŋas] ‘they carried the food’

d. ‘Iterative’ Consonant Deletion

/ɛ-rɛnt-RED/ → [ɛ-rɛϕϕ-rɛnt] ‘it is light’
/na-maɲj-RED/ → [na-maϕϕ-maɲj] ‘he knows’

7 McCarthy footnotes that the prior deletion of *t* is arbitrary.

e. Miscellaneous

/takun-mbi…/ → [takuϕ-mbi…]   ‘he must not...’

/ban#ɲa/ → [baϕ#ɲa] (*[baɲ#ɲa])   ‘finish now’

The consonant that persists in the context _____ (#) C is limited to the first member of the geminate nasal and the nasal consonant homorganic with the following consonant, as is observed in (a). These nasal consonants are derived by the rule of nasal assimilation. They survive the application of the rule in charge of deleting consonants, whereas the forms in (b-e) are subject to it. This is practically tantamount to deleting the consonant that is not produced by the rule of nasal assimilation. The rule of consonant deletion must thus be disjunctive with the rule of nasal assimilation in accordance with the following Elsewhere Condition proposed in Kiparsky (1973):

(23) The Elsewhere Condition

Two adjacent rules of the form

A → B /P _____ Q

C→ D /R _____ S

are disjunctively ordered if and only if

(a) the set of strings that fit PAQ is a subset of the set of strings that fit RCS, and

(b) the structural changes of the two rules are either identical or incompatible.

The rules formulated in Kiparsky (1973) will now be introduced. He states the rule equivalent to that given below for the phenomenon of nasal assimilation observed in the forms in (22a):

(24) Rule of Nasal Assimilation in Diola Fogny

[C, +nas] → [α place] / _____ {[C, +nas, α place], (#) [-son, α place]}

This rule requires that the nasal consonant be assimilated in place of articulation to the following nasal consonant, or to the following obstruent with an optional word boundary intervening. Besides, he states the following deletion rules:

(25) Deletion Rules in Diola Fogny

a. C → ϕ / _____ + (#) C (under Elsewhere Condition)

b. C → ϕ / _____ + CC

The environment of rule (a) is simplified owing to the Elsewhere Condition that enjoins it to apply disjunctively with rule (24).

The rules introduced above can be stated as C-pairs in NDP. Rule (24) is transformed into the following C-pair:

(26) C-Pair for Nasal Assimilation in Diola Fogny[8]

*$\mathbf{N}${N, (#) [C, -son]} (NA) » IDENT (PL)

The markedness constraint NA expands to ***N** (#) [C, -son] and ***N**N. And rule (25a) is stated as the following C-pair:

(27) C-pair for Rule (25a)

***C** (#) C (C-DEL) » MAX

Rule (25b) is stated as the C-pair ***C**CC (*COMPLEX) » MAX, which drops the consonant in the context _____CC. And the unpaired constraint C-RED is required that makes the reduplicative morpheme RED copy the preceding base.

The Elsewhere Condition that directs rule (25a) to apply disjunctively with the rule of nasal assimilation (24) must be replaced by the CFC on C-DEL, which corresponds to rule (25a), in NDP. C-DEL, an instantiation of M in the CFC schema, chooses (a) from the CFC schema by default, constituting the CFC on itself. The CFC on C-DEL requires that C-DEL not apply to derived structure. The environment of C-DEL is simplified due to the CFC on itself as in the corresponding rule (25a).

In Kiparsky (1973), in addition, the vacuous application of a rule is counted as an authentic application in order to invoke the Elsewhere Condition. On the basis of this fact a universal ranking principle is established:

(28) Vacuous Application Principle (VAP)

Apply M vacuously.

Definition: M applies vacuously if it applies causing no structural change.

Condition: M ranked according to VAP must feed another M.

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[8] 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.

The constraint ranked according to VAP is said to be V-ranked. The V-ranked constraint overrides other constraints in accordance with the natural ranking VAP » NRP » MFP » AMP. The satisfaction mark enclosed with square brackets represents the vacuous application of a constraint.

At length the derivations of the forms in (22) are illustrated in the following tableau. We can compare the HS tableaux in (21) and the NDP subtableau (d).

(29) Tableau for the (21) Forms in Diola Fogny in NDP

	CFC	C-RED	*COMPLEX » MAX	NA » IDENT (PL)	C-DEL » MAX
a. /ni-maŋ-RED/					
1. ni-maŋ-maŋ		√			
2. → ni-mam-maŋ				√	M
3. ni-maϕ-maŋ	*				√
b. /na-laɲ-RED/					
1. na-laɲ-laɲ		√			
2. → na-laϕ-laɲ					√
c. /lɛt-ku-jaw/					
1. → lɛϕ-ku-jaw					√
d. /ɛ-rɛnt-RED/					
1. ɛ-rɛnt-RED				[√]	N
2. ɛ-rɛnt-rɛnt		√			N
3. ɛ-rɛnt-rɛnt				[√]	NN
4. → ɛ-rɛϕϕ-rɛnt			√		√N
5. ɛ-rɛϕϕ-rɛϕt	*				√
e. /na-maɲj-RED/					
1. na-maɲj-RED				[√]	N
2. na-maɲj-maɲj		√			N
3. na-maɲj-maɲj				[√]	NN
4. → na-maϕϕ-maɲj			√		√N
5. na-maϕϕ-maϕj	*				√
f. /najum#tɔ/					
1. najun#tɔ				√	M
2. → najuϕ#tɔ	*				√
g. /takun-mbi…/					

1. takun-mbi…				[√]	N
2. takum-mbi…			M	√	NM
3. takuϕ-mbi…	*!				√N
3. → takuϕ-mbi…			√		N
4. takuϕ-ϕbi…	*				√
h. /ban#ɲa/					
1. → baϕ#ɲa					√
	CFC	C-RED	*COMPLEX » MAX	NA » IDENT (PL)	C-DEL » MAX

C-RED derives [1] in (a-b) and [2] in (d-e); furthermore, in (d-e), it overrides N-ranked C-DEL in accordance with the natural ranking NRP » AMP. NA derives [2] in (a) and [1] in (f), M-feeding C-DEL, in accordance with the natural ranking MFP » AMP. In (a, f), the last candidate violates CFC, since C-DEL applies to the structure derived (by NA). In (b-c), C-DEL derives the surface form without violating CFC, since it applies to the non-derived structure. In (d-e), V-ranked NA derives [1] vacuously according to VAP, overriding N-ranked C-DEL and AMP-ranked C-RED, in accordance with the natural ranking VAP » NRP » AMP. V-ranked NA derives [3] vacuously according to VAP too, overriding the two N-ranked instantiations of C-DEL. The two O-related constraints *COMPLEX and C-DEL O-derive [4] according to AMP, overriding N-ranked C-DEL. N-ranked C-DEL derives [5], but it violates CFC, since it applies to the structure derived (vacuously by NA in [3]). In (g), V-ranked NA derives [1], applying to the intramorphemic sequence *mb* vacuously, overriding N-ranked C-DEL that may apply to the same sequence *mb*, AMP-ranked *COMPLEX, AMP-ranked NA that may apply to the sequence *n-m* and AMP-ranked C-DEL that may apply to the same sequence *n-m*, in accordance with the natural ranking VAP » NRP » AMP. AMP-ranked NA derives [2], overriding N-ranked C-DEL and M-feeding *COMPLEX and C-DEL that may apply to the structure *n-m*. The AMP-ranked constraints C-DEL and *COMPLEX constitute MCR's in compliance with C-on-U, overriding N-ranked C-DEL. C-DEL that derives the loser is M_E, it is O-related with *COMPLEX that derives the winner, and they are ranked according to the same URP (i.e., AMP); hence, they are qualified to be M_O's, being able to construct MCR's in accordance with C-on-U. The loser violates CFC, since C-DEL applies to the structure derived (by NA). The winner derived by *COMPLEX does not violate CFC, which constrains only C-DEL. Note that two different constraints derive the same candidate in the same MCR's. N-ranked C-DEL derives [4] from the winner in MCR's, but it violates CFC, since it applies to the structure derived (vacuously by NA in [1]). In (h), the underlying representation does not meet the SD of NA; hence, the stem-final *n* is legally deleted by C-DEL. If the archiphoneme /N/ is posited in (d-e, g) (as in /ɛ-rɛNt-RED/ (d), /na-maNj-RED/ (e), and /takun-Nbi…/ (g)), NA will apply non-vacuously, and the constraints will apply *mutatis mutandis*, giving rise to the same correct surface forms. And even if the reduplicative morpheme RED is placed before the base in the underlying representations, the result will be the same.

To sum up, the derivation of /e-rent-rent/ → [e.re.rent] in the HS tableaux in (21) entirely ignores its interconnectedness with other derivations exemplified in the tableau (29) constructed in NDP. The facts brought into relief by the data presented in (22) and the tableau for them teach us that the phenomenon of consonant deletion in Diola Fogny is a process not to be lightly treated as in constructing the HS tableaux in (21).

6. Conclusion

It has been demonstrated that Harmonic Serialism is inadequate for the purpose intended. The "invariant" requirement of the constraint hierarchy cannot be easily fulfilled in the Arabic HS tableaux. The Makassarese case similar to the Arabic case produces a perplexing situation. Despite the limitation of HS's GEN to "doing one thing at a time" two constraints one of which is a "faithful" constraint must operate simultaneously in a single step in the HS tableau for Cairene Arabic. But the corresponding NDP tableau proves that the contrary is the case. Serious shortcomings are pointed out in the HS tableaux to be constructed for the Yawelmani case analogous to the Cairene Arabic case. Finally, the lesson we learn from the HS tableaux in (21) for Diola Fogny is that we must not ignore a greater whole in the interest of a fragment.

The analyses made in HS have been reinterpreted in NDP. In NDP, constraints have only to apply in compliance with URP's, permitting E-constraints to filter out the wrong outputs they may yield.

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