The Strict Cycle Condition in Stratal OT

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Abstract

In this paper, I argue that the phonological phenomena traditionally attributed to the Strict Cycle Condition (henceforth SCC, Kean 1974, Mascaró 1976) are better understood as the result of ranked and violable constraints in Stratal Optimality Theory.[1]

1. Introduction

A simple example of a potential SCC effect is hiatus resolution in Emai where a word-final vowel is deleted if it is followed by a vowel-initial word (e.g. /kɔ/ 'plant' +/ema/ 'yam' → [kema], Casali 1997:513). This could be captured by a Phrase-Level rule as in (1):

(1) V → Ø /__V

Word-internal hiatus is not repaired in the same way. Thus the noun [oa] 'house' apparently surfaces as such in isolation (not as *[o]) and in contexts where it triggers vowel deletion across words (e.g., /ɔli/ 'the' +/oa/ 'house' → [ɔloa], Casali 1997:512). This asymmetry could be captured in a stratal model of phonology with three stratal domains (Stem Level, Word Level, and Phrase Level) and no stratum-internal cycles by a condition as in (2):

(2) *Strict Cycle Condition:* A phonological process in a given stratal domain *S* applies if and only if its focus and context match material not exclusively contained in a single stratal domain embedded in *S*.

Under the standard assumptions that internal brackets of a stratum are deleted at the point when computation enters a subsequent stratum, at the Phrase Level

[1] I will not address here SCC effects where other phonological processes in a given cycle license the application of an SCC-bound alternation, as predicted by the version of the SCC advocated in Mascaró (1976). See Gleim (2023) on different versions of the SCC proposed in the literature.

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the only embedded domains visible for SCC are the Word Level boundaries, as in (3):

(3) [[ɔli]$_{\text{Word Level}}$ [oa]$_{\text{Word Level}}$]$_{\text{Phrase Level}}$

Thus (3) correctly predicts that rule (1) is not applied to the string **oa** since both the focus and the context V of the rule are contained in a Word Level domain. On the other hand, (1) applies to the string **io** where **i** (matching the focus-V) is contained in one embedded domain and **o** (matching the context-V) in a different embedded domain (see section 5.2 for an alternative analysis).

The SCC can also be applied to word-internal processes. Thus it is well-known that front vowels in Finnish trigger spirantization ('assibilation') on preceding coronal stops as in (4a). However this happens only across morpheme boundaries (4b):

(4) *Assibilation in Finnish* (Kiparsky 1993)

a.	/halut-i/	→	[halusi]	'want-PAST'
	/halut-a/	→	[haluta]	'want-INF'
b.	/koti/	→	[koti], *[kosi]	'home'

This asymmetry could be captured by (2) under the assumption that bare roots are Stem-Level domains in a SOT architecture whereas Assibilation applies at the Word Level:

(5) a. [[halut]$_{\text{Stem Level}}$ i]$_{\text{Word Level}}$ b. [[koti]$_{\text{Stem Level}}$]$_{\text{Word Level}}$

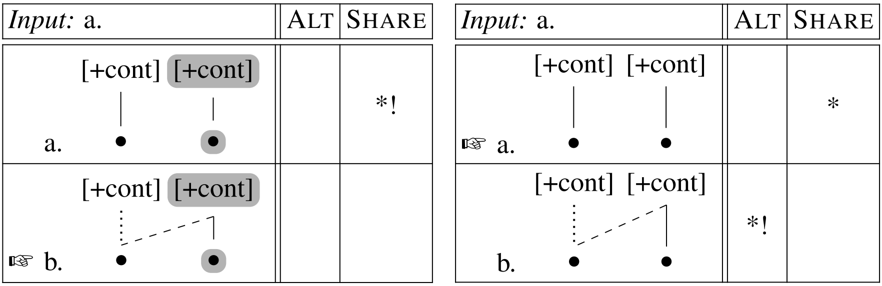
The alternative to a general unviolable SCC I will advocate here following van Oostendorp (2008) is that apparent SCC effects follow from specific constraints sensitive to morphological colors.

van Oostendorp's crucial observation is that most cases of SCC effect involve feature spreading, and as pointed out by Wolf (2008:329) this holds also for Finnish assibilation which might be interpreted as spreading of [+continuant] from a high front vowel to a left-adjacent [t].
High-ranked ALTERNATION as defined in (6) would block this process morpheme-internally (e.g. in [koti]) since the [+cont] feature of [i] and the root node of [t] have the same morphological color, and spreading would mean that an epenthetic association line links them.

(6) ALTERNATION: If an association line links two elements of color α, the line should also have color α. (van Oostendorp, 2007:16)

Ranked above the relevant constraint triggering spreading (here: SHARE), this predicts assibilation across a morpheme boundary (7a), but not inside a morpheme (7b) (see below on the encoding of morphemes by color/background shading):

(7) *Finnish Assibilation*



There are both conceptual and empirical reasons to assume that SCC effects are due to specific violable constraints and not to a general inviolable convention. Conceptually there doesn't seem to be a natural way to implement the idea that a process must involve new material in OT. This is because OT lacks a reified notion of process (which are largely equivalent in rule-based phonology where a rule typically captures a process). Consider again the case of Emai. Vowel deletion is an operation of GEN, but vowel deletion by itself (i.e., viewed independently from its trigger) doesn't happen in any reasonable sense across morpheme or word boundaries. It is always the vowel of a single morpheme (and word) which is deleted. One might consider requiring that a general SCC convention should restrict the application not of processes, but of markedness constraints triggering them. However, under the standard assumption that vowel deletion under hiatus is due to the constraint ONSET, this also would not work out for Emai since the relevant ONSET at a word/morpheme boundary as in [ebe ɔna] would also be restricted to a single word/morpheme (the syllable containing [ɔ]).

Empirically, there are many obvious violations of the SCC. An especially well-documented case is American English flapping which changes intervocalic coronal stops after stressed vowels into flaps:

(8) *American English flapping (Kenstowicz 1994:195)*

a. á[ɾ]om cf. a[t]óm-ic c. whát[ɾ] is wrong? cf. whá[t]
b. méé[ɾ]ting cf. méét[t]

Flapping happens across word boundaries, as shown by (8c), hence must be phrasal, but also happens inside single words/morphemes (8a,b), which would violate the SCC if it is a Phrase Level process.

Another case is Arabic vowel insertion which breaks up consonant clusters. It is clearly a phrasal process since it can be bled by a following vowel-initial word, but it applies in single isolated words:

(9) *Arabic vowel insertion: /fihm/ 'understanding' (Kiparsky 2000:352)*

a. fíhm il-wálad 'the boy's understanding'
b. fíhim 'understanding'
c. fíhimna 'our understanding'

A tonal example is Jita where an underlying H-tone shifts to a following syllable (10c). Again, this must be a phrasal process because it applies across word boundaries (11a,b) and is barred from applying to phrase-final positions (10b). At the same time it can apply in single words as in (10c):

(10) *Jita tone shift (Downing 2014:103)*

a. /oku-ljá/ [oku-ljá] 'to eat'
b. /oku-βóna/ [oku-βóna] 'to see'
c. /oku-βón-an-a/ [oku-βon-án-na] 'to see each other'

(11) *Jita tone shift (Downing 2014:103)*

a. [oku-βóna iiɲoɲi] 'to see a bird'
(cf. [oku-βóna] 'to see'; iiɲoɲi 'bird'
b. [oku-lja múnó] 'to eat a lot'
(cf. [oku-ljá] 't eat'; munó 'a lot'

Now it is well-known and virtually universally acknowledged in the phonological literature that the SCC cannot be an unconditional restriction on all phonological processes. The general research strategy in Lexical Phonology has been to define a class of processes that are universally subject to the SCC and a complement class that is not. (12) lists the most important hypotheses pursued in this tradition:

(12) *Potential criteria for SCC compliance*

SCC-compliant	*SCC-non-compliant*
a. lexical phonology	postlexical phonology
b. neutralizing/phonemic	allophonic/non-phonemic
c. structure-changing	structure-building
d. cyclic	non-cyclic

Kiparsky (1993) provides a general refutation of most of these claims, and we have already seen some other counterexamples. Thus Emai is a bona fide case of a phrasal phonological process which is SCC-compliant counter to (12a). Vowel epenthesis in Arabic is neutralizing and non-allophonic violating (12b). The Finnish coalescence process discussed by Kiparsky (1993) is clearly structure-changing and cyclic but not subject to the SCC (violating (12c) and (12d)). Note also that in the version of Stratal OT adopted here there is no stratum-internal cyclicity, hence there is no distinction between cyclic and non-cyclic processes.

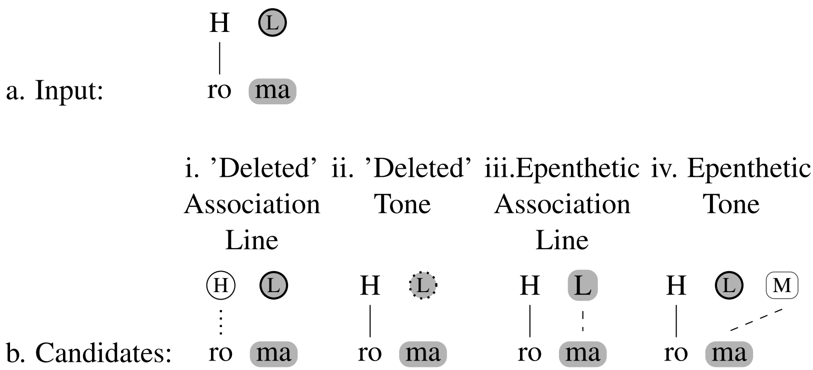
2. Theoretical Background

I will adopt a substantially restricted implementation of Optimality Theory – Colored Containment Theory – and a minimal version of Stratal Optimality Theory which only comprises three strata: Stem, Word, and Phrase Level (following Bermúdez-Otero 2018, pace Kiparsky 1982, Rubach 2011).

Colored Containment Theory (Revithiadou 2007, van Oostendorp 2008, Trommer 2011, Paschen 2018) is a conservative extension of the original implementation of OT in Prince and Smolensky (1993) with a more limited set of possible structural changes than Correspondence Theory – restricting them basically to insertion and marking for non-pronunciation – and principled modularity restrictions on the phonology-morphology interface. Crucially, the theory limits access of phonology to morphosyntactic information to 'colors', an encoding of morphemic affiliation, especially useful for autosegmental representations, which I illustrate with a toy example in (13). Thus in the structure in (13a), color (realized here graphically by background shading) identifies the floating Low-tone as part of the same morpheme as the syllable

[ma] (and distinct from [ro] and its H-tone) with a different color, even though they do not form a coherent phonological object, a fact which would be difficult to capture by morpheme boundaries. The second crucial function of color is to distinguish underlying (= morphological = colored) and epenthetic (= non-underlying = colorless) material. Thus the notation used here for the lack of morphological colors, dashing of association lines as in (13b-iii,iv) and boxes for tones (13iv), directly encodes their status as epenthetic material in output representations. The Containment Requirement of the theory states that input structure can never be literally deleted in possible outputs. The representation of deletion is instead by diacritically marking parts of the input as phonetically invisible, graphically indicated by dotting of association lines (13b-i), and circles for floating tones (13b-ii). Crucially, there is no candidate where tones (or segments) would be literally removed from possible output representations. Thus inputs and then changes performed by GEN are fully reconstructable from outputs, obviating input-out comparisons and indices as in Correspondence Theory. Hence, (13b) illustrates *all* possible tonal changes to the input candidate in (13a). Besides full deletion of a tone, changing a tone (say from High to Low), splitting a tone, or tone metathesis are in principle excluded.

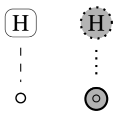
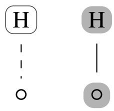
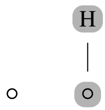
(13) *Autosegmental representations in Colored Containment Theory*



Containment allows optimality-theoretic markedness constraints to still access structure which is floating or marked as phonetically invisible.

This is illustrated in (14) with a constraint which plays an important role in the analysis of dissimilation effects in section 4.1, the ban on adjacent identical melody tones, a version of the well-known Obligatory Contour Principle (Leben 1973, Myers 1997). The general version is abbreviated as OCP τ and its phonetic clone as OCP τ. The input representation (14c) violates neither constraint, whereas (14b), where a melody-H is inserted to associate to the unspecified tonal root node violates both. The crucial contrast between the two versions of the constraint emerges in (14a) where the second tone and its root node are 'deleted' (rendered phonetically invisible). Since the second melody-H is invisible for the phonetic constraint version OCP τ, this is not violated here. In contrast, the generalized constraint clone OCP τ evaluates the full phonological representation and is hence violated by (14a), just like by the visible tone in (14b).

(14) *Phonetic and general constraints: The OCP for melody tones*

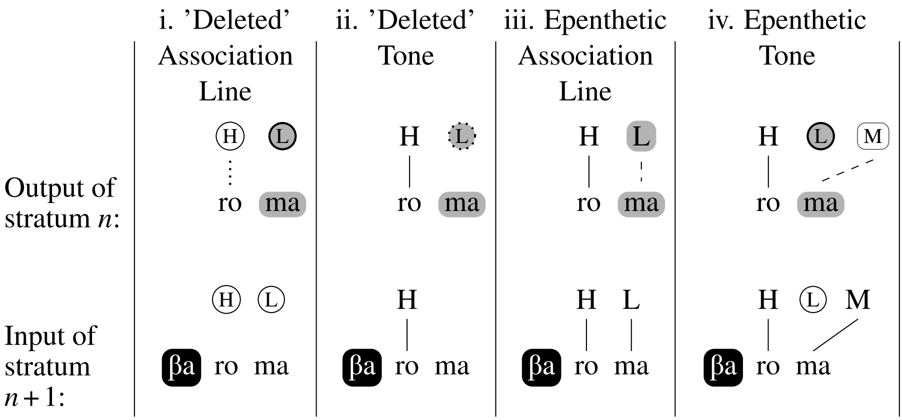
Input: c.	OCP τ	OCP τ
a. 		*
b. 	*	*
c. 		

Generalized and phonetic constraint versions will also play a crucial role for Klamath in section 5.3 below.

In contrast to early work in Colored Containment which assumes a single parallel evaluation cycle (van Oostendorp 2005, Revithiadou 2007), I integrate the theory here into **Stratal Optimality Theory** (Kiparsky 2000, Bermúdez-Otero 2018). This raises the question what happens at the transition from one stratum to the next. I assume that there are two natural, but significant processes illustrated with the toy examples from (14b) in (15), assuming that the next stratum adds a new morpheme, [βa]. *Cleanup* removes all material which is marked as phonetically invisible such as the association line in (i) and the Low-tone in (ii) from the representation. This means that

Containment holds for the optimality-theoretic evaluation at a single stratum, but not globally across strata. *Monochromization* assigns a uniform color to all material which is the result of an evaluation at a previous stratum. Thus the two morphemes and the epenthetic Mid tone (and its association line), which can all be differentiated in their morphological status in (15iv) at the output of Stratum n all acquire the same color (i..e, behave representationally as a single morpheme) as the input of the next stratum $n+1$ in contrast to [βa] which didn't participate in the earlier evaluation cycle. Monochromization is thus the Colored Containment equivalent of Bracket Erasure in Lexical Phonology and other versions of Stratal OT (Pesetsky 1979, Kiparsky 1982).

(15) *Clean-up and Monochromization ("Bracket Erasure") between strata*



3. Reranking of ALTERNATION between Strata: Catalan

The following cases (as others in latter chapters) show that ALTERNATION must be ranked differently in different strata.

3.1. Catalan

In Catalan, unstressed high vowels after another vowel become glides. This happens across words and word-internally (16) but is blocked in specific cases word-internally (17):[2]

[2]The analysis here is based on the assumption that the descriptive generalizations made in Mascaró (1976) are correct. See Gleim (2023) for critical empirical discussion.

(16) *Catalan diphthongization (Kenstowicz 1994:206 after Mascaró 1976)*

a. [i,u] → [j,w] /V__ (in unstressed syllable

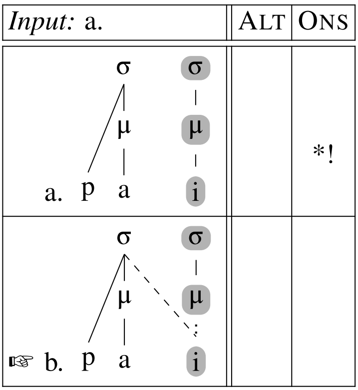
b. sál i pá	‘salt and bread’	pá j sál	‘bread and salt’
féř-u	‘iron’	dé-w	‘god’
férrous	‘iron’	əlʒəbrá-jk	‘algebraic’
		rej	‘king’

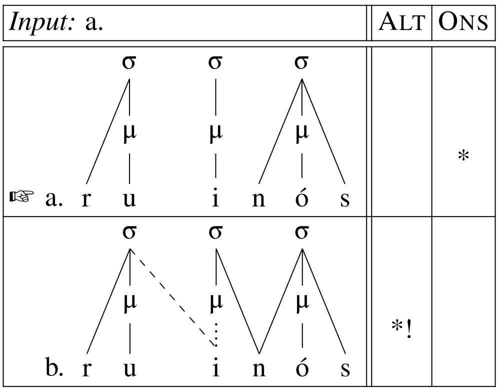
(17) *No word-internal diphthongization (Kenstowicz 1994:206*

a. rəím	‘grape’	rəim-ɛ́t	diminutive
b. ruín-ə	‘ruin’	ruin-ós	‘ruinous’

Again the blocking follows straightforwardly from ALTERNATION high-ranked at the Phrase Level:

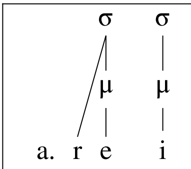
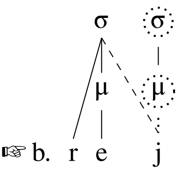
(18) *Catalan Phrase Level evaluations*

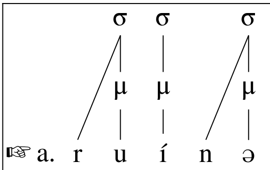
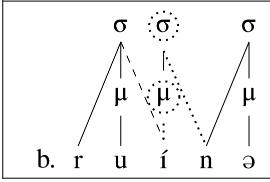




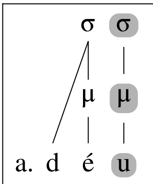
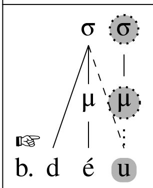
However, diphthongization may happen word-internally and even root-internally (as in [de-w] and [rej]). The decisive factor here is not ALTERNATION, but stress. An underlyingly stressed high vowel cannot glide (in (20ii) stress is represented graphically as an autosegmental grid mark to make explicit its underlying presence):

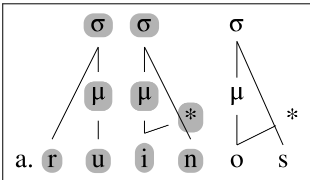
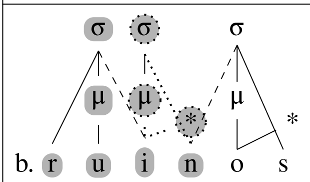
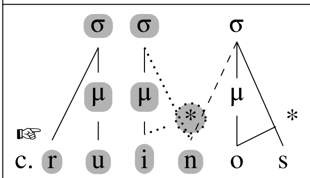
(19) *Catalan Word Level evaluations*

Input: a.	MAX V́	ONS	ALT
		*!	
			*

Input: a.	MAX V́	ONS	ALT
		*	
	*!		*

(20) *Catalan Word Level evaluations*

Input: a.	ALT	MAX V́	ONS
			*!
			

Input: a.	ALT	MAX V́	ONS
			**!
		*!	
			*

3.2. Kuria

Mora-counting tone in Kuria also nicely illustrates both SCC effects and their violability. The discussion here is based on the more detailed Stratal-OT analysis of these data in Trommer (2023).

Kuria expresses the Remote Future of verbs by imposing a High tone on the 3rd mora of the stem, as shown in (21) (this tone then spreads further rightwards postlexically):

(21) *Remote Future (μ3) (MMP:254) 'we will ... '*

a. 3μ-*Stems*:	n-to-re-[tɛrɛk-á̲]	'brew'
b. 4 μ-*Stems*	n-to-re-[teremé̲k-a]	'be calm'
	n-to-re-[karaáŋg-a]	'fry'
c. 5 μ-*Stems*	n-to-re-[koondó̲kór-a]	'uncover'
	n-to-re-[kiriɣí̲ít-a]	'scrub'
d. 6 μ-*Stems*	n-to-re-[hootó̲ótér-a]	'reassure'
	FOC-1PL-TAM-[√-FV]	

Following Trommer (2023) I capture this by the morphological melody Ⓛ Ⓛ Ⓗ, which associates left-to-right and one-by one to a tonally underspecified verb stem. This is shown in (22)

(22) *Kuria Stem Level (Remote Future/μ3)*

Input: a.	$^{*}{}_{L}\underline{\mu}_{H}$	τ ⊳ μ
a. tɛ rɛ ka (L L H unassociated)		**!*
b. tɛ rɛ ka (L–tɛ, L–rɛ, H–rɛ)	*!	
☞ d. tɛ rɛ ka (L–tɛ, L–rɛ, H–ka)		

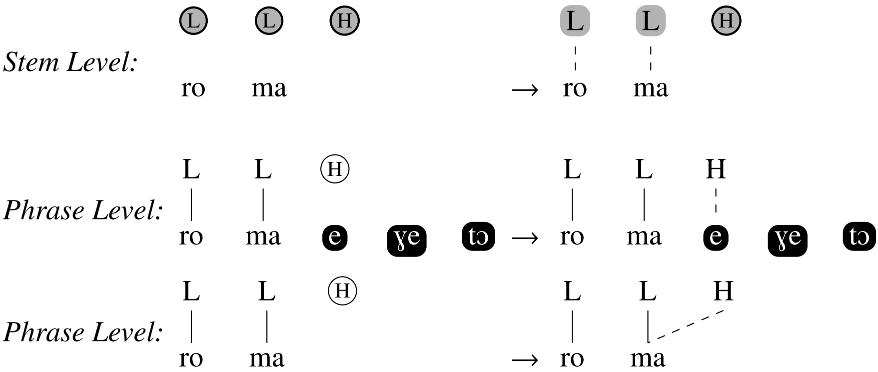
If the verb stem is shorter by one mora than the tone melody, there are different repairs depending on the phrasal context. For verbs which are followed by a direct object, the tone melody is realized on the combination of verb+object:

(23) *Remote Future μ3 on following object (MMP:259)*

a. n-to-re-[rj-a] eɣé̱tɔ́ɔ́kɛ
FOC-1PL-TAM-[eat-FV] banana
'we will eat a banana'

b. n-to-re-[rom-a] é̱ɣétɔ́ɔ́kɛ
FOC-1PL-TAM-[bite-FV] banana
'we will bite a banana'

(24)



On the other hand, if the verb is in phrase-final position, the H tone is realized on the verb itself:

(25) *Remote Future (μ3) (MMP:254) 'we will . . . '*

a. 1μ-*Stems*: n-to-re-[rj-a] 'eat'
n-to-re-[h-a] 'give'

b. 2μ-*Stems*: n-to-re-[rom-ǎ̱] 'bite'
n-to-re-[βun-ǎ̱] 'break'

The following tableaux show how this is derived in SOT. At the Stem Level, the final H remains floating to avoid a final contour:

(26) *Kuria Stem Level (Remote Future/μ3)*

Input: a.	$^{*}{}_{L}\underline{\mu}_{H}$	τ ⊳ μ
a. ro ma (Ⓛ Ⓛ Ⓗ)		**!*
b. ro ma (L L H)	*!	
☞ d. ro ma (L L Ⓗ)		*

At the Word Level, undominated ALTERNATION blocks association of the floating H to the tautomorphemic word-final mora:

(27) *Kuria Word Level (Remote Future/μ3)*

Input: a.	ALT	*ⓣ…]	$^{*}{}_{L}\underline{\mu}_{H}$	$^{*}{}_{L}\underline{\mu}_{L}$	τ ⊳ μ	MAX τ
☞ a. ro ma (L L Ⓗ)					*	
b. ro ma (L L H)	*!			*		
c. ro ma (L Ⓛ H)	*!	*				
d. ro ma (L L Ⓗ)					*	*!

In contrast at the Phrase Level, ALT is ranked below τ ⊳ μ, and the H finally associates:

(28) *Phrase Level (Remote Future/μ3)*

Input: a.	*ⓣ…]	$^{*}{}_{L}\mu_{L}$	MAX τ	τ ▷ μ	$^{*}{}_{L}\mu_{H}$
a. ro ma (L | ro, L | ma, Ⓗ floating)				*!	
b. ro ma (L | ro, Ⓛ ⋮ ma, H - - ma)	*!				
c. ro ma (L | ro, dotted-circle L ⋮ ma, H - - ma)			*!		
d. ro ma (L | ro, L | ma, dotted-circle H)			*!	*	
☞ e. ro ma (L | ro, L | ma, H - - ma)					*

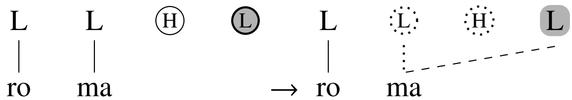
Thus again ALTERNATION must be ranked crucially differently at the Word and Phrase Level.

That the blocking of H-tone association at the Word Level is due to ALT and not to general faithfulness constraints protecting already associated tones is evident from the fact that affixal Word Level tones in fact associate to bases with already associated tones and overwrite them. Thus the L-tone suffix expressing negation in the Negative Remote Future replaces the associated H-tone on the last mora in (29):

(29) *Kuria (Negative) Remote Future (μ3) (Mwita 2008:198)*

	Remote Future	*Negative Remote Future₁*	
	'we will . . . '	'they will not . . . then'	
a. 1μ-*Stems*:	n-to-re-[rj-a]	βa-ta-re-[rj-à]	'eat'
b. 2μ-*Stems*:	n-to-re-[rom-ǎ]	βa-ta-re-[rom-à]	'bite'
c. 3μ-*Stems*:	n-to-re-[tɛrɛk-á]	βa-ta-re-[tɛrɛk-à]	'brew'
	FOC-1PL-TAM-[√-FV]	3PL-NEG-TAM-[√-FV]	

This is illustrated for (29b) in (30):

(30) 

Similarly, in the Inceptive and Immediate Past, Word Level H tone prefixes overwrite associated L stem tones (see Trommer 2023 for details).

4. Other Constraints on Color as SCC-Triggers

4.1. Tone Spreading and Dissimilation in Bari

Bari has two interacting processes, H-tone spreading, where a word-final High tone spreads to a following word-initial L-toned syllable and replaces its tone (31), and H-dissimilation where a word-initial H is replaced by L after a word-final High (32):

(31) *H-Spreading (Yokwe, 1986:208)*

a. ríp	'sawed'	+	dù.pà	'cradle'	→	ríp dú.pà
b. nín	'twisted'	+	gwàkà	'forked stick'	→	nín gwá.kà

(32) *H-Dissimilation (Yokwe, 1986:207)*

a. dók	'fetched'	+	kó.pò	'cup'	→	dók kò.pò
b. gwó	'kicked'	+	gú.rè	'dove'	→	gwó gù.rè

Derivationally speaking, H-deletion may feed H-Spreading, as shown by the examples in (33):

(33) *H-Dissimilation feeds H-Spreading (Yokwe, 1986:206)*

a.	dép	'held'	+	ké.ré	'gourd'	→	dép ké.rè
b.	kúr	'dug'	+	kí.dí	'well'	→	kúr kí.dì

Thus (33a) can be understood as first applying dissimilation (/dép ké.ré/ → dép kè.rè) and subsequently spreading (dép kè.rè → [dép ké.rè]). However with slightly different inputs H-Dissimilation applies without following H-Spreading:

(34) *H-Dissimilation counterfeeds H-Spreading . . .*

a.	dók	'fetched'	+	kó.pò	'cup'	→	dók kò.pò
b.	gwó	'kicked'	+	gú.rè	'dove'	→	gwó gù.rè

The crucial difference between (34) and (33) seems to be that in the cases in (34), H-spreading would restore the input pronunciation (/dók kó.pò/ → [dók kò.pò] → *[dók kó.pò]).

We are now in a position to turn to the relevance of Bari tone for SCC effects. Crucially, H-spreading does not happen word-internally:

(35) *No word-internal H-spreading* (Yokwe, 1986:126+129+130)

a.	dúlúr	'castor oil plant'	d.	bírìsì	'mat'
b.	bángìʔ	'marijuana'	e.	básàlà	'onion'
c.	wúrì	'cork'	f.	ng'únùmì	'whiskers'

Similarly, spread H-tone does not trigger word-internal dissimilation:

(36) *H-Spreading counterfeeds H-Dissimilation*

a.	tór	'tied'	+	bòn.gó	'dress'	→	tór bón.gó
b.	pák	'scared'	+	dì.rán	'birds'	→	pák dí.rán

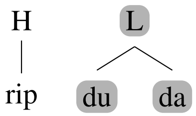
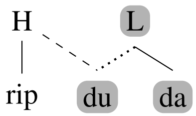
While we could attribute, the blocking of word-internal H-spreading to ALTERNATION, this wouldn't account for the blocking of dissimilation. Fortunately, there seems to be a single unifying principle behind both data. Specifically I propose that Bari tone shows the effect of the constraint in (37a):

(37)

a. [σ_H	Assign $*$ to every initial syllable in a prosodic word which is not the right edge of a morphological or phonetic H-tone span
b. OCP	Assign $*$ to every pair of adjacent H-tones in I
c. *ⓣ	Assign $*$ to every floating epenthetic tone
d. FAITH |	Assign $*$ to every epenthetic or deleted association line

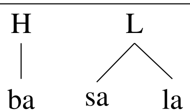
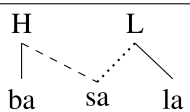
[σ_H triggers spreading across a word boundary:

(38) *H-Spreading*

Input: = a.	OCP	[σ_H	*ⓣ	FAITH |
a. 		*!		
☞ b. 				**

Word-internally H-spreading of initial Hs is blocked simply because [σ_H is already satisfied, and additional spreading would involve unnecessary violations of FAITH |:

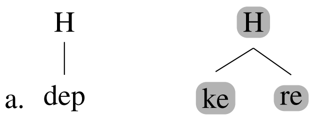
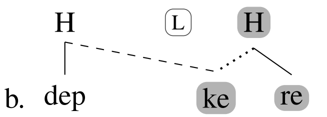
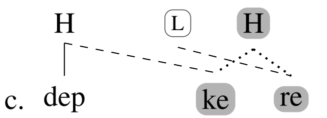
(39) *Blocking of word-internal H-Spreading*

Input: = a.	OCP	[σ_H	*ⓣ	FAITH |
☞ a. 				
b. 				*!*

The tableau in (40) illustrates dissimilation in conjunction with concomitant

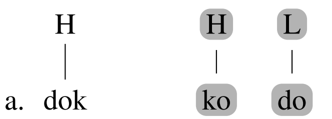
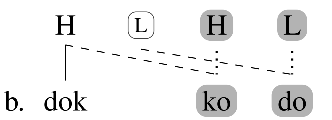
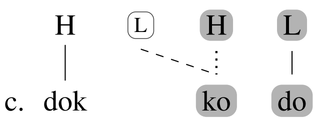
H-spreading. A L-tone is inserted to satisfy the OCP. Since it cannot remain floating by virtue of *ⓣ, the final syllable becomes L:

(40) *H-Spreading + L-Epenthesis*

Input: = a.	OCP	[σ_H	*ⓣ	FAITH |
 a. dep ke re	*!	*!		
 b. dep ke re			*!	**
 ☞ c. dep ke re				****

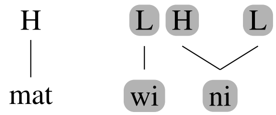
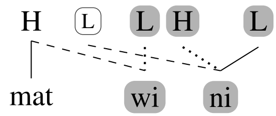
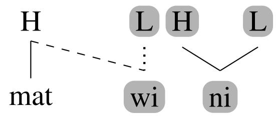
For H-initial Hs, spreading is again blocked because [σ_H is already satisfied by the underlying H-tone:

(41) *Duke-of-York Blocking: L-Epenthesis without H-Spreading*

Input: = a.	OCP	[σ_H	*ⓣ	FAITH |
 a. dok ko do	*!		*	
 b. dok ko do				***!*
 ☞ c. dok ko do				**

The crucial SCC effect is derived in (42). H spreads to the following word. That the OCP does not trigger dissimilation follows directly from Containment, as laid out in section 2. OCP (in contrast to its clone <u>OCP</u>) is a generalized markedness constraint. Hence the unpronounced underlying initial L-tone of [winî] is visible to it, thus it is not violated by the sequence HLH, and deassociating the underlying H is simply blocked by FAITH |:

(42) *SCC for Dissimilation: Blocking of L-Epenthesis by Underlying L*

Input: = a.	OCP	[σ_H	*ⓣ	FAITH |
a. 		*!		
b. 				***!*
☞ c. 				**

4.2. CRISP EDGE: Kashaya Laryngeal Dissimilation

Kashaya Laryngeal Dissimilation (Buckley 1994) is a SCC effect which obviously cannot be captured by ALTERNATION since it does not involve spreading. Crucially, word-initial aspirated stops lose their aspiration if they are followed by another aspirated stop or by [h]:

(43) *Kashaya Laryngeal Dissimilation (Buckley 1994:83)*

a. /p^{h}i-^{h}mi-w/	→	[pihmíw]	‘see in detail’
b. /p^{h}u-^{h}c^{h}a-w/	→	[puhc^{h}áw]	‘blow over’
c. /p^{h}a-hol-ʔ/	→	[pahól’]	‘look for an unseen object with end of stick’

However, Laryngeal Dissimilation only applies across morpheme boundaries, i.e., it is not triggered by other root internal laryngeal features:

(44) *Kashaya: No root-internal dissimilation (Buckley 1994:85)*

a. ṭ^{h}ahqa-	‘play’	c. ṭ^{h}eq^{h}á-le	‘elderberry’
b. q^{h}oh´j	‘eighty’	d. k^{h}om^{h}ca	‘eight’

I assume that dissimilation involves the feature [spread glottis] ([sg]) characterizing aspirate stops and [h], and is triggered by OCP [sg]. Assuming that [sg] is the only feature on its autosegmental tier, this OCP constraint can only be repaired by deleting (making phonetically invisible) one of the involved features or by fusion, implemented here as orthogonal association. Following Trommer (2018) I assume that fused nodes count as single objects for markedness constraints, hence [sg] - - - [sg] avoids violating OCP [sg]. The SCC effect can now be captured by a constraint type which is in a sense the logical complement of ALTERNATION, CRISP EDGE (Ito and Mester 1999, Kaplan 2018)

(45) CRISPEDGE□ (CE□) Assign ∗ to every nodes of different color which are connected by an epenthetic association line

Now root-internally fusion of two adjacent [sg] features is preferred over deletion due to ranking MAX [sg] above DEP – (which penalizes insertion of a horizontal association line) as shown by (46i). However across a morpheme boundary fusion would violate CE-□, and deletion applies instead (46ii):

(46) *Kashaya Laryngeal Dissimilation*

(i) *Root-internal fusion*

Input: a.	OCP [sg]	CE □	MAX [sg]	DEP –
a. [sg] [sg] / p p	*!			
b. [sg] [sg] / p p			*!	
☞ c. [sg] - [sg] / p p				*

(ii) *Intermorphemic deletion*

Input: a.	OCP [sg]	CE □	MAX [sg]	DEP –
a. [sg] [sg] / p p	*!			
☞ b. [sg] [sg] / p p			*	
c. [sg]–[sg] / p p		*!		*

4.3. Turkish Velar Deletion

In Turkish, specific (vowel-initial) suffixes such as the accusative and person number inflection trigger deletion of a final velar obstruent (47), whereas others such as the Future suffix -[edʒek] do not (48):

(47) *Turkish affixes triggering velar deletion (Orgun 1996:106)*

a.	badʒak	badʒa-a	badʒa-ɯ	badʒa-ɯm	badʒa-ɯn
	'leg'	'leg-DAT'	'leg-ACC'	'leg-1SG.POSS'	'leg-2SG.POSS'
b.	salak	sala-ɯm	sala-ɯz		
	'stupid'	'stupid-1SG.SUBJ'	'stupid-1PL.SUBJ'		

(48) *Turkish affixes not triggering velar deletion (Orgun 1996:106)*

gʲedʒikʲ	gʲedʒikʲ-edʒekʲ	gʲedʒikʲ-ebilʲ-ir	gʲedʒikʲ-indʒe
'be late'	'be.late-FUT'	'be.late-ABIL.IMPF'	'be.late-ADV'

Strict cycle effects emerge with two kinds of data. First, velar deletion does not apply to intervocalic velars in underived roots:

(49) *No velar deletion in underived roots (Inkelas and Orgun 1995:768)*

a.	gaga	'beak'	c.	oku	'read'
b.	sigara	'cigarette'	d.	sokak	'street'

Second, if an affix triggering velar deletion embeds a non-trigger affix, only the outer affix itself causes deletion of the preceding velar, the non-trigger affix still fails to trigger the process.

(50) *Turkish deletion triggers outside of non-triggers (Orgun 1996:106)*

a.	gʲedʒikʲ-edʒe-im 'be.late-FUT-1SG.SUBJ'	b.	birikʲ-edʒe-i 'accumulate-FUT-3SG.SUBJ'
c.	bɯrak-adʒa-ɯn 'let.go-FUT-2SG.SUBJ'	d.	gʲerekʲ-edʒe-imiz 'be.necessary-FUT-1PL.SUBJ'

I assume that velar deletion itself is a Phrase-Level process which deletes intervocalic velars (51a) except in case this is the onset of a syllable

(51) *Velar deletion (Phrase Level)*

Input: a.	MAX $_\sigma$[C	*VkV	MAX C
a. [sɑ][lɑk]-[ɯm]		*!	
☞ b. [sɑ][lɑː k]-[ɯm]			*

Input: a.	MAX $_\sigma$[C	*VkV	MAX C
☞ a. [o][ku]		*	
b. [o][k u]	*!		*

The crucial contribution of the lexical phonology is to ensure the word-internal syllabification of velars in a way such that this leads to the correct outputs in every case. Before we consider the apparent SCC effects, let us turn to an important purely phonological restriction on velar deletion which patterns nicely with the syllable-based approach pursued here. Velar deletion is also blocked after long vowels:

(52) *No velar deletion after long vowels (Inkelas 2009:394)*

	Nominative	*Dative*	
a. /infilaːk/	[in.fi.lak]	[in.fi.laː.ka]	'explosion'
a. /meraːk/	[me.rak]	[me.raː.ka]	'curiosity'

This can be captured by the constraint $*\sigma_{3\mu}$ which penalizes trimoraic syllables and is independently motivated by the fact that Turkish has regular vowel shortening in closed syllables (der Hulst and Weijer 1991):

(53) *Syllabification of velars after short and long vowels (Word Level)*

Input: a.	PRS	$*\sigma_{3\mu}$	$^*_\sigma$[k	ONS
a. sɑlɑk-ɯm	*!			
b. [sɑ][lɑ]-[kɯm]			*!	
☞ c. [sɑ][lɑk]-[ɯm]				*

(→ Phrase Level [sɑ][lɑː(k)]-[ɯm])

Input: a.	PRS	$*\sigma_{3\mu}$	$^*_\sigma$[k	ONS
a. meraːk-a	*!			
☞ b. [me][raː][k-a]			*	
c. [me][raːk]-[a]		*!		*

(→ Phrase Level [me][raː][k-a])

The crucial constraint for the SCC-effect is □ONS:[3]

(54) □ONS: Assign ∗ to every consonant which is not in the onset of a tautomorphemic right-adjacent vowel

(55) *Syllabification of velars after short and long vowels (Word Level)*

Input: a.	PRS	$*\sigma_{3\mu}$	□ONS	$^*_\sigma$[k	ONS
a. oku	*!				
b. [ok][u]			*!		*
☞ c. [o][ku]				*	

(→ Phrase Level [o][ku])

Let us finally address the fact that velar deletion is blocked for velars which are the final consonants of verb roots (der Hulst and Weijer 1991:35). I assume that this is the reflex of a categorial verbal theme marker consisting of a

[3]For reasons of space, I do not analyze the fact here that velar deletion is also blocked inside morphemes in roots which are broken up by an epenthetic vowel due to phonotactic reasons (e.g., /aks/ → [akis] 'reflection', Inkelas and Orgun 1995:776) . This could be captured either by an additional constraint requiring that colorless (epenthetic) vowels have onsets, or by generalizing □ONS such that it requires syllabification of a consonant with an (underlyingly) following tautomorphemic segment.

floating mora which attaches to the final syllable of the word.[4] This effectively forces [k] to form an onset, despite lower-ranked $^{*}_{\sigma}$[k:

(56) *Syllabification of velars after verb root (Word Level)*

Input: a.	PRS	$*\sigma_{3\mu}$	□ONS	$^{*}_{\sigma}$[k	ONS
a. gedʒik$^{\mu}$-en	*!				
b. [ge][dʒik$^{\mu}$][-en]		*!			*
☞ c. [ge][dʒi$^{\mu}$][k-en]				*	

(→ Phrase Level [ge][dʒi$^{\mu}$][k-en])

4.4. Turkish Bisyllabicity

A further apparent SCC effect for some speakers of Turkish cited by Inkelas and Orgun (1995, 1998) is a disyllabic minimality requirement restricted to derived forms. Thus the name of the musical note C [doː] is grammatical in isolation, but not in combination with a non-syllabic possessive affix (*[doː-m] 'my C', cf. [sol^{j}] 'musical note G' and [sol^{j}-ym] 'my G', which are both grammatical, Orgun 1996:19). Inkelas and Orgun (1995) further argue that this minimality requirement is tied to specific phonological strata since it can be repaired by 'inner' affixes such as possessive suffixes, but not by outer affixes such as case suffixes (compare, e.g., [sol^{j}-ym] 'my G' and *[doː-m-u] 'my C (Acc.)', Orgun 1996:19).

(57) *Strata in Turkish according to Inkelas and Orgun (1998:368)*

<table>
<tr><td>Level:</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Morphology</td><td>root</td><td>passive
aspect
relative
negative</td><td>plural
possessive</td><td>case</td><td>tense
agreement
interrogative</td></tr>
<tr><td rowspan="3">Phonology</td><td>[μμ]</td><td colspan="4"></td></tr>
<tr><td></td><td colspan="2">[σσ]</td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="3">velar deletion</td></tr>
</table>

I will not attempt a full analysis of this pattern here since it hinges on the

[4]This syllable is catalectic in the sense of Kiparsky (1991) See Zimmermann and Trommer (2014) for extensive independent evidence for catalectic moras in morphophonology.

orthogonal controversial question of how to implement absolute ungrammaticality in OT. However in principle, the disyllabic minimality requirement could be simply in Colored Containment SOT by a version of Downing's Morpheme-Syllable Correlation (Downing 2006:ch.3)

(58) MORPHEME-SYLLABLE CORRELATION (MSC): A form containing at least two colors should also contain at least two syllables

Consider finally how this could be embedded into a model which allows only for two word-internal strata, as assumed here, in contrast to the 5 strata posited by Inkelas and Orgun (1998) shown in the diagram in (57). I assume that Turkish has a Stem Level comprising levels 1+2+3 of Inkelas & Orgun, and a Word Level comprising complete word forms. The Stem Level under this definition is not only the domain for the bisyllabicity constraint under discussion, but also corresponds also to the site which can undergo suspended affixation (Inkelas and Orgun 1995:765). As already indicated by the diagram in (57), Inkelas and Orgun (1995, 1998) do not provide any specific evidence for distinguishing stratum 4 and stratum 5, and their only reason for distinguishing stratum 2 and 3 is velar velar deletion, which as already shown in section 4.3 can be captured purely representationally (the fact that level-2 affixes in Turkish don't allow suspended affixation is also an argument against positing a separate stratum 2). The only evidence Inkelas and Orgun (1995) provide for stratum 1, is a process where certain speakers the long vowel of monosyllabic roots such as [doː] 'C' is shortened in a construction Inkelas and Orgun call 'root compounding' (e.g. [do-dijez] 'C-sharp', Inkelas and Orgun 1995 :773). Inkelas and Orgun attribute this to a bimoraic minimality requirement at stratum 1 (comprising root compounding) such that monosyllabic roots lengthen in all contexts apart from root compounds. but it could also be captured by assuming that the underlying linking element of these compounds triggers shortening of preceding roots. Again this could be implemented by positing a floating mora as linker which leads to shortening in a similar way as described for shortening morphologies in Zimmermann and Trommer (2014). Independent evidence for the assumption that this is morphological shortening comes from the fact that Turkish has roots which are not subject to the alleged bimoraicity constraint for all speakers (e.g., [je] 'eat' and [su] 'water' Inkelas and Orgun 1995:786).

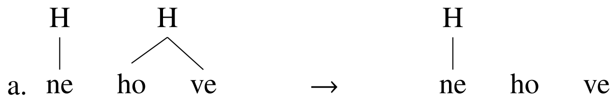
5. Beyond Colors: Representational Sources of SCC-Effects

5.1. Fusion and the OCP across Strata

in Shona High tone (= H-tone) dissimilation (‘Meeussen’s Rule’), the second of two adjacent H-tones is deleted (e.g. [né] + [mbwá] → [né mbwa] ‘with a dog’, inside a phonological word at the Phrase Level , but crucially this effect is restricted to appear across word boundaries. Thus a H-toned verb such as /hóvé/ ‘fish’ is not changed to [hóve] at the Phrase Level. The standard account for this and similar facts in Autosegmental Phonology is based on the assumption that the two cases differ representationally because the OCP has applied word-internally as a morpheme structure constraint (Hyman 2014) or as an OT-constraint at the Word Level in a Stratal OT approach. Thus [hóve] does not have two H-tones, but just one which is doubly linked escaping the applicability of the OCP:

(59)


Independent evidence for this representation comes from the fact that in words such as [hóve] all adjacent H-tone syllables become L if preceded by a H-toned word (e.g. [né] + [hóvé] → [né hove] ‘with a fish’.[5]

(60)


5.2. Syllabification as an SCC-Trigger: Emai

If generalized to syllable structure, the representational-stratal account of SCC effects in Shona tone in section 5.1 can also account for the Emai data discussed at the very beginning of this paper. Assume that the relevant markedness constraint *HIATUS is only violated by adjacent vowels in different syllables. At the Word Level, *HIATUS violations of two consecutive vowels are repaired phonetically vacuously by grouping them into the same syllable (oa → $[oa]_{\sigma}$).

[5]Note that the Shona case is different from laryngeal dissimilation in Kashaya, where dissimilation/deletion and fusion are possible inside the same stratum.

At the Phrase Level, the generalized markedness constraint *[VV]$_\sigma$ blocks creation of new diphthongal syllables ([kɔ]$_\sigma$ [e]$_\sigma$[ma]$_\sigma$ *→ [kɔe]$_\sigma$[ma], but diphthongs inherited from the Word Level are maintained (since *[VV]$_\sigma$ is a generalized markedness constraints modifying it would not avoid the constraint violation triggered by such a syllable since it would still be visible to the constraint due to Containment). At the same time, Phrase Level *HIATUS violations are repaired by deletion ([kɔ]$_\sigma$ [e]$_\sigma$[ma]$_\sigma$ → [ke]$_\sigma$[ma]$_\sigma$), but isolated [oa]$_\sigma$ is maintained because by assumption it does not violate *HIATUS in the first place.

5.3. Klamath

As Catalan (see section 3.1), vowel reduction and deletion in Klamath has been used as one of the major arguments for the SCC based on the classical paper by Kean (1974). Here I will show that the relevant effects can also be captured making use of the basic representational mechanism of Containment Theory. See Gleim (2023) on a critical evaluation of Kean's original analysis.

The phonological process involved is schwa epenthesis in consonant clusters containing sonorants (e.g., /tgalm/ → [tgaləm] 'west', Kean 1974:188). This interacts with another general process in Klamath the initial vowel of vowel-initial stems and formatives is obligatorily deleted (e.g. /lolal-op-ga/ → [lolal-p-ga], 'are lying down (pl.)', p.184).The classification of these elements as vowel-initial is somewhat abstract since the putative vowels are virtually always deleted. The major evidence for their presence is the behavior of vowel-initial stems in combination with reduplicative prefixes such as [pV]- 'pull' (e.g., toːka 'hair falls out' ~ [po-toːka] 'pull hair out', p. 180; [katsga] 'tooth falls out' ~ [pa-kətsga] 'pull someone's tooth out', p.181). Before a vowel-initial root these prefixes copy the initial root vowel (which is simultaneously deleted,, as in all other contexts): /-aciːk-/ 'wrings out' → pa-ciːka 'pulls and twists'; /-odg-/ 'out of container' → [po-tga]'pulls out of container' (p.182). (61) shows one of the three examples for the alleged SCC effects cited by Keane (the other two examples are almost completely parallel wrt the underlying phonological features and alternations involved). Phonological rules (cycles) apply after the addition of every new formative. No epenthesis happens in cycle 1 since ə-insertion is restricted to consonant clusters with three consonants (or two-consonant clusters at the end of a word). The vowel of [elg] is not deleted since the deletion rule in Kean's analysis only applies after a morpheme boundary (since the relevant vowel-initial formatives never surface without a further prefixal element, this still means that their initial vowel is deleted across the board). In the second cycle a prefix is added and the root-initial [e] is deleted. This in turn results in a 4-consonant cluster involving sonorants which triggers ə-insertion. In cycle 3 the initial vowel of [otən] is deleted and its final [n] assimilates to the following [l]. The SCC-effect diagnosed by Keane now consists in the fact that the 3-consonant cluster [n-l-g] in the input of Cycle 3 doesn't trigger an additional instance of ə-epenthesis:

(61) *[ntiwtəllga] 'falls against something' (Kean 1974:188)

		[elg-a]	Cycle 1	
		[elg-a]		
	[otn-	[elg-a]]	Cycle 2	(ə-epenthesis + V-deletion)
	[otən-	[lg-a]]		
[ntiw-	[otən-	[lg-a]]	Cycle 3	(V-deletion + n/l-assimilation)
[ntiw-	[təl-	[lg-a]]		
*[ntiw-	[tən-	[əlg-a]]		(additional ə-epenthesis)

My reanalysis of this datum is based on the observation that additional insertion of a vowel here would essentially consist in a Duke-of-York derivation (similarly to the Bari case discussed in section 4.1). Insertion of a schwa in this position would add a vowel exactly at the point where root-initial [e] was deleted in the first cycle. In Containment, this can be captured by the constraint *VV (Assign $*$ to every pair of adjacent vowels). Since this is a generalized markedness constraint sensitive to input and output structure alike, it crucially excludes the Duke-of-York/SCC candidate (62b). (in contrast, *[V and *CLUSTER are phonetic markedness constraints, hence they can in principle be satisfied by vowel deletion). I refrain from formally defining the constraint *CLUSTER here since the conditions triggering vowel epenthesis in clusters in Klamath are complex. For the sake of the tableau in (62), I assume that it is violated by every distinct phonetic three-consonant sequence containing at least one sonorant. Thus there is one violation in the winning candidate (62d) (incurred by [l-l-g]) and two in (62c) (incurred by w-t-n and t-n-l).[6]

[6] With Zoll (2002), I assume that suffixes, roots (and prefixal intensive reduplication) form the

(62) *Blocking of Duke of York epenthesis in Klamath*

Input: a.	*[V	*VV	*CLUSTER	MAX V	DEP V
a. [ntiw- [otn- [elga]]	*!*				
b. [ntiw- [:o:t(ə)n-(ə)[:e:lga]]		*!		**	**
c. [ntiw- [:o:tn- [:e:lga]]			**!	**	*
☞ d. [ntiw- [:o:t(ə)l- [:e:lga]]			*	**	*

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Stem Level stratum in Klamath, whereas all other prefixes are added at the Word Level. Since the derivation in (i) happens at the Word Level, the suffix has acquired the same morphological color as the root, and is hence not incurring a violation of *[V.

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