(Im)possible opacity patterns in containment theory

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The Opacity Problem

Opacity (McCarthy, 1999)

A generalization is **not surface-true**

Generalization G plays an active role in language L, but there are surface forms of L that violate G.

➙ Underapplication

A generalization is **not surface-apparent**

A generalization G shapes the surface form F, but the conditions that make G applicable are not visible in F.

➙ Overapplication

Opacity in Rule-Based Phonology

Feeding and Bleeding

Rules are ordered:

◆ application of rule 1 creates the context for rule 2: Feeding
◆ application of rule 1 destroys the context for rule 2: Bleeding

		Feeding	**Bleeding**		
		/toi/	/tio/	/tou/	/tie/
V1 Deletion:	$V \rightarrow \emptyset/\underline{\quad} V$	t i	t o	t u	t e
Palatalization:	$t \rightarrow t\int/\underline{\quad} [-bk]$	t∫i			t∫e
		[t∫i]	[to]	[tu]	[t∫e]

Opaque: Counterfeeding and Counterbleeding

Rules are ordered:

◆ if rule 2 would have applied earlier, it would have created the context for rule 1: Counterfeeding ➙ non-surface true

◆ if rule 2 would have applied earlier, it would have destroyed the context for rule 1: Counterbleeding ➙ non-surface apparent

		CF	**CB**		
		/toi/	/tio/	/tou/	/tie/
Palatalization:	$t \rightarrow t\int/\underline{\quad} [-bk]$		t∫io		t∫ie
V1 Deletion:	$V \rightarrow \emptyset/\underline{\quad} V$	t i	t∫ o	t u	t∫ e
		[ti]	[t∫o]	[tu]	[t∫e]

Opacity in Optimality Theory

Feeding in OT

(1)

/toi/		Onset	*Tl	Max	Ident C
☞	a. [tʃi]			*	*
	b. [ti]		*!	*	
	c. [toi]	*!			

Bleeding in OT

(2)

/tio/		Onset	*TI	Max	Ident C
	a. [tʃo]			*	*!
☞	b. [to]			*	
	c. [tio]	*!	*!		

Harmonic Bounding of Counterbleeding

(3)

/tio/	*TI	Ident C	Onset	Dep	Ident V	Max
☞ a. [to]						*
☞ b. [tʃo]		*!				*

Contradictory Requirements for Counterfeeding

/ti/	*TI	Ident C	Onset	Dep	Ident V	Max
a. [ti]	*					
b. [tʃi]		*				

/ti/	…	*TI	Ident C	…
a. [ti]		*!		
☞ b. [tʃi]			*	

/toi/	*TI	Ident C	Onset	Dep	Ident V	Max
a. [ti]	*					*
b. [tʃi]		*				*

/toi/	…	Ident C	*TI	…
☞ a. [ti]			*	
b. [tʃi]		*!		

Containment Theory and Cloning

Correspondence Theory vs. Containment

Input-Output Mapping in Correspondence Theory

$t_1o_2u_3$		ONSET	DEP	MAX
☞	a. t_1u_3			*
	b. $t_1o_2tu_3$		*!	
	c. $t_1o_2u_3$	*!		

Input-Output Mapping in Containment Theory

| tou		ONSET	DEP	MAX
☞	a. t o u			*
	b. to t u		*!	
	c. tou	*!		

Specific Assumptions

◆ **Hierarchical Nonlinear Representations:** combining Prosodic Phonology and Feature Geometry

◆ **Colors:** Each morpheme has a unique color characterizing all of its underlying nodes and association lines and distinguishing underlying from epenthetic ('colorless' material)

◆ **Radical Containment:** No erasure of association lines ↔ marking association lines as invisible is the only counterpart to deletion operation in non-containment approaches

Colors and Epenthesis

a. *Underlying structure*   b. *Output structure*
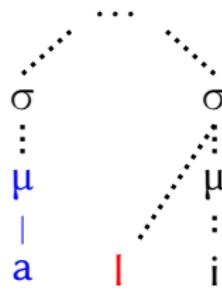
Notation of Association (Trommer and Zimmermann, 2014)

Morphological association relations		Epenthetic association relations
phonetically visible:	phonetically invisible:	phonetically visible:
X	X	X
|	ǂ	⋮
Y	Y	Y

Axiom of Phonetic Visibility (Trommer and Zimmermann, 2014)

A phonological node is visible to phonetics

if and only if

it is dominated by the designated root node of the structure

through an uninterrupted path of phonetic association lines

Deletion and Phonetically Invisible Association Lines

M

σ

μ   μ

i-   e
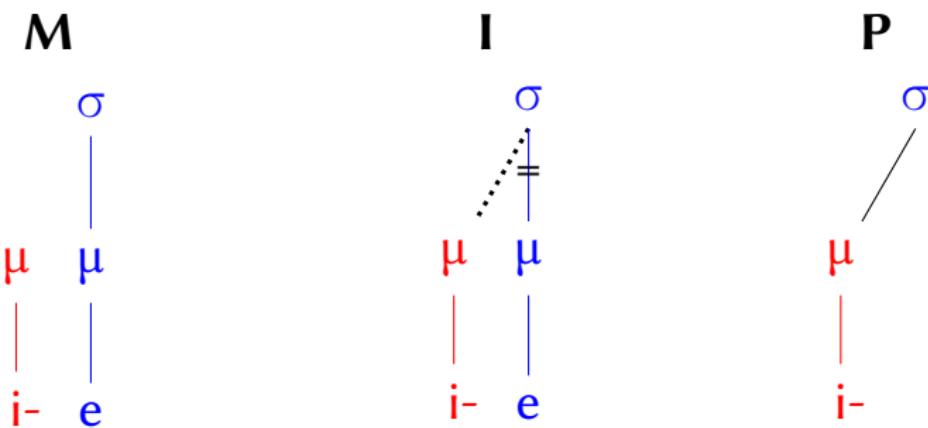
Morphological
Structure
(Input)

I

σ

μ   μ

i-   e

Integrated
Structure
(Candidate)

P

σ

μ

i-

Phonetic
Structure
(Output)

Following: 'Deleted'/Phonetically unrealized elements notated as ' V '

Generalized Markedness Constraints

The Cloning Hypothesis: Two-Level Containment

Every markedness constraint exists in 2 incarnations:

The **general clone** refers to all structure in I

The **phonetic clone** refers only to structure in P

(cf. Cloning in Correspondence Theory, McCarthy and Prince (1995))

Generalized Markedness Constraints

(4) a. *VV
Assign a violation mark for every pair of adjacent vowels in **P**.

b. <u>*VV</u>
Assign a violation mark for every pair of adjacent vowels in **I**.

(5) *Constraint Cloning: Illustrating example*

/pau/	<u>*VV</u>	*VV	Dep	Max
a. pau	*!	*		
b. pa u		*!		*
☞ c. paʔu			*	

Opaque Patterns which Follow

Counterfeeding: Lomongo

Counterfeeding in Lomongo (Bakovic, 2011, 45)

			Counterfeeding
	/o-isa/	/ba-bina/	/o-bina/
1. Gliding (i/u→j/w /__V)	wisa	–	–
2. Deletion ([+vc,+son]→ø/V__)	–	baina	oina
	'you (sg)'	'hide'	'they dance'

Lomongo in Two-Level Containment: Constraints

(6)   a. $*V_{+hi}V$
          Assign a violation mark for every high vowel that is adjacent to
          another vowel in **P**.

      b.   *VbV
          Assign a violation mark for every intervocalic voiced sonorant in
          P.

      c.   *[CC
          Assign a violation mark for every pair of adjacent non-moraic
          segments at the left word edge that are linked to the same
          syllable node in **I**.

Lomongo in Two-Level Containment

(7) *Gliding*

/oisa/	*[CC	*VbV	*V$_{+h}$V	MAXS	MAXμ
a. oisa			*!		
☞ b. wisa					*
c. isa				*!	

(8) *Deletion*

/babina/	*[CC	*VbV	*V$_{+h}$V	MAXS	MAXμ
a. babina		*!			
☞ b. ba b ina				*	

Lomongo in Two-Level Containment

(9)   *Deletion but no gliding*

/obina/		*[CC	*VbV	*V$_{+h}$V	MaxS	Maxμ
a. obina			*!			
☞ b. o b ina				*	*	
c. w b ina		*!			*	*

Counterbleeding: Tiberian Hebrew

Counterbleeding: Tiberian Hebrew (McCarthy, 1999, 333)

			Counterbleeding
	/melk/	/qaraʔ/	/deʃʔ/
1. Epenthesis	melex	–	deʃeʔ
2. ʔ-Deletion	–	qara	deʃe
	'king'	'he called'	'tender grass'

Tiberian Hebrew in Two-Level Containment: Constraints

(10)   a.   *CC]
            Assign ∗ for every sequence of two adjacent consonants at the
            right word edge in **I**.

       b.   *ʔ]
            Assign ∗ for every [ʔ] at the right word edge in **P**.

Tiberian Hebrew in Two-Level Containment

(11)   *Vowel Insertion*

/melk/		*CC]	*ʔ]	Dep	Max
a.	melk	*!			
b.	mel k	*!			*
☞ c.	meləx			*	

(12)   *ʔ-Deletion*

/qaraʔ/		*CC]	*ʔ]	Dep	Max
a.	qaraʔ		*!		
☞ b.	qara ʔ				*
c.	qaraʔə			*!	

Tiberian Hebrew in Two-Level Containment: Counterbleeding

(13)   *Insertion and deletion*

/deʃʔ/	*CC]	*ʔ]	Dep	Max
a. deʃʔ	*!	*!		
b. deʃ ʔ	*!			*
c. deʃəʔ		*!	*	
☞ d. deʃə ʔ			*	*

Self-Destructive Feeding: Turkish

Self-Destructive Feeding: Turkish (Bakovic, 2007, 226)

			S-D. Feeding
	/ip-n/	/bebek-i/	/bebek-n/
1. Epenthesis (ø→i /C__C#)	ipin	–	bebekin
2. Deletion (k→ø/V__V)	–	bebei	bebein
	'king'	'he called'	'tender grass'

◆ vs. CB: The reverse ordering does not result in bleeding!

'the vowel-epenthesis rule P sows the seed of its own non-surface-apparentness'
(Bakovic, 2007, 226)

Turkish in Two-Level Containment: Constraints

(14) a.   *CC]
            Assign ∗ for every sequence of two adjacent consonants at the
            right word edge in **I**.

      b.   *VκV
            Assign ∗ for every intervocalic [k] in **P**.

Turkish in Two-Level Containment: Self-Destructive Feeding

(15)   *Deletion*

/bebek-i/	*CC]	*VᴋV	MᴀxC	DᴇᴘV
a. bebeki		*!		
☞ b. bebe k i			*	

(16)   *Insertion*

/ip-n/	*CC]	*VᴋV	MᴀxC	DᴇᴘV
a. ipn	*!			
☞ b. ipin				*

Turkish in Two-Level Containment: Self-Destructive Feeding

(17)   *Insertion and deletion*

/bebek-n/		*CC]	*VĸV	MᴀxC	DᴇᴘV
a.	bebekn	*!			
b.	bebekin		*!		
☞ c.	bebe k in			*	*
d.	bebe k n	*!		*	

Grandfather Effects: Meccan Arabic

Grandfather Effects: Mekkan Arabic (McCarthy, 2002)

◆ a structure is avoided if newly created but preserved if present underlyingly

◆ in Mekkan Arabic (18), regressive voicing assimilation for obstruents (18-a) fails to produce new voiced obstruent (18-b)

◆ but underlying voiced obstruents are preserved (18-c)

(18)   *Mekkan Arabic (McCarthy, 2002, 3)*
a.	ʔagsam	aksam	'he swore and oath'
	mazkuːr	maskuːr	'mentioned'
b.	ʔakbar	akbar, *ʔagbar	'older'
c.	ʔibnu	ʔibnu	'his son'

Mekkan Arabic and Rule Ordering

◆ No ordering of a general coda devoicing and a general assimilation rule
can capture this pattern:

	/ʔagsam/	/ʔakbar/	/ʔibnu/
1. Assimilation	ʔaksam	ʔagbar	–
2. Devoicing	ʔaksam	ʔakbar	*ipnu

	/ʔagsam/	/ʔakbar/	/ʔibnu/
1. Devoicing	ʔaksam	ʔakbar	*ipnu
2. Assimilation	ʔaksam	*ʔagbar	–

Grandfather Effects in Two-Level Containment

(19)   *VᴄᴅOʙs
        Assign ∗ for every obstruent that is associated to [+vcd] in I.

◆ the generalized version (19) is always violated by an underlyingly
   voiced obstruent – no (deletion) operation can help avoid this violation
   (cf. Trommer, 2014)

◆ if an obstruent is underlyingly voiceless, a violation of *VᴄᴅOʙs can be
   avoided if no feature [+vcd] associates

Grandfather Effects in Two-Level Containment

(20)   *Voicing assimilation creates a voiceless obstruent*

/ʔagsam/	*NoVcdObs	Share$_{-son}^{vcd}$	Id-vc
a. ʔagsam	*	*!	
☞ b. ʔaksam	*		*

(21)   *No voicing assimilation creates new voiced obstruents*

/ʔakbar/	*NoVcdObs	Share$_{-son}^{vcd}$	Id-vc
☞ a. ʔakbar		*	
b. ʔagbar	*!		*

(22)   *Underlyingly voiced obstruent is preserved*

/ʔibnu/	*NoVcdObs	Share$_{-son}^{vcd}$	Id-vc
☞ a. ʔibnu	*		
b. ʔipnu	*		*!

Problematic Patterns

Underlying Triggers Only: Yawelmani

Problem 1: Underlying Triggers Only

(23) *Two processes in Yawelmani (McCarthy, 1999)*

    a. *Rounding Assimilation for Same-Height Vowels*
       /bok'-al/ → [bok'ol] 'might find'
       /dub-al/ → [dubal] 'might lead by the hand'

       /bok'-mi/ → [bok'mi] 'having found'
       /dub-mi/ → [dubmu] 'having lead by hand'

    b. *Lowering of long Vowels*
       c'uːm-al → c'oːmal 'might destroy'

Underlying Triggers Only: Yawelmani

	Counterbleeding	**Counterfeeding**
	c'ujuː-hin	c'uːm-al
1. Rounding Assimilation	c'ujuː-hun	–
2. Lowering	c'ojoː-hun	c'oːmal
	'urinates'	'might destroy'

Yawelmani and Two-Level Containment: CB of Rounding

(24)   *Yawelmani rule interaction: constraints*

a. SHR_{hi}^{rd}
Assign a violation mark for every pair of adjacent vowels that
have identical values for [±high] and are not associated to the
same feature value for [±round] in **I**.

b.   <u>*Iː</u>
Assign a violation mark for every high long vowel in **P**.

Yawelmani and Two-Level Containment: Capturing Counterbleeding

(25)

/cuːjuː-hin/ (ul=a.)	*ḷː	Sʜʀ$_{hi}^{rd}$	Max [rd]	Max [hi]
a.	*!	*!		
b.		*!		*
☞ c.			*	*

Yawelmani and Two-Level Containment: Overapplication for CF

(26)

/cuːm-al/ (ul=a.)		*Iː	SHR$_{hi}^{rd}$	MAX [rd]	MAX [hi]
a.	[+rd] [-rd] [+hi] [-hi] c uː m a l	*!		*	
☞ b.	[-hi] [+rd] [-rd] [+hi] [-hi] c oː m a l		*!		*
☞ c.	[-hi] [+rd] [-rd] [+hi] [-hi] c oː m o l			*	*

Output Triggers only: Makassarese

Problem 2: Output Triggers Only

◆ only /ʔ/ and /ŋ/ are licit word-final codas in Makassarese: Copy-vowel epenthesis to avoid illicit codas and ʔ-epenthesis to avoid a final open syllable (27-a)

◆ stems that are underlyingly V-final do not undergo /ʔ/-epenthesis (27-b)

(27)   *Makassarese (McCarthy, 2002, 20)*
      a.   rantas   rántasaʔ 'dirty'
             teʔter   tettereʔ   'quick'
      b.   lompo   lompo   'big'   (*lompoʔ)

Makassarese and Rule Ordering

◆ the existence of the two rules of V-epenthesis and C-epenthesis
necessarily results in C-epenthesis for an underlyingly V-final stem (28)
➙ Overapplication of C-epenthesis

	Feeding	
	/rantas/	/lompo/
1. V-epenthesis	rantasa	–
2. C-epenthesis	rantasaʔ	*lompoʔ

Makassarese and Two-Level Containment

(28)   a.   CODACOND
            Assign ∗ for every consonant at the right word edge that has a
            place feature in **P**.

        b.   FINALC
            Assign ∗ for every right word edge that is not right-aligned
            with a consonant in **P**.

Makassarese and Two-Level Containment: Overapplication problem

(29)   *Vowel- and Consonant epenthesis*

/rantas/	FINALC	CODACOND	DEP-C	DEP-V
a. rantas		*!		
b. rantasa	*!			*
☞ c. rantasaʔ			*	*

Makassarese and Two-Level Containment: Overapplication problem

(29) *Vowel- and Consonant epenthesis*

/rantas/	FINALC	CODACOND	DEP-C	DEP-V
a. rantas		*!		
b. rantasa	*!			*
☞ c. rantasaʔ			*	*

(30) *Misprediction: Consonant epenthesis*

/lompo/	FINALC	CODACOND	DEP-C	DEP-V
☛ a. lompo	*!			
☞ b. lompoʔ			*	

Non-iterativity in Lardil

Problem 3: Non-iterativity in Lardil

- ◆ a final short V (of a word longer than two µ's) undergo V-deletion (31-a)
- ◆ only apicals are possible codas: C-deletion for non-apicals (31-b)
  (with some additional complications)
- ◆ V-deletion potentially feeds C-deletion (31-c) but never vice versa

(31)   *Fed counterfeeding in Lardil (Kavitskaya and Staroverov, 2010, 256)*

	UNDERLYING	SURFACE	
a.	jilijili	jilijil	'oyster species'
	wiwala	wiwal	'bush mango'
b.	wangalk	wangal	'boomerang'
	wungkunung	wungkunu	'queenfish'
c.	bulumunidami	bulumunida	'dugong'
	dibirdibi	dibirdi	'rock cod'

Lardil and Rule Ordering

			Counterfeeding
	/wangalk/	/jilijili/	/dibirdibi/
1. Final V-deletion	–	jilijil	dibirdib
2. Final [–apic]-C-deletion	wangal	–	dibirdi
	'boomerang'	'oyster species'	'rock cod'

Lardil and Two-Level Containment

(32)   a.   CODACOND
            Assign a violation mark for every coda consonant that is not
            [apical] and not assimilated to a following onset consonant in
            P.

       b.   FINALC
            Assign a violation mark for every vowel at the right edge of a
            PrWd in **P**.

Lardil and Two-Level Containment

(33)   *Lardil in Containment: C-deletion*

/wangalk/		FINALC	CODACOND	MAX-V	MAX-C
a. wangalk			*!		
☞ b. wangal k					*

Lardil and Two-Level Containment

(33)   *Lardil in Containment: C-deletion*

/wangalk/	FinalC	CodaCond	Max-V	Max-C
a. wangalk		*!		
☞ b. wangal k				*

(34)   *Lardil in Containment: V-deletion*

/jilijili/	FinalC	CodaCond	Max-V	Max-C
a. jilijili	*!			
☞ b. jilijil i			*	

Lardil and Two-Level Containment: Overapplication

(35)   *Lardil in Containment: iterative deletion*

/dibirdibi/	FINALC	CODACOND	MAX-V	MAX-C
a. dibirdibi	*!			
b. dibirdib i		*!	*	
☞ c. dibirdi bi	*!		*	*
d. dibird ibi		*!	**	*
☞ e. dibir dibi			**	**

Multi-Level Containment as a Solution?

Multi-Level Containment and the Problematic Pattern

Multi-Level Containment

◆ in the correspondence-theoretic model in McCarthy (1996), all
   constraint parameters are specified for their level of application:

   • 'surface',
   • 'indifferent'*, or
   • 'underlying'

(36)   *Constraint triggering umlaut in Icelandic (McCarthy, 1996)*

*	Condition	Level
α	a	Surface
β	ü	Indifferent
Linear Order	α> β	Underlying
Adjacency	V-to-V	Indifferent

Note: Not containment! 'Indifferent' = in the 'underlying' *or* the surface structure
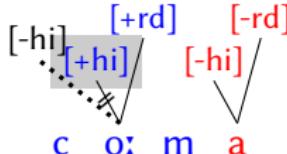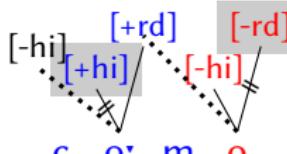
Yawelmani and Multi-Level Containment

(37) Sh_h^{rd}
        Assign ∗ for every pair of vowels that are underlyingly specified for the
        same [±hi] value and are not specified for the same value of [±round].

Yawelmani and Multi-Level Containment: CF

(38)

/cuːm-al/ (ul=a.)		Vː_{−H}!	Sh_h^{rd}	Max[RD]	Max[HI]
a.	[+rd] [-rd] [+hi] [-hi] c uː m a l	*!			
☞ b.	[-hi] [+rd] [-rd] [+hi] [-hi] c oː m a l				*
c.	[-hi] [+rd] [-rd] [+hi] [-hi] c oː m o l			*!	*

Yawelmani and Multi-Level Containment: CB

(39)

/cuːjuː-hin/ (ul=a.)	V:ᵣ₋ₕ!	Sh_h^{rd}	M[ʀᴅ]	M[ʜ]
a. c u j uː h i n	*!	*		
b. c u j oː h i n		*!		*
☞ c. c u j oː h u n			*	*

Makassarese and Multi-Level Containment

(40)   *FinalC*
       Assign ∗ for every phonetic final vowel that is not present underlyingly.

Makassarese and Multi-Level Containment

(41)   *Vowel- and Consonant-epenthesis*

/rantas/		*FinalC*	CODACOND	DEP-C	DEP-V
a.	rantas		*!		
b.	rantasa	*!			*
☞ c.	rantasaʔ			*	*

Makassarese and Multi-Level Containment

(41)   *Vowel- and Consonant-epenthesis*

/rantas/		*FinalC*	CODACOND	DEP-C	DEP-V
a. rantas			*!		
b. rantasa		*!			*
☞ c. rantasaʔ				*	*

(42)   *No Consonant-epenthesis*

/lompo/		*FinalC*	CODACOND	DEP-C	DEP-V
☞ a. lompo					
b. lompoʔ				*!	

Lardil and Multi-Level Containment

(43)   *FinalC*
       Assign ∗ for every phonetic vowel that is underlyingly final.

➙ different from above: reference to underlying *and* phonetic status

Lardil and Multi-Level Containment

(44)   *Final V-deletion*

/jilijili/	*FinalC*	CODACOND	MAX-V	MAX-C
a. jilijili	*!			
☞ b. jilijil i			*	

(45)   *Final V- and C-deletion*

dibirdibi/	*FinalC*	CODACOND	MAX-V	MAX-C
a. dibirdibi	*!			
b. dibirdib i		*!	*	
☞ c. dibirdi bi			*	*
d. dibird ibi			**!	*

Further predictions of Multi-Level Containment

Prediction 1: Counterbleeding and Insertion

(46)   *German' under rule-ordering*

	Counterbleeding
	/werk-n/
1. Assimilation	werk-ŋ
2. Insertion	werk-əŋ

German' and Multi-Level Containment

(47) *$C_{\alpha Pl}C_{-\alpha Pl}$*
      Assign ∗ for every pair of underlyingly adjacent consonants associated phonetically with different place features.

German' and Multi-Level Containment

(48)

/werk-n/		$^*C_{\alpha Pl}C_{-\alpha Pl}$	$^*\underline{CC}_\sigma$	DEPS	MAX[PL]
a.	werkn	*!	*!		
b.	werkŋ		*!		*
c.	werkən	*!		*	
☞ d.	werkəŋ			*	*

German' and Two-Level Containment

◆ The inserted element intervenes in the phonetically visible and the 'all'-structure: there is no underlying adjacency that can be preserved

(49) *German' in containment: constraints*

     a. $\underline{{}^*C_{\alpha PL}C_{-\alpha PL}}$
        Assign ∗ for every pair of adjacent consonants associated with different place feature in **P**.

     b. $\underline{{}^*CC]_\sigma}$
        Assign ∗ for every consonant at the right word egde that is directly adjacent to a preceding consonant in **P**.

German' and Two-Level Containment

(50)

/werk-n/		$^*C_{\alpha PL}C_{-\alpha PL}$	$^*CC]_\sigma$	DEPS	MAX[PL]
a.	werkn	*!	*!		
b.	werkŋ		*!		*
☞ c.	werkən			*	
☛ d.	werkəŋ			*	*!

Prediction 2: Underlying Adjacency

◆ palatalization (51-a) and vowel deletion (51-b) exist

◆ vowel deletion bleeds palatalization (51-c)

◆ but at the same time counterfeeds palatalization (51-d)

(51)   *Palatalization in Finnish'*

	Underlying	Surface
a.	pat-i	patʃi
b.	ka-u	ku
c.	pat-i-o	pato
d.	kat-o-is	katis

Finnish': Rule Ordering

◆ under the assumption that the same V-deletion (=hiatus avoidance)
  applies in both contexts, this pattern can not be modeled

(52) *Impossible with rule ordering: Overapplication of palatalization*

	/pat-i-o/	/kat-o-is/
1. Deletion	pato	katis
2. Palatalization	–	*katʃis

(53) *Impossible with rule ordering: Overapplication of palatalization*

	/pat-i-o/	/kat-o-is/
1. Palatalization	patʃio	–
2. Deletion	*patʃo	katis

Finnish': Multi-Level Containment

(54) *ti*

*Assign * for every phonetically [-pal] stop that is underlyingly and phonetically followed by a high vowel.*

Finnish': Multi-Level Containment

(55)

	*VV	*ti	Max[pal]	Max-V
i. /pat-i/				
a. pati		*!		
b. patʃi			*	
ii. /pat-i-o/				
a. patio	*!	*!		
☞ b. pat i o				*
c. patʃ i o			*!	*
iii. /kat-o-is/				
a. katois	*!			
☞ b. kat o is				*
c. katʃ o is			*!	*

Finnish' and Two-Level Containment

(56)

	*VV	*ti	Max[PAL]	Max-V
i. /pat-i/				
a. pati		*!		
b. patʃi			*	
ii. /pat-i-o/				
a. patio	*!	*!		
☞ b. pat i o				*
c. patʃ i o			*!	*
iii. /kat-o-is/				
a. katois	*!			
☞ b. kat o is		*!		*
☞ c. katʃ o is			*	*

Summary: (Further) Predictions of Multi-Level Containment

Pattern	Predicted by:		
	RO	2LC	MLC
Underlying Triggers: Yawelmani	☺	☹	☺
Phonological DEE: Makassarese	☹	☹	☺
Non-iterativity: Lardil	☺	☹	☺
CB and Insertion: German'	☺	☹	☺
Underlying Adjacency: Finnish'	☹	☹	☺

(RO=rule ordering; 2LC=Two-Level Containment; MLC=Multi-Level Containment)

The Empirical Picture

CB and Insertion: German'

- ◆ Karvonen and Sherman (1997) argue that glide deletion and subsequent /ɣ/ epenthesis are an instance of CB and Insertion

- ➝ Riggs (2008) argues that this is in fact a transparent process (due to avoidance of */ji/)

- ◆ Vaux (2002) argues that Armenian assimilation and /ə/-epenthesis are instances of CB

- ➝ Bakovic (2007) argues that this is not convincing; there is an easy alternative that assimilation applies *across* /ə/ (and Bert Vaux, p.c., agrees)

Non-Iterativity in Lardil

◆ the final vowel deletion is only found in the nominative and is hence not phonological at all (Hale, 1973; McCarthy and Prince, 1993; Horwood, 2001; Bye, 2006; Round, 2011)

◆ cf. Staroverov (2015) for counterarguments against this claim

Underlying Triggers in Yawelmani

◆ most extensively discussed in the theoretical literature (e.g. Archangeli,
  1984; Cole and Kisseberth, 1995; Krämer, 2003, among many)

Underlying Triggers in Yawelmani

◆ most extensively discussed in the theoretical literature (e.g. Archangeli, 1984; Cole and Kisseberth, 1995; Krämer, 2003, among many)

But:

→ 'The data discussed here are taken from Stanley Newman's (1944) description. [...] It should be pointed out that **not all of the forms** cited in this section, nor in the previous generative analyses of Yawelmani, **are actually attested in** Newman's grammar, **the only published source on the language**. All nonattested forms are, however, completely parallel in behaviour and patterns of alternation to forms tha are amply attested in Newman's description.'
(emphasis ours; Kenstowicz and Kisseberth, 1977, 78)

Phonological DEE in Makassarese

◆ well-discussed in the theoretical literature (Aronoff et al., 1987; Basri et al., 1997; McCarthy, 2002)

◆ empirical facts in the recent description by Jukes (2006):

  1. word-final /ʔ/ 'can be realised rather weakly, and it can be difficult to tell if it is there at all.' (Jukes, 2006, 70)
  2. the 'echo syllable' is not only present finally but also before pronominal clitics, the determiner, or the stress-shifting possessive suffix!

➜ we should at least be **suspicious** about the empirical generalization!

(57)   *Non-final Echo syllable (Jukes, 2006, 99)*

a.	appásarakaʔ	b.	botolóʔna
	aC-pasar=a		botol=na
	MV-'market'=1		'bottle'=3.Poss
	'I go to the market'		'his bottle'

(There is a regular process of glottal strengthening: /ʔ/ in onset position becomes /k/)

Summary: Problematic Patterns and the Empirical Picture

Pattern	Predicted by:			Attested?
	RO	2LC	MLC	
Underlying Triggers: Yawelmani	☺	☹	☺	Not necessarily
Phonological DEE: Makassarese	☹	☹	☺	Not necessarily
Non-iterativity: Lardil	☺	☹	☺	Not necessarily
CB and Insertion: German'	☺	☹	☺	No
Underlying Adjacency: Finnish'	☹	☹	☺	No

(RO=rule ordering; 2LC=Two-Level Containment; MLC=Multi-Level Containment)

Conclusion

General Summary

Pattern	Predicted by:				Attested?
	RO	SCOT	2LC	MLC	
Counterfeeding: Lomongo	☺	☹	☺	☺	Yes
Counterbleeding: T. Hebrew	☺	☹	☺	☺	Yes
S-D. Feeding: Turkish	☺	☹	☺	☺	Yes
Underlying Triggers: Yawelmani	☺	☹	☹	☺	Not necessarily
Phonological DEE: Makassarese	☹	☹	☹	☺	Not necessarily
Non-iterativity: Lardil	☺	☹	☹	☺	Not necessarily
CB and Insertion: German'	☺	☹	☹	☺	No
Underlying Adjacency: Finnish'	☹	☹	☹	☺	No

(RO=rule ordering; SCOT=standard correspondence-theoretic OT; 2LC=Two-Level Containment; MLC=Multi-Level Containment)

Conclusion

◆ containment is able to solve opacity problems standard correspondence-theoretic OT faces

◆ multi-level containment overgenerates (Finnish', German', …)

◆ two-level containment is the more restrictive theory: it apparently undergenerates

◆ however, the examples for phonological DEE, underlying triggers, and non-iterativity are isolated instances and allow at least more interpretations of the empirical facts

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Opacity and Syllable Structure: Beduoin Arabic (McCarthy, 1999, 334)

(58)

		Counterbleeding
	/katab/	/badw/
1. Syllabification	ka.tab	badw
2. Raising in open σ	kitab	–
3. Vocalization	–	badu
	'he wrote'	'Bedouin'

Beduoin Arabic and Two-Level Containment

(59) a. $\underline{{}^*CC_{+HI}}$
          Assign $*$ for every [+high] segment that is not associated to a μ
          but preceded by a consonant in **P**.

      b. $\underline{{}^*V_{-HI}]_\sigma}$
          Assign $*$ for every [−high] vowel that is not followed by a
          consonant associated to the same syllable node in **P**.

Beduoin Arabic and Two-Level Containment: Overapplication

(60)

/katab/		$*CC_{+HI}$	$*V_{-HI}]_{\sigma}$	MAX[HIGH]	DEPμ
a.			*!		
☞ b.				*	

Beduoin Arabic and Two-Level Containment

(61)

/badw/	$^*CC_{+HI}$	$^*V_{-HI}]_\sigma$	MAX[HIGH]	DEPμ
a.	*!			
☛ b.		*!		*
☞ c.			*	*

Beduoin Arabic: Reference to syllable structure
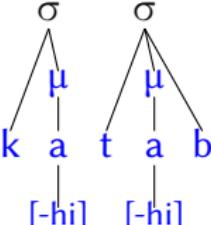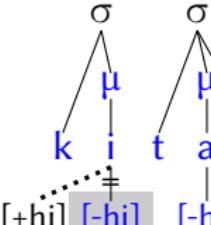
◆ follows if stem to which affix is added is already syllabified
  (=underlying or stratal optimization)

(62) $V_{+HI}]_\sigma$!
       Assign $*$ for every vowel not associated to [+high] that is not
       followed by a consonant associated to the same syllable node in **I**.

Beduoin Arabic: Reference to syllable structure

(63)

/katab/ (ul=a.)	*CC₊ₕᵢ	V₊ₕᵢ]σ!	Max[ʜɪɢʜ]	Depμ
a.		*!		
☞ b.			*	

Beduoin Arabic: Reference to syllable structure

(64)

/badw/ (ul=a.)	*CC₊ₕᵢ	V₊ₕᵢ]σ!	Max[high]	Depμ

The tableau rows:

- a. (structure: σ with μ, b a d w, [-hi] [+hi]) — *CC₊ₕᵢ: *!
- ☞ b. (structure: σ σ with μ μ, b a d u, [-hi] [+hi]) — Depμ: *
- c. (structure: σ σ with μ μ, b i d u, [+hi] [-hi] [+hi]) — Max[high]: *! Depμ: *