

The Typology of Opacity and Containment Theory

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Opacity (McCarthy, 1999)

- (1) 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**

- (2) 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**

Opaque: Counterfeeding in Lomongo (Bakovic, 2011)

Rules are ordered:

- ◆ if rule 2 would have applied earlier, it would have created the context for rule 1: Counterfeeding → **Underapplication**

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

Opaque: Counterbleeding in Tiberian Hebrew

Rules are ordered:

- ◆ if rule 2 would have applied earlier, it would have destroyed the context for rule 1: Counterbleeding → **Overapplication**

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

Opacity in Standard Optimality Theory

In contrast to a rule-based analyses, opacity is a **formal problem for standard OT** (McCarthy, 1999; Bakovic, 2007).

‘Unless further refinements are introduced, OT cannot contend successfully with any non-surface-apparent generalisations nor with a residue of non-surface-true generalisations.’ (McCarthy, 1999, 332)

1. The Opacity Problem

- 1.1 Opacity in Rule-Based Phonology
- 1.2 Opacity in Optimality Theory

2. Two-Level-Containment

- 2.1 Correspondence Theory vs. Containment
- 2.2 Generalized Markedness Constraints
- 2.3 Predicting Opaque Patterns in Two-Level-Containment

3. Two-Level-Containment as Restrictive Theory

- 3.1 Patterns Excluded by Two-Level-Containment
- 3.2 The Empirical Picture

4. Conclusion

Two-Level-Containment

Correspondence Theory vs. Containment

Correspondence Theory (McCarthy and Prince, 1995)

t₁o₂u₃

↓

t₁u₃

Deletion=

an input element without an output correspondent

Containment Theory (Prince and Smolensky, 1993/2002)

tou

↓

t o u

‘Deletion’=

Non-parsing of an underlying element

Two-Level-Containment: Background Assumptions

- ◆ **Radical Containment:** No erasure of association lines \leftrightarrow marking association lines as invisible is the only counterpart to deletion operation in non-containment approaches
(Trommer and Zimmermann, 2014; Trommer, 2011; Zimmermann, to appear)
- ◆ **Hierarchical Nonlinear Representations:** combining Prosodic Phonology and Feature Geometry (Nespor and Vogel, 1986; McCarthy, 1981)
- ◆ **Colors:** Each morpheme has a unique color characterizing all of its underlying nodes and association lines and distinguishing underlying from epenthetic ('colorless' material)
(van Oostendorp, 2003, 2008, 2007; Revithiadou, 2007)

Axiom of Phonetic Visibility (Trommer and Zimmermann, 2014)

A phonological node is visible to phonetics

if and only if

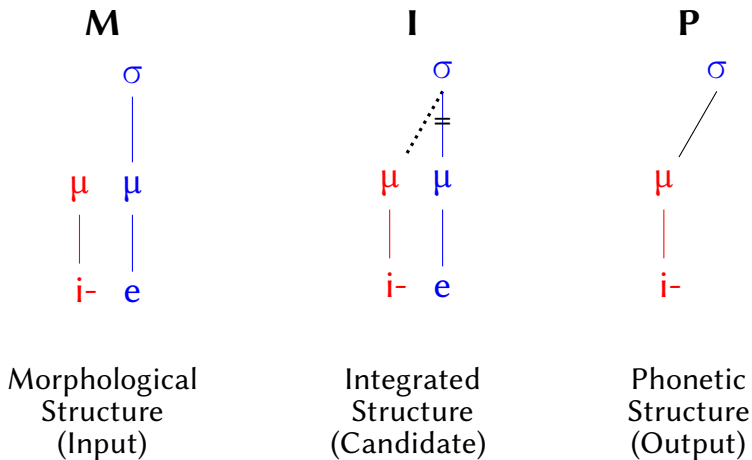
it is dominated by the designated root node of the structure

through an uninterrupted path of phonetic association lines

Notation of Association (Trommer and Zimmermann, 2014)

Morphological association relations		Epenthetic association relations
phonetically visible:	phonetically invisible:	phonetically visible:
X Y	X ‡ Y	X ⋮ Y

Deletion and Phonetically Invisible Association Lines



In the following: ‘Deleted’/Phonetically unrealized elements notated as ‘V’

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

- (3) a. *VV
Assign a violation mark for every pair of adjacent vowels in **P**.
- b. *VV
Assign a violation mark for every pair of adjacent vowels in **I**.

(4) *Constraint Cloning: Illustrating example*

/pa-u/	<u>*VV</u>	*VV	DEP	MAX
a. pau	*!	*		
b. pa u		*!		*
 c. pa?u			*	

Predicting Opaque Patterns in Two-Level-Containment

Counterbleeding: Tiberian Hebrew (McCarthy, 1999, 333)


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

Tiberian Hebrew in Two-Level Containment: Constraints


- (5) 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

(6) *Vowel Insertion*


/melk/	*CC]	*?]	DEP	MAX
a. melk	*!			
b. mel k	*!			*
 c. meləx			*	

(7) *?-Deletion*

/qara?/	*CC]	*?]	DEP	MAX
a. qara?		*!		
 b. qara ?				*
c. qara?ə			*!	

Tiberian Hebrew in Two-Level Containment: Counterbleeding

(8) *Insertion and deletion*

/defʔ/	*CC]	*ʔ]	DEP	MAX
a. defʔ	*!	*!		
b. defʔ	*!			*
c. defəʔ		*!	*	
 d. defəʔ			*	*

Counterbleeding in Two-Level-Containment: Summary

A ‘deleted’ segment remains in the structure

and can trigger a process.

(=In Tib.Hebrew: Without epenthesis, a cluster with a ‘deleted’ C results)

Counterfeeding in Lomongo (Bakovic, 2011, 45)

			Counterfeeding
1. Gliding ($V_{-high} \rightarrow j/w / _V$)	/o-isa/ wisa	/ba-bina/ –	/o-bina/ –
2. Deletion ($[+vc,+son] \rightarrow \emptyset / V _$)	–	baina	oina
	‘you (sg)’	‘hide’	‘they dance’

Lomongo in Two-Level Containment: Constraints

- (9) a. *VV
Assign a violation mark for every pair of adjacent vowels in **P**.
- b. *Vb
Assign a violation mark for every postvocalic 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

(10) *Gliding*

/oisa/	*[CC	* <u>V</u> b	* <u>VV</u>	MAXS	MAX μ
a. oisa			*!		
☞ b. wisa					*
c. isa				*!	

(11) *Deletion*

/babina/	*[CC	* <u>V</u> b	* <u>VV</u>	MAXS	MAX μ
a. babina		*!			
☞ b. ba b ina			*	*	

Lomongo in Two-Level Containment: Counterfeeding

(12) *Deletion but no gliding*

/obina/	*[CC	* <u>V</u> b	* <u>VV</u>	MAXS	MAXμ
a. obina		*!			
b. o b ina			*	*	
c. w b ina	*!			*	*

Counterfeeding in Two-Level-Containment: Summary

A ‘deleted’ segment remains in the structure

and can block a process.

(=In Lomongo: Gliding results in C-cluster with ‘deleted’ C)

Summary: The patterns Two-Level-Containment predicts

Some examples collected from theoretical literature on opacity
 McCarthy (1999, 2002); Bakovic (2007, 2011); Ettliger (2008)

	Predicted by		2LC	RO	SCOT
Counterbleeding	T. Hebrew Ojibwa Shimakonde Polish	Epenthesis, Deletion Assimilation, Deletion Assimilation, Reduction Raising, Devoicing	☺	☺	☹
Counterfeeding	Lomongo Bed. Arabic Mafa Icelandic	Gliding, Deletion Raising, Glide-Voc. Harmony, Gliding Rounding, Epenthesis	☺	☺	☹
Grandfather Effects	Mekk. Arabic Warlpiri Sundanese	Voicing V-Harmony Dissimilation	☺	☹	☹
S-D. Feeding	Turkish Turkish	Epenthesis, Deletion [+cont]-Deletion, C-Del.	☺	☺	☹

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

Two-Level-Containment as Restrictive Theory

Patterns Excluded by Two-Level-Containment

Counterbleeding and Insertion

(13) *German' under rule-ordering*

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

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

(14) *German' in containment: constraints*

a. *KN



Assign * for every pair of adjacent consonants associated with different place feature in **P**.

b. *CC]_σ

Assign * for every consonant at the right word edge that is directly adjacent to a preceding consonant in **P**.

German' and Two-Level Containment

(15)

/werk-n/	* <u>KN</u>	* <u>CC</u>] _σ	DEPS	MAX[PL]
a. <i>werk</i> n	*!	*!		
b. <i>werk</i> ŋ		*!		*
 c. <i>werk</i> ən			*	
 d. <i>werk</i> əŋ			*	*!

Yawelmani: Underlying triggers only

	Counterbleeding	Counterfeeding
1. Rounding Ass. (if same height)	c'uju:-hin c'uju:-hun	c'u:m-al –
2. Lowering (V: _[+high] → V: _[-high])	c'ujo:-hun	c'o:mal

Yawelmani impossible in Two-Level-Containment

(16) *Counterbleeding for /cu:ju:-hin/*

	SHARE _{hi} rd
<p>a.</p> <p>c u j o: h u n</p>	

→ Underlying [+high] enables rounding

(17) *No Counterfeeding for /cu:m-al/*

	SHARE _{hi} rd
<p>a.</p> <p>c o: m a l</p>	*!
<p>b.</p> <p>c o: m o l</p>	

→ Underlying [-high] should enable rounding

Non-iterativity in Lardil

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

Lardil and Two-Level Containment

- (18) a. CODACOND
Assign a violation mark for every coda consonant that is not [apical] and does not share a place feature with 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: Overapplication

(19) *Lardil in Containment: iterative deletion*

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

The Empirical Picture

Underlying triggers only 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 that are amply attested in Newman’s description.’
(emphasis ours; Kenstowicz and Kisseberth, 1977, 78)

Non-Iterativity in Lardil

- ◆ no instance of non-iterativity of two phonological processes in Lardil: the final vowel deletion is only found in the nominative and is hence **morphological, not phonological**
(Hale, 1973; McCarthy and Prince, 1993; Horwood, 2001; Bye, 2006; Round, 2011)
- ◆ cf. Staroverov (2015) for counterarguments against this claim

CB and Insertion in German'

- ◆ **unattested in the languages of the world?:** '[t]his kind of interaction between assimilation and epenthesis appears to be completely unattested, as originally suggested by Kenstowicz & Kisseberth (1971)' (Bakovic, 2007, 246); cf. also Kiparsky (1973)
- ◆ Counterexamples in Icelandic (Karvonen and Sherman, 1997), Armenian dialects (Vaux, 1998), English dialects, Modern Greek (Vaux, 2016)?
- ➔ **reanalysis** as transparent interaction (Riggs (2008) for Icelandic or Bakovic and Pajak (2011) for Armenian)

Conclusion

General Summary: Predicted Patterns

Pattern	Predicted by:			Attested?
	RO	SCOT	2LC	
Counterfeeding: Lomongo	☺	☹	☺	Yes
Counterbleeding: T. Hebrew	☺	☹	☺	Yes
S-D. Feeding: Turkish	☺	☹	☺	Yes
Grandfather Effect: M. Arabic	☹	☹	☺	Yes
Non-iterativity: Lardil	☺	☹	☹	Not necessarily
CB and Insertion: German'	☺	☹	☹	Not necessarily
Underlying Triggers: Yawelmani	☺	☹	☹	No

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

Conclusion

- ◆ Two-Level-Containment is able to solve opacity problems standard correspondence-theoretic OT faces
- ◆ based on Cloning Hypothesis: a more restrictive version than, for example ‘Multi-level’ containment where reference to only the input structure is possible (McCarthy, 1996) – this theory overgenerates
- ◆ several opaque patterns possible under rule-ordering are excluded in Two-Level-Containment: unattested or isolated instances that allow at least more interpretations of the empirical facts

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