

Laryngeal markedness and the typology of repair

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1 Introduction

(1) Too Many Solutions problem (Steriade 2001a, Lombardi 2001)

- a. Many logically possible ‘repairs’ for markedness statements are unattested.
- b. *Ex.* Laryngeal markedness: feature changes, but not epenthesis or deletion.

Constraint	Violating structure	Attested repair	Unattested repairs
NOVOIOBSTR ¹	ʔaɪpad	ʔaɪpaɫ	ʔaɪpadə, ʔaɪpa_
AGREEVOI ²	ʔabta	ʔaɪpta (ʔabdɑ)	ʔabəta, ʔa_tɑ, ʔab_a

¹Survey: Lombardi (2001). ²Survey: Steriade (2001b)

(2) Role of similarity

- a. General idea: Attested repairs are maximally similar to violating structures.
- b. Specific issue: How do grammars encode relative similarity?

(3) Two approaches

- a. Hierarchical faithfulness
 - Segment deletion entails featural unfaithfulness (Lombardi 2001)
 - Universal faithfulness ranking encodes similarity (Steriade 1997, 1999, 2001)
- b. Targeted markedness (Wilson 2001, 2003; Bakovic & Wilson 2000)
 - Markedness constraints prefer only maximally similar repairs [§2].

(4) Main claims

- a. Hierarchical faithfulness can be subverted by interaction with markedness.

/ʔabta/	AGREEVOI	MAXC	MAXVOI	DEPV
i. ʔabta	* !			
ii. ʔaɪpta			* !	
iii. ʔabəta				*

AGREEVOI fails to distinguish assimilation ([ʔaɪpta]) from epenthesis ([ʔabəta]).

- b. Targeted constraints avoid this problem by limiting markedness preferences.

/ʔabta/	T-AGREEVOI	MAXC	IDENTVOI	DEPV
i. ʔabta	+ !			
ii. ʔaɪpta			+	
iii. ʔabəta	⊕ !			+

Epenthesis ([ʔabəta]) is not the minimal change— T-AGREEVOI does not prefer it.

2 Targeted-constraint analysis

(8) OT with targeted constraints (TCOT; revision of Wilson 2000, 2001)

- a. Targeted markedness constraints prefer only maximally similar repairs.
- b. Targeted markedness constraints generate candidate sets (modulo prosody).

(9) Calculation of dissimilarity (Δ)

- a. Prosodic licensing: more costly to change elements in licensing positions.
Beckman 1997, 1998, Lombardi 2001; see also Goldsmith 1990, 1993 Ito 1986
- b. P-Map: more costly to change elements that have richer perceptual cues.
Steriade 2001; see also Fleischhacker in progress, Padgett 2004, Zhang 2001

(10) Laryngeal markedness and similarity

- a. Release cues or Onset position protect the [voice] specification of the second member of an obstruent cluster. *Ex.* $\Delta(\text{?abta}, \text{?abda}) > \Delta(\text{?abta}, \text{?apta})$.
- b. Assume that other possible repairs, including epenthesis and deletion, are more costly than changing [voice] specification of the first obstruent.
Ex. $\Delta(\text{?abta}, \text{?abata}), \Delta(\text{?abta}, \text{?a_ta}), \Delta(\text{?abta}, \text{?ab_a}), \dots > \Delta(\text{?abta}, \text{?apta})$.

(11) Targeted markedness constraints

- a. Structural description of a markedness constraint M defines a relation from candidates to candidate sets.

$$\mathbf{M}(x) = \{ y \in \text{Rep}_{UG} \mid \#M(x) > \#M(y) \},$$

where $\#M(\alpha)$ stands for the # of instances of M 's struct. descrip. in α (Prince 2003).

- b. Targeted markedness constraint selects the member(s) of $M(x)$ that is/are most similar to x (i.e., such that dissimilarity Δ is minimal).

$$\mathbf{T-M}(x) = \text{argmin}_{y \in M(x)} \Delta(x, y) = \{ y \in M(x) \mid \forall z \in M(x) [\Delta(x, z) \geq \Delta(x, y)] \}$$

(12) Targeted AGREEVOI

Structural description: *[-sonorant, α voice][-sonorant, $-\alpha$ voice]

- a. $\text{AGREEVOI}(\text{?abta}) = \{ \text{?apta}, \text{?abda}, \text{?abata}, \text{?a_ta}, \text{?ab_a}, \emptyset, \dots \}$
- b. $\text{T-AGREEVOI}(\text{?abta}) = \{ \text{?apta} \}$

(13) TCOT axiom of preference

Given a reference candidate x , the marks assigned by targeted constraint T-M must conform to the following axiom of preference:

$$\mathbf{T-M \text{ prefers } y \text{ over } x} \Leftrightarrow y \in \mathbf{T-M}(x)$$

(14) **Mark addition:** add a mark (\oplus) to every non-minimal member of $T-M(x)$.

/ʔabta/	T-AGREE _{VOI}	MAXC	IDENT _{VOI}	DEPV
i. ʔabta	+			
ii. ʔap̣ta			+	
iii. ʔaḅta				+

Problem: T-AGREE_{VOI} prefers ʔaḅta to ʔabta, but ʔaḅta \notin T-AGREE_{VOI}(ʔabta)

/ʔabta/	T-AGREE _{VOI}	MAXC	IDENT _{VOI}	DEPV
i. ʔabta	+ !			
ii. ʔap̣ta			+	
iii. ʔaḅta	\oplus !			+

Mark addition eliminates the illegitimate preference.

(15) **Candidate generation**

- a. OT: universal function GEN provides an infinite candidate set for each input.
- b. TCOT: universal targeted markedness constraints generate finite cand. sets.

(16) **Alignment of preference and generation**

Given a reference candidate x , a targeted constraint T-M generates all and only the alternative candidates that it prefers: $GEN_{T-M}(x) = T-M(x)$.

Unfaithful candidates can be optimal only if markedness prefers them (Moreton 2004), thus it makes sense to place the burden of candidate generation on the markedness constraints.

(17) **TCOT grammar architecture**

- a. Harmonic serialism (Prince & Smolensky 1993/2002:§5.2.3.3, McCarthy 2000):
Iterative generation-and-optimization until no improvement is possible.
- b. Candidates and marks are calculated relative to the output of the preceding step of the derivation (initially the input): this is the ‘reference candidate’.
 $GEN(x) = \cup GEN_{T-M}(x)$ (union over the set of targeted constraints)

Residual universal GEN_{Pros} creates all possible prosodic parses of the structures in $GEN(x)$, allowing for fully parallel computation of (e.g.) stress; not directly relevant today.

(18) **Summary:** similarity & structural descriptions \rightarrow preferences \rightarrow candidate sets

- a. Mark addition aligns preferences with similarity (axiom of preference).
- b. Markedness-based GEN aligns candidate sets with preferences.

(19) Factorial typology of laryngeal repair

/ʔabta/	T-AGRVOI	T-NOVOIOBST	IDVOI	MAXC	DEPV	NOCODA
i. ʔabta	+	+				+
ii. ʔa <u>p</u> ta			+			+
iii. ʔab <u>ə</u> ta	⊕	⊕			+	
iv. ʔa <u> </u> ta	⊕	⊕		+		
v. ʔab <u> </u> a	⊕	⊕		+		

/ʔapda/	T-AGRVOI	T-NOVOIOBST	IDVOI	MAXC	DEPV	NOCODA
i. ʔapda	+	+				+
ii. ʔa <u>b</u> da		++	+			+
iii. ʔa <u>p</u> ta	⊕		+			+
iv. ʔap <u>ə</u> da	⊕	+			+	
v. ʔa <u> </u> da	⊕	+		+		
vi. ʔap <u> </u> a	⊕	⊕		+		

3 Comparison with hierarchical faithfulness

(20) Review of Lombardi 2001

a. Deletion of a voiced (coda) obstruent entails deletion of its voicing

/ʔaipad/	NOVOIOBSTR	MAXVOI	MAXC
i. ʔaipad	*		
ii. ʔaipat̚		*	
iii. ʔaip <u>a</u>		*	*

Harmonic bounding: /ʔaipad/ → ʔaipat̚ > /ʔaipad/ → ʔaipa (holds only if there is no constraint IDENTVOI; deletion of voiced and voiceless codas can be forced by NOCODA).

b. Vowel epenthesis does not repair a voiced (coda) obstruent

/ʔaipad/	NOVOIOBSTR	MAXVOI	DEPV
i. ʔaipad	*		
ii. ʔaipat̚		*	
iii. ʔaipad <u>ə</u>	*		*

Collective bounding: /ʔaipad/ → ʔaipat̚ or ʔaipad > /ʔaipad/ → ʔaipadə (holds only if there is no NOVOIOBSTR/CODA = NOVOIOBSTR & NOCODA (Ito & Mester 2003)).

(21) Basic problem: no harmonic bounding in clusters

- a. Analysis of singletons depends upon absence of a markedness constraint that prefers epenthesis or deletion over featural unfaithfulness.
- b. Harmonic bounding does not extend to clusters, because AGREEVOI can be satisfied by epenthesis into a disagreeing cluster.

/ʔabta/	AGREEVOI	MAXC	MAXVOI	DEPV
i. ʔabta	* !			
ii. ʔap <u>ta</u>			* !	
iii. ʔab <u>a</u> ta				*

(22) Unintended typological consequences: unattested markedness reversals

- a. Only voiced obstruents allowed in coda

/pat/	MAXVOI	NoCODA	MAXC	NoVOIOBSTR
i. pa <u>d</u>		* !		*
ii. pat		* !		
iii. pa_			*	

Coda voiceless obstruents are deleted: [NoCODA>>MAXC].

/pad/	MAXVOI	NoCODA	MAXC	NoVOIOBSTR
i. pa <u>d</u>		*		*
ii. pa <u>t</u>	* !	*		
iii. pa_	* !		*	

MAXVOI protects coda voiced obstruents from deletion: [MAXVOI>>MAXC].

- b. Only clusters of voiced obstruents escape deletion

/ʔapda/	/ʔabta/	MAXVOI	NoCODA	MAXC	NoVOIOBSTR
i. ʔapda	i. ʔabta		* !		*
ii. ʔa_da	ii. ʔab_a			*	*
iii. ʔap_a	iii. ʔa_ta	* !		*	

Voiceless obstruents in clusters are deleted: [{MAXVOI, NoCODA} >> MAXC].

/ʔabda/	MAXVOI	NoCODA	MAXC	NoVOIOBSTR
i. ʔ <u>ab</u> da		*		**
ii. ʔa_da	* !		*	*
iii. ʔab_a	* !		*	*

MAXVOI protects both members of a voiced cluster from deletion: [MAXVOI>>MAXC].

(23) Unintended typological consequences: unattested deletion patterns

a. Voiceless obstruents preferentially delete in clusters

/ʔapda/	/ʔabta/	NoCODA	MAXC	MAXVOI	NoVOIOBSTR
i. ʔapda	i. ʔabta	* !			*
ii. ʔa_da	ii. ʔab_a		*		*
iii. ʔap_a	iii. ʔa_ta		*	* !	

MAXVOI emerges to protect a voiced obstruent in a cluster with a voiceless obstruent; deletion occurs in all-voiced clusters, voiceless obstruents surface faithfully in onsets.

b. Voiced obstruents preferentially delete in clusters

/ʔapda/	/ʔabta/	NoCODA	MAXC	NoVOIOBSTR	MAXVOI
i. ʔapda	i. ʔabta	* !		*	
ii. ʔa_da	ii. ʔab_a		*	* !	
iii. ʔap_a	iii. ʔa_ta		*		*

NoVOIOBSTR emerges to delete an obstruent in a cluster with a voiceless obstruent; deletion also occurs in all-voiced clusters, voiced obstruents surface faithfully in onsets.

(24) Additional unintended typological consequences

a. Underlying voiced obstruents delete in onset but device in coda

- { NoVOIOBSTR, IDONSVOI } >> { MAXC, ONSET, MAXVOI }

b. Vowel epenthesis breaks up only underlying voiced+voiceless clusters

- { MAXVOI, AGREEVOI, IDONSVOI } >> DEP V

(25) Summary

- MAXVOI is not sufficient to restrict the factorial typology: untargeted AGREEVOI can force epenthesis into disagreeing clusters.
- MAXVOI predicts several unattested markedness reversals: MAXF protects marked segments from deletion in a way that IDENTF cannot.

(26) Review of Steriade 1997, 2001

- Similarity according to the P-Map projects universal rankings of faithfulness constraints; e.g., MAXC and DEP V universally dominate IDENTVOI.

/ʔaɪpad/	NoVOIOBSTR	MAXC	DEP V	IDENTVOI
i. ʔaɪpad	* !			
ii. ʔaɪpaɪ				*
iii. ʔaɪpa_		* !		
iv. ʔaɪpadɔ			* !	

b. Same result holds for clusters.

/ʔapda/	AGREEVOI	MAXC	DEPV	IDENTVOI
i. ʔapda	* !			
ii. ʔ a da				*
iii. ʔa_da		* !		
iv. ʔap <u>ə</u> da			* !	

(27) **Problem: intervention of other markedness constraints**

- a. Universal rankings of faithfulness can be circumvented by markedness constraints that mimic the preferences of lower-ranked faithfulness.
- b. *Ex.* unattested /si/→se mapping (due to palatalization) can be achieved.³

/si/	PAL	NOPOSTSIB	IDENTHI	IDENTANT
i. si	* !			
ii. <u>š</u> i		* !		*
iii. <u>se</u>			*	

³Survey of “solutions” to PAL: Steriade (2001b).

4 Restricting solutions with targeted constraints

(28) **Similarity dependence** (Steriade 2001)

Independently motivated similarity relations (as represented by the P-Map) determine the range of attested repairs.

(29) **Invariance under ranking: {M₁, F₁...F_n}** (Lombardi 2001, Steriade 2001)

The set of predicted repairs for a given type of marked structure (e.g., “voiced codas”) must be invariant under all possible faithfulness rankings.

(30) **Ranking invariance: full interaction ({M₁...M_n, F₁...F_n})**

- a. Targeted constraints are required to restrict the set of predicted repairs under all rankings of markedness and faithfulness.
- b. *Ex.* harmonic bounding of unattested /si/→se mapping.

/si/	T-PAL	T-NOPOSTSIB	IDENTHI	IDENTANT
i. si	+			
ii. <u>š</u> i		+		+
iii. <u>se</u>	⊕		+	

(31) Summary and conclusion

- a. Previous approaches to the Too Many Solutions problem succeed only in the special case of a *single* markedness constraint interacting with faithfulness.
- b. TCOT provides a more general solution: repairs that are not preferred by markedness constraints are not generated, and therefore lose under any ranking of *all* markedness and faithfulness constraints.

See also applications of TCOT to phonological opacity (Wilson 2001), harmonic transparency (Bakovic & Wilson 2000), and unbounded spreading (Wilson 2003)

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