

Rules, Constraints, and Overlapping Violations: the case of Acoma accent loss

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1. Introduction

This paper compares and contrasts Targeted Constraint Optimality Theory (TCOT) (Wilson, in prep) and rule-based phonology. Though the two systems share striking similarities, the TCOT system provides an analysis for a pattern involving overlapping violations that is difficult for the rule-based system. This pattern is attested in Acoma accent loss.

Section 2 introduces TCOT and highlights its similarities to rule-based phonology. Section 3 introduces the Acoma data. Section 4 compares Anderson's (1974) rule-based account with a TCOT account of the Acoma data. Section 5 concludes that Wilson's most recent version of TCOT is most accurately viewed as a system of rules and constraints but much more fully formalized than pre-OT proposals (e.g. Paradis 1988, Myers 1991).

2. Targeted Constraint Optimality Theory

Wilson's (in prep) instantiation of OT, Targeted Constraint OT (TCOT), is a derivational framework that extends the theory in Wilson (2001). TCOT avoids two difficulties of *classic OT*, the instantiation in Prince and Smolensky (1993). First, TCOT both predicts opacity effects, many of which are well-known to be difficult for classic OT (see Kager 1999 for an overview).¹ Second, TCOT avoids a less familiar problem, the sort of non-local interactions illustrated below.

2.1 The Problem of Non-local Interaction

Wilson (in prep) shows how, in a classic OT system, an empirically motivated spreading constraint and a standard OT constraint can give rise to an unattested kind of non-local interaction. Consider a system that includes

*Special thanks are due to Paul Smolensky, Colin Wilson, Luigi Burzio, Bob Frank, Gaja Jarosz, Sara Finley, and audiences at PLC 30 and GLOW 29 for their helpful discussion and valuable feedback.

¹See, however, Bakovic 2006 for a type of opacity effect that is difficult for rule-based phonology and straightforward for classic OT.

the non-local spreading constraint given in (1), a paraphrase of the constraint proposed by Walker (1998/2000) in her analysis of unbounded nasal spreading in Malay, the phenomenon illustrated in (2). This constraint evaluates elements of an unbounded distance from the [+nasal] domain.

- (1) SPREAD-R([+nasal], PrWd):
 For every [+nasal] autosegment *n*, assign 1 violation for every segment in the same prosodic word that is to the right of *n*'s domain.
- (2) a. mǎnǎwǎn 'to capture'
 b. mǎkan 'to eat'
 c. pəŋǎwǎsan 'supervision'

Suppose further that the constraint in (1) is ranked above *CC#, a standard constraint against word-final consonant clusters, and that its violations are repaired by forcing epenthesis, as exhibited in /dawakast/ → [dawakasət]. When given the hypothetical input /nawakast/, this system favors the form without epenthesis over the form with epenthesis, as shown in tableau 1. The epenthetic vowel causes candidate a in Tableau 1 to incur one additional violation of SPREAD-R([+nasal], PrWd).

/nawakast/	SPREAD-R([+nasal], PrWd)	*CC#
a. nǎwǎkasət	*****!	
b. nǎwǎkast	****	*

Tableau 1: Non-local blocking of vowel epenthesis

As Wilson notes, the predicted pattern is as follows:

“Vowel epenthesis applies to a form with a final cluster *except when* there is a preceding [+nasal] feature anywhere in the word that is blocked from spreading to the right edge.

This is obviously problematic, because naturally-occurring epenthesis processes are never sensitive to this type of global, feature-based condition. Any real language that maps /dawakast/ to an output with an epenthetic vowel will also do the same for /nawakast/ . . .”

2.2 The Proposed System

TCOT is not the first variation of OT to incorporate a derivational aspect. However, there are several novel aspects of theory:

1) How change is integrated:
Changes are introduced by GENs associated with a particular targeted markedness constraint.

2) How changes are evaluated:
Individual constraints reward certain changes but penalize others.

Both aspects utilize both pieces of information carried by targeted constraints: marked patterns and the preferred repair.

(3) A targeted constraint C is a pairing of a locus of violation (λ) with a change (δ). (Wilson, in prep)

Wilson's claim is that δ is limited to the minimal perceptual change (e.g., Steriade's 2001 P-map). The formal machinery, however, allows any rewrite rule to have a targeted constraint analogue. For example, a relatively complex rewrite rule, such as (4), can be converted into a targeted constraint, as in (5). The rewrite part of the rule, the section to the left of the slash, corresponds to δ . The context part of the rule plus the segment to be changed, the section to the right of the slash, corresponds to λ . The symbol "T:" indicates that the constraint is targeted.

(4) $V \rightarrow [-\text{accent}] / [+obst] ___ [+obst] C_0 [+ \text{syll}, + \text{accent}]$

(5) T:*CLASH:
 λ : two consecutive [+accent] syllables, where the first vowel is short and is flanked on both sides by an obstruent.
 δ : [+accent] \rightarrow [-accent] in the first syllable

Note that because an accented syllable may be either the target or context of a change, a segment may be simultaneously part of two instances of λ .

These are the cases we refer to as *overlapping violations*.

The first novel aspect places the responsibility of candidate generation on the targeted constraints. In TCOT, there is a GEN_C associated with each targeted-constraint C. Each GEN_C maps each candidate to a candidate set, derived by applying change δ to zero or more instances of λ in the input candidate. For example, given an input with two overlapping violations, $C\acute{V}C\acute{V}C\acute{V}$, $GEN_{T:*CLASH}$ produces four candidates. I.e., $GEN_{T:*CLASH}(C\acute{V}C\acute{V}C\acute{V}) = \{ C\acute{V}C\acute{V}C\acute{V}, CVC\acute{V}C\acute{V}, C\acute{V}CVC\acute{V}, CVCVC\acute{V} \}$.²

²In Wilson's conception of the TCOT architecture, the prosodic parsing of candidates arises from GEN_{PROS} , which is not associated with a targeted-constraint. Like the GEN in classic OT, the members in the output set of GEN_{PROS} are not

0 applications of δ	$C\acute{V}C\acute{V}C\acute{V}$	completely faithful candidate
1 application of δ	$CVC\acute{V}C\acute{V}$	δ applies to left λ
1 application of δ	$C\acute{V}CVC\acute{V}$	δ applies to right λ
2 applications of δ	$CVCVC\acute{V}$	δ applies to both λ 's

The second novel aspect, how changes are evaluated, requires that each member of the set of candidates generated by GEN_C be evaluated relative to the particular input form from which it was derived.

- (6) Constraint evaluation in TCOT
 Let C be any constraint that specifies both a locus λ and a change δ ,
 x be an input representation to GEN_C ,
 y be a member of $GEN_C(x)$, and
 Δ be the change from x to y .
- a. For every $\lambda \in C(y)$, assign one mark to y .
 - b. For every $\lambda \in C(x)$ that is repaired in the way specified by δ , remove one mark from y .
 - b'. For every $\lambda \in C(x)$ that is repaired in a way not specified by δ , add one mark to y .³

Tableau 2 shows us how the members in our earlier example output set, $GEN_{T:*CLASH}(C\acute{V}C\acute{V}C\acute{V})$ are evaluated. The candidate most preferred by our example targeted constraint is the fourth candidate, the candidate in which all violations λ of $T:*CLASH$ are repaired as specified by δ .

The targeted constraint continues to generate candidates and evaluate until a faithful pairing wins. In our example, $CVCVC\acute{V}$ becomes the new input to $GEN_{T:*CLASH}$. Since there are no λ 's in $CVCVC\acute{V}$, the output set $GEN_{T:*CLASH}(CVCVC\acute{V}) = \{CVCVC\acute{V}\}$. This single member of the output set is necessarily the preferred candidate of $GEN_{T:*CLASH}$ at this step of the derivation. Since the faithful candidate is the winning candidate, the system moves on: $CVCVC\acute{V}$ becomes the input to the GEN_C associated with next

determined by applying a specific repair. Rather, GEN_{PROS} adds all universally-possible prosodic parses of the candidates. If x is the original candidate, then the resulting prosodically parsed candidate set is $GEN_{PROS}(GEN_C(x))$. Since what is novel is constraint specific GEN_S , we will set aside GEN_{PROS} in the comparison here.

³Wilson's formalization actually states that for every $\lambda \in C(x)$ that is repaired in a way not specified by δ , one mark is removed from the completely faithful candidate. However, he later states, "The alternative solution would be to *add* a mark to y ." For Wilson, the two formalizations are equivalent because he compares only two candidates at a time. His examples have only one violation and thus, only one y . The version here facilitates comparison between more than two candidates at a time.

highest ranked targeted constraint. The architecture of the whole system is given in (7).

input x : CVCVCV

Candidate y	Violations that remain	Violations fixed as specified by δ	Violations fixed, but not as specified by δ	Total
CVCVCV	+2	0 + 0	0 + 0	= +2
CVCVCV	+1	(-1) + 0	0 + 0	= 0
CVCVCV	0	0 + (-1)	+1 + 0	= 0
CVCVCV	0	(-1) + (-1)	0 + 0	= -2

Tableau 2: Evaluation of $\text{GEN}_{\text{T}:\text{*CLASH}}$ (CVCVCV)

- (7) Derivational TCOT (Wilson's (33) repeated)
 Let $H = [C_1 \gg C_2 \dots \gg C_n]$ be any constraint hierarchy and in be any input.
- a. The initial output, out_0 , is the surface form that is identical to in .
 - b. For every constraint C_k where $(1 \leq k \leq n)$, an output is derived by repeatedly generating with $[\text{GEN}_{\text{PROS}} \circ \text{GEN}_{C_k}]$ and selecting the most harmonic member of the candidate set with the entire hierarchy H .
 - i. The initial input for C_k , $in_{k,0}$, is equal to out_{k-1} .
 - ii. For $m > 0$, $out_{k,m} = H\text{-max}([\text{GEN}_{\text{PROS}} \circ \text{GEN}_{C_k}](out_{k,m-1}))$.
 If $out_{k,m} = out_{k,m-1}$, then the final output for C_k , out_k , is equal to $out_{k,m}$ and generation with C_k ends.
 - c. The final output of the last constraint, out_n , is the output that the grammar generates for input in .

2.3 TCOT and Rule-based Phonology

Thus far, we have seen that both TCOT and rule-based phonology specify preferred repairs, generate intermediate representations, and avoid difficulties of classic OT. In fact, the same profile of output wellformedness in Tableau 2 can be obtained by rewarding an output form for each rule application. The last column of Table 1 shows the result obtained by using the number of potential rule applications, i.e. instances where the input form satisfies the conditions for rule application, as the initial "wellformedness score" and subtracting 2 for each actual rule application.

input x : CVCVCV̇

Output y	Number of times rewrite rule could apply	(-2) reward for each rule application	Total
CVCVCV̇	2	0 * (-2)	= +2
CVCVCV̇	2	1 * (-2)	= 0
CVCVCV̇	2	1 * (-2)	= 0
CVCVCV̇	2	2 * (-2)	= -2

Table 1: Outcome of rewarding rule application

These similarities raise the question of whether TCOT and rule-based phonology are in fact notational variants of one another, or whether one is to be preferred over the other on principled grounds. For Wilson, the notion of minimal perceptual change sets the δ of targeted constraints apart from stipulative changes of rewrite rules. It is not clear yet, however, that all observed changes can be independently motivated or that the notion of minimal perceptual change could not also be incorporated into rule-based theory. It is clear, however, that the architectures of the two systems diverge. TCOT retains the notion of competing output candidates evaluated against a ranking of violable constraints. Below, we see how this allows TCOT to straightforwardly account for a pattern that is difficult for rules.

3. Accent Loss in Acoma

Acoma is a Native American language spoken by the people group of the same name. Acoma pueblo, also called Sky City, is located about sixty miles west of Albuquerque, New Mexico. Acoma is closely related to other pueblo languages, which together make up the Keres language family. The data given here are drawn from Miller's (1965) book.

In Acoma, one of three accents can appear on a given vowel: a high pitch (marked with an acute accent); a falling pitch (marked with a circumflex); and a 'glottal' falling pitch (marked with a glottal stop). The accentual pattern is not easily characterized, but for a large group of forms, accent assignment is systematic. This is the set of forms which contain suffixes conditioning what Miller calls 'accent ablaut'. Approximately twelve suffixes are ablauting suffixes, and when one is present, the high accent is assigned to every syllable of the word (together, in some cases, with the lengthening of the final vowel).⁴ (8a) shows the effect on the accent

⁴Certain final syllables are exceptions, but this will not affect our discussion.

pattern when an ablauting suffix is added to the form in (8b).

- (8) a. with accent ablaut: r ú u n í š í i z é ‘on Monday’
 b. without accent ablaut: r û u n i š i ‘Monday’

Miller also noted that certain circumstances lead to subsequent loss of the high accents assigned by the accent ablaut rule: a short syllable between obstruents followed by an accented syllable loses its accent.⁵ Anderson (1974) formalized this generalization as the rewrite rule in (9). This is the same rule as in (4), used earlier in section 2 to illustrate how a targeted constraint analogue can be created from a rewrite rule.

- (9) V → [-accent] / [+obst] _____ [+obst] C₀ [+syll, +accent]

Anderson uses the term *context* to refer to the conditions for rule application and *focus* to refer to the segments that satisfy the conditions. Examples of accent loss in a form containing a single focus are given in (10). A vowel that has lost its accent is denoted with underling and italicization.

- (10) a. k u b é n í ‘at sunset’
 b. s í u k a č á n í ‘when I saw him’
 c. s é i n ú u s t’ u z í m í ‘when I put the fire out’

When two consecutive vowels meet the conditions for application of the rule in (9), more than one syllable can lose its accent. This is particularly interesting because one focus of the rule may be part of the context for another possible application of the rule. That is, there is the potential to bleed a reapplication of a rule, though it seems that this is not what happens:

- (11) a. k’ a p i š ó n í ‘at night’
 b. s’ i p a k á a w á n í ‘when I chopped wood’
 c. k’ a c a k á n’ í ‘his cigarettes’

This pattern can be accommodated with directional rule application. If we posit the rule to apply right to left, we predict an incorrect form. If we

⁵Short syllables adjacent to a glottalized sonorant also lose their accents. Again, this will not affect our discussion.

derivation that maximizes rule application requires looking very far “downstream.” Also illustrated by the two-foci case, some rules must be allowed to reapply.

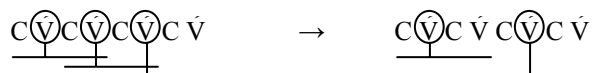


Figure 1: All potential rule applications and independent rule applications

4. TCOT and Overlapping Violations

Because the goal here is to compare the patterns allowed by the machinery of TCOT with those allowed by rules, using a targeted constraint that is transparently related to Anderson’s rule makes comparison maximally straightforward. We have already introduced such a targeted-constraint in (5), and we repeat it in (15a). The remaining markedness constraints used in this analysis are modified constraints from the stress literature (Prince and Smolensky 1993/2004, Gordon 2002).⁶ The discussion below assumes *EXTLAPSE-ACCENT and *LAPSE-ACCENT are untargeted markedness constraints of the usual kind. The ranking in (16) yields the desired result.⁷

(15) Constraints used in TCOT analysis of Acoma accent loss

a. T:*CLASH:

λ: two consecutive [+accent] syllables, where the first vowel is short and is flanked on both sides by an obstruent.

δ: [+accent] → [-accent] in the first syllable

b. *LAPSE-ACCENT: penalize two consecutive unaccented syllables

c. *EXTLAPSE-ACCENT: penalize three consecutive unaccented syllables

d. FAITH-ACCENT: penalize changes in a syllable’s accent

(16) *EXTLAPSE-ACCENT >> T:*CLASH >> *LAPSE-ACCENT, FAITH-ACCENT

In the two overlapping λ’s case, schematized as CVCVCVCV, T:*CLASH prefers the form with two repairs, schematized as CVCVCVCV. Though this form violates *LAPSE-ACCENT, T:*CLASH’s higher ranking overrides the preference of *LAPSE-ACCENT, making CVCVCVCV the correctly predicted output pattern.

⁶It is worth noting that T:*CLASH also shares similarities to a constraint from the stress literature, *CLASH: no stressed syllables are adjacent (Lieberman 1975).

⁷This analysis owes significantly to direct suggestions by C. Wilson (p.c.).

In the three overlapping λ 's case, schematized as $C\acute{V}C\acute{V}C\acute{V}C\acute{V}$, T:*CLASH will again most prefer the form with the maximum number of repairs, schematized as $C\acute{V}C\acute{V}C\acute{V}C\acute{V}$. The form with three repairs, however, violates the higher ranked *EXTLAPSE-ACCENT. T:*CLASH's next-most preferred candidates are those forms with two repairs: $C\acute{V}C\acute{V}C\acute{V}C\acute{V}$, $C\acute{V}C\acute{V}C\acute{V}C\acute{V}$, and $C\acute{V}C\acute{V}C\acute{V}C\acute{V}$. Among these three, only the latter satisfies *LAPSE-ACCENT. Thus, $C\acute{V}C\acute{V}C\acute{V}C\acute{V}$ is the correctly predicted output form.

Let us consider the derivation of (11a), [k'apísəní], our example of the case of two overlapping λ 's, in more detail. (A derivation chart is given in below.) We begin with the form that results after accent ablaut has assigned a high accent to every syllable, which we follow Miller in taking to be /k'apísəní/. At step 1, it is evaluated against *EXTLAPSE-ACCENT. Recall that candidate generation is the work of targeted markedness constraints. Since *EXTLAPSE-ACCENT is not targeted, no new candidates will be generated. As the only candidate, the faithful form will be the most harmonic candidate. Since the input is the same as the output, we can move to step 2, evaluation against T:*CLASH. There are two violations of T:*CLASH in the input. As we saw in the generic $C\acute{V}C\acute{V}C\acute{V}$ example above in section 2, $GEN_{T:*CLASH}$ produces four candidates. Since targeted constraints will always prefer the form in which δ applied maximally, the most harmonic candidate is the one in which δ is applied to both loci of violation. For concreteness, we arbitrarily assign the third position in the hierarchy to FAITH-ACCENT and the fourth position to *LAPSE-ACCENT. Neither FAITH-ACCENT nor *LAPSE-ACCENT are targeted constraints. Thus, neither has an associated GEN_C , and no new candidates are generated.

Step	Input	Candidate set	Output	Comments
0	k'apísəní		k'apísəní	
1	k'apísəní	{k'apísəní}	k'apísəní	No change
2, 1	k'apísəní	$GEN_{T:*CLASH}(k'apísəní)$ = {k'apísəní, k'apísəní, k'apísəní, k'apísəní}	k'apísəní	Loss of accent on both loci of violation
2, 2	k'apísəní	$GEN_{T:*CLASH}(k'apísəní)$ = {k'apísəní}	k'apísəní	No change
3	k'apísəní	{k'apísəní}	k'apísəní	No change
4	k'apísəní	{k'apísəní}	k'apísəní	No change

Chart 1: Derivation chart for (k'apísəní, k'apísəní)

k'apíšəní	*EXT LAPSE- ACCENT	T:*CLASH	FAITH- ACCENT	*LAPSE- ACCENT
k'apíšəní		k'apí : violation +1 píšə : violation +1 Total = 2 (!)		
k'apíšəní		k'apí : not fixed as in δ: +1 píšə : fixed as in δ: -1 Total = 0 (!)	*	
k'apíšəní		k'apí : fixed as in δ: -1 píšə : violation +1 Total = 0 (!)	*	
→ k'apíšəní		k'apí : fixed as in δ: -1 píšə : fixed as in δ: -1 Total = -2	**	*

Tableau 3: Evaluation of $GEN_{T:*CLASH}(k'apíšəní)$ against T:*CLASH

The discussion above should equip the reader to understand chart 2, the derivation of (13c) [súçítístáaní], our example of the three overlapping λ 's case, and tableau 4, the evaluation of [súçítístáaní] at T:*CLASH.

Step	Input	Candidate set	Output	Comments
0	súçítístáaní		súçítístáaní	
1	súçítístáaní	{súçítístáaní}	súçítístáaní	No change
2, 1	súçítístáaní	$GEN_{T:*CLASH}(súçítístáaní)$ = {súçítístáaní, súçítístáaní súçítístáaní, súçítístáaní súçítístáaní, súçítístáaní súçítístáaní, súçítístáaní}	súçítístáaní	Loss of accent on first and third syllables
2, 2	súçítístáaní	$GEN_{T:*CLASH}(súçítístáaní)$ = {súçítístáaní}	súçítístáaní	No change
3	súçítístáaní	{súçítístáaní}	súçítístáaní	No change
4	súçítístáaní	{súçítístáaní}	súçítístáaní	No change

Chart 2: Derivation chart for (súçítístáaní, súçítístáaní)

$\text{sú}\check{\text{c}}\acute{\text{i}}\text{ú}\text{í}\text{stá}\text{a}\text{n}\acute{\text{i}}$	*EXT-LAPSE-ACCENT	T:*CLASH	FAITH-ACCENT	*LAPSE-ACCENT
$\text{sú}\check{\text{c}}\acute{\text{i}}\text{ú}\text{í}\text{stá}\text{a}\text{n}\acute{\text{i}}$		$\text{sú}\check{\text{c}}\acute{\text{i}}$: violation +1 $\check{\text{c}}\acute{\text{i}}\text{í}$: violation +1 $\text{ú}\text{í}\text{stá}\text{a}$: violation +1 Total = +3 (!)		
$\text{sú}\check{\text{c}}\acute{\text{i}}\text{ú}\text{í}\text{stá}\text{a}\text{n}\acute{\text{i}}$		$\text{sú}\check{\text{c}}\acute{\text{i}}$: violation +1 $\check{\text{c}}\acute{\text{i}}\text{í}$: not fixed as in δ : +1 $\text{ú}\text{í}\text{stá}\text{a}$: fixed as in δ : -1 Total = +1 (!)	*	
$\text{sú}\check{\text{c}}\acute{\text{i}}\text{ú}\text{í}\text{stá}\text{a}\text{n}\acute{\text{i}}$		$\text{sú}\check{\text{c}}\acute{\text{i}}$: not fixed as in δ : +1 $\check{\text{c}}\acute{\text{i}}\text{í}$: fixed as in δ : -1 $\text{ú}\text{í}\text{stá}\text{a}$: violation +1 Total = +1 (!)	*	
$\text{sú}\check{\text{c}}\acute{\text{i}}\text{ú}\text{í}\text{stá}\text{a}\text{n}\acute{\text{i}}$		$\text{sú}\check{\text{c}}\acute{\text{i}}$: not fixed as in δ : +1 $\check{\text{c}}\acute{\text{i}}\text{í}$: fixed as in δ : -1 $\text{ú}\text{í}\text{stá}\text{a}$: fixed as in δ : -1 Total = -1	**	*!
$\text{sú}\check{\text{c}}\acute{\text{i}}\text{ú}\text{í}\text{stá}\text{a}\text{n}\acute{\text{i}}$		$\text{sú}\check{\text{c}}\acute{\text{i}}$: fixed as in δ : -1 $\check{\text{c}}\acute{\text{i}}\text{í}$: violation +1 $\text{ú}\text{í}\text{stá}\text{a}$: violation +1 Total = +1 (!)	*	
\rightarrow $\text{sú}\check{\text{c}}\acute{\text{i}}\text{ú}\text{í}\text{stá}\text{a}\text{n}\acute{\text{i}}$		$\text{sú}\check{\text{c}}\acute{\text{i}}$: fixed as in δ : -1 $\check{\text{c}}\acute{\text{i}}\text{í}$: not fixed as in δ : +1 $\text{ú}\text{í}\text{stá}\text{a}$: fixed as in δ : -1 Total = -1	**	
$\text{sú}\check{\text{c}}\acute{\text{i}}\text{ú}\text{í}\text{stá}\text{a}\text{n}\acute{\text{i}}$		$\text{sú}\check{\text{c}}\acute{\text{i}}$: fixed as in δ : -1 $\check{\text{c}}\acute{\text{i}}\text{í}$: fixed as in δ : -1 $\text{ú}\text{í}\text{stá}\text{a}$: violation +1 Total = -1	**	*!
$\text{sú}\check{\text{c}}\acute{\text{i}}\text{ú}\text{í}\text{stá}\text{a}\text{n}\acute{\text{i}}$	*!	$\text{sú}\check{\text{c}}\acute{\text{i}}$: fixed as in δ : -1 $\check{\text{c}}\acute{\text{i}}\text{í}$: fixed as in δ : -1 $\text{ú}\text{í}\text{stá}\text{a}$: fixed as in δ : -1 Total = -3	***	

Tableau 4: Evaluation of $\text{GEN}_{\text{T}:\text{*CLASH}}(\text{sú}\check{\text{c}}\acute{\text{i}}\text{ú}\text{í}\text{stá}\text{a}\text{n}\acute{\text{i}})$ against T:*CLASH

By retaining the OT architecture, TCOT also inherits the attribute of predicting typologies. We have already seen that the ranking in (16) simulates Anderson's proposed rule application process. The three other types of rule application discussed by Anderson, simultaneous, left-to-right, and right-to-left, can be simulated by re-ranking these constraints. When T:*CLASH is ranked above both *EXTLAPSE and *LAPSE, the winning candidates are those that remove the accents from all λ , the same outcome predicted by simultaneous rule application and left-to-right application. If instead T:*CLASH is ranked below both *EXTLAPSE and *LAPSE, the ranking predicts the same patterns as right-to-left application, so long as T:*CLASH continues to penalize any λ 's in the candidates throughout the derivation.

While we may not find another language identical to Acoma except in its accent loss pattern, what is important is that these other patterns of repair for overlapping violations are attested. Anderson uses multiple instances of Mandarin third tone sandhi ([tone 3] → [tone 2] / ___ [tone 3]) as an example of a pattern often attributed to left-to-right rule application (3-3-3-3# becomes 2-2-2-3#). Stress assignment has also been proposed to have a directionality parameter (Lieberman and Prince 1977, Prince 1983) and the strong tendency towards rhythmic alternation could be recast as the result of a directionally applying rule. For example, the stress system of Warao assigns main stress to the penultimate syllable and secondary stress to all even-numbered syllables counting back from the main stress (Kager 1999). A naïve account of Warao might include a rule ([σ] → [$\acute{\sigma}$] / ___ [σ]) that, when applied from right to left, would yield the pattern ($\sigma\sigma\sigma\sigma$ → $\sigma\acute{\sigma}\sigma\sigma$).

5. Interacting Rules and Constraints

While TCOT addresses weaknesses of classic OT by incorporating a number of aspects from classic generative phonology, the different predictions made indicate that TCOT is not a return to rule-based phonology, cleverly packaged in OT terms. Instead, TCOT's approach is a return to the strategy of pre-OT works in which output constraints (e.g. the OCP, Goldsmith 1976; No-Clash, Lieberman 1975) were posited to block or trigger rule application. Prior to the introduction of OT, the use of these mixed models raised the question of what principles governed the interaction of rules and constraints (e.g. Paradis 1998, Myers 1991). With the rise of classic OT, however, the problem dissolved, because classic OT posited that there were no rules, only interacting constraints. The TCOT framework incorporates crucial aspects of both approaches, but the problem of rule-constraint interaction is solved. TCOT can be viewed as a formalized answer to the question of how constraints and rules might interact within a single system.

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