

# An OT Perspective on Phonological Variation

Paul Kiparsky  
Stanford University

## The problem of structured variation in language

- (1)
  - a. Why does variation occur?
  - b. Are patterns of variation part of linguistic competence? If so, how are they represented? If not, how are they to be accounted for?
  - c. How are preferences related to categorical constraints?

The case of *-t/-d*-deletion in English:

- (2) Why is there the most deletion when the next word begins with a consonant? Why does “pause” have different effects on the frequency of deletion? The following table shows the rate of retained *-t*, *-d* for five groups of speakers:

	_##C	_##	_##V
Philadelphians (Guy 1980)	.00	.88	.62
New Yorkers (Guy 1980)	.00	.17	.34
Sansei (Iwai 1993)	.12	.48	.84
Nisei (Iwai 1993)	.41	.36	.70
Chicanos (Santa Ana 1991)	.39	.68	.67

Deletion is most frequent before C for all speakers. It is least frequent in some dialects before V, in others before “pause” (final position in some prosodic constituent). Pause can also group with C (e.g. Nisei) or with V (e.g. Chicanos). (Within C, the differentiation depends on onset structure: more frequent deletion before *l* than before *r*, etc. (Singh & Ford 1984, Guy 1991). Also the expected left context effects: sibilants > other obstruents > nasals > liquids > V.)

- (3) Why are *-t,-d* retained more often in level 2 inflectional endings, least often in monomorphemic words? Why is the retention rate an exponential function of boundary strength (Guy 1991)?

word type	% retained	Guy 1991		Santa Ana 1991	
		observed	predicted	observed	predicted
<i>toss#ed</i>	$r$	84.0		74.3	
<i>los+t</i>	$r^2$	66.1	70.6	59.3	55.2
<i>cost</i>	$r^3$	61.9	59.3	42.1	41.0

Guy proposes an explanation for this morphological factor on the basis of Lexical Phonology and Morphology (LPM). *toss#ed* is subject to *t/-d*-deletion once (after level 2 affixation), *los+t* twice (after level 1 affixation and again at level 2), and *cost* three times (prior to affixation, after level 1 affixation, and at level 2). If  $r$  is the fraction of forms that do not undergo the rule in a single application, then  $r^2$  will remain unaffected after two applications, and  $r^3$  after three applications. Two (potential) problems: (1) LPM is not about on-line speech production but about grammar, i.e. knowledge of language; (2) Guy’s explanation assumes a derivational model, inconsistent with evidence for constraint-based phonology.

## An optimality account: “t-/d-deletion” by interaction of violable universal constraints

Aim: derive variation patterns from UG principles.

Assumption: variation comes from competition of grammatical systems (in the individual or in the community), not from a probabilistic component in the rules of the language. A traditional argument for this position: variation between incommensurable systems (e.g. different underlying forms).

There are three ways to treat *-t*, *-d*, each with a cost:

- a. Syllabified as a coda, e.g. [lost][everything] (brackets show the syllabification). Cost: coda complexity. (Here is where the morphological conditions will come into play: syllable structure is enforced on roots, stems, and words.)
  - b. Syllabified as an onset (by resyllabification), e.g. [los][teverything]. Cost: an “alignment violation”: languages want word boundaries to coincide with syllable boundaries. (Resyllabification onto obstruents, nasals, *l*, is blocked by a dominant constraint, in line with the general constraints on onsets in English.)
  - c. Not syllabified, e.g. [los]t[everything]. This amounts to deletion. Cost: a “parsing violation” (an unrealized segment).
- (4) The constraints:
- a. SYLL(ABLE)-W(ELL)F(ORMEDNESS)
    - a. \*COMPLEX: No tautosyllabic clusters.
    - b. \*CODA: No codas.
  - b. ALIGN
    - a. ALIGN-LEFT-WORD: no resyllabification across word boundaries.
    - b. ALIGN-RIGHT-PHRASE: phrase-final C’s are not deleted.
  - c. PARSE
- (5) Ranking the constraints  
If PARSE  $\gg$  SYLL-WF, there is no deletion. If SYLL-WF  $\gg$  PARSE, there are three ways to order the remaining constraints. Each ordering yields a different categorical deletion pattern:
- a. SYLL-WF  $\gg$  ALIGN  $\gg$  PARSE: deletion everywhere.
  - b. ALIGN  $\gg$  SYLL-WF  $\gg$  PARSE: deletion before C and V.
  - c. SYLL-WF  $\gg$  PARSE  $\gg$  ALIGN: deletion before C and pause.
- (6) How to read the tableaux: each row shows one candidate output. The columns show the constraints, left to right in order of dominance. Stars mark constraint violations. Start with the leftmost column. If there is one unstarred candidate, select it. If there is a tie, discard the others and repeat on the next column until all but one candidate has been eliminated. Subsequent constraints are then irrelevant (marked by shading the row). Exclamation marks draw attention to the knockout constraint.

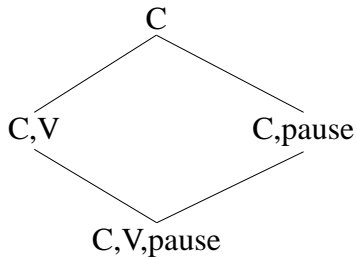
		SYLL-WF	ALIGN	PARSE		ALIGN	SYLL-WF	PARSE
1a.	t][V	*			t][V		*!	
1b.	☞ ]ℓ[V			*	☞ ]ℓ[V			*
1c.	][tV		*!		][tV	*		
2a.	t][C	*!			t][C		*!	
2b.	☞ ]ℓ[C			*	☞ ]ℓ[C			*
2c.	][tC	*!	*		][tC	*	*	
3a.	t]]	*!			☞ t]]		*	
3b.	☞ ]]ℓ		*	*	]]ℓ	*!		*

	SYLL-WF	PARSE	ALIGN
t][V	*		
][ℓ[V		*!	
☞ ][tV			*
t][C	*!		
☞ ]ℓ[C		*	
][tC	*!		*
t]]	*!		*
☞ ]]ℓ		*	*

Splitting ALIGN-LEFT-WORD from ALIGN-RIGHT-PHRASE yields deletion before C only:

	ALIGN-RIGHT-PHR	SYLL-WF	PARSE	ALIGN-LEFT-WORD
t][V		*		
][ℓ[V			*!	
☞ ][tV				*
t][C		*!		
☞ ]ℓ[C			*	
][tC		*!		*
☞ t]]		*		*
]]ℓ	*!		*	

(7) The resulting hierarchy of deletion contexts:



No system of dominance relations deletes only before V, or before V and pause. Given this constraint system, the variation in [2] can be derived from partial (or competing) dominance relations.

## The Morphological Effects

The basis for explaining the exponential relationship in [3] is that syllable well-formedness is evaluated on each level at which prosodic constraints apply: lexical entries (“roots”), level 1 (“stems”), and the word level. I.e. we break down SYLL-WF into SYLL-WF<sub>root</sub>, SYLL-WF<sub>stem</sub>, SYLL-WF<sub>word</sub> (COMPLEX is the relevant part of it):

Candidates	SYLL-WF <sub>root</sub>	SYLL-WF <sub>stem</sub>	SYLL-WF <sub>word</sub>
1a. [cost]	*	*	*
1b. [cos]t			
2a. [los+t]		*	*
2b. [los]t			
3a. [toss#t]			*
3b. [toss]#t			

(NB: in a non-derivational phonology, a violation at any given level is necessarily a violation at all superordinate levels (but not conversely). So SYLL-WF<sub>word</sub> should really be thought of as the general, unrestricted case SYLL-WF (cf. the Strict Domain Hypothesis).

If PARSE  $\gg$  SYLL-WF, there is no deletion, as before. Deletion is activated by one or more of the rankings in [8a,b,c].

- (8)
- a. SYLL-WF<sub>root</sub>  $\gg$  PARSE: *cos*  $\not\ell$
  - b. SYLL-WF<sub>stem</sub>  $\gg$  PARSE: *cos*  $\not\ell$ , *los*  $\not\ell$
  - c. SYLL-WF<sub>word</sub>  $\gg$  PARSE: *cos*  $\not\ell$ , *los*  $\not\ell$ , *toss*  $\not\ell$

If PARSE dominates SYLL-WF<sub>word</sub> or SYLL-WF<sub>stem</sub>, categorical morphological splits result. For example, if SYLL-WF<sub>root</sub>  $\gg$  PARSE  $\gg$  SYLL-WF<sub>stem</sub>, root-final consonants delete obligatorily. Variation again arises from competing systems with different constraint hierarchies.

The probability that at least one of  $n$  independent events with probability  $p_1, p_2, \dots, p_n$  will happen is  $1 - (1 - p_1)(1 - p_2) \dots (1 - p_n)$ . Assume that each constraint in [8] has the same probability  $p$  of being imposed. Then the probability of  $t$ -,  $d$ -deletion in a given form is  $1 - (1 - p)^n$ , where  $n = 3$  for *cost*,  $n = 2$  for *lost*,  $n = 1$  for *tossed*. Hence the probability of *retention* is  $(1 - p)^n$ . This derives Guy’s generalization, answering question [3].

General prediction: the frequency of a variant is a function of the number of allowed constraint rankings in which it is the optimal output.