

The formal properties of phonological precedence

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This talk will examine the proposal that the phonological precedence relation is intransitive. This proposal is argued to account for gaps in constraint types. It requires a different approach to deletion and epenthesis, and modification of morpho-phonological constraints.

1. Introduction

- (1) *General enterprise*
 - What are the formal properties of phonological relations?
- (2) *Issue*

Is phonological precedence *immediate* precedence or not?

 - i.e. is the phonological precedence relation *intransitive* (i.e. immediate precedence) or is it *transitive* with an additional notion of adjacency?
 - ☞ Immediate precedence is *less powerful* than transitive precedence.
- (3) *Proposal in brief*

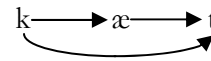
That the phonological precedence relation ($P^<$) encodes *immediate* precedence.
- (4) *What is 'phonological precedence'?*
 - (a) A relation that holds in the phonological module between autosegments on the same tier.
 - (b) In the phonetic module, $P^<$ is *translated* into a phonetic relation, which (ultimately) is realized as temporal ordering of articulatory gestures (or acoustic events).
- (5) *Phonological Precedence ($P^<$)*
 - (a) $P^<$ does not directly encode temporal precedence (the phonetic relation it's translated into does that).
 - (b) Even so, the traditional assumption is that it has the formal properties of a precedence relation:
 - (a) *Irreflexive*: it's never the case that $xP^<x$
 - (b) *Asymmetric*: if $xP^<y$, then it's not the case that $yP^<x$
 - (c) *Transitive*: if $xP^<y$ and $yP^<z$, then $xP^<z$

- (6) *Why assume?*
 Ultimately the $P^<$ relation must be translated into temporal precedence. Temporal precedence results in a linear order – it is connected and strict (i.e. irreflexive, asymmetric, transitive).
 (a) The minimal assumption is that nothing special happens to $P^<$ on its way to being translated into temporal precedence. Therefore, $P^<$ is assumed to be a strict linear order.
 (b) Temporal precedence:
 (i) if k precedes a , then a can't precede k .
 (ii) if k precedes a , and a precedes t , then k precedes t
 (iii) k cannot precede itself.

- (7) *Example of expected view*

/kæt/ $\{kP^<a, kP^<t, aP^<t\}$

Note: no $kP^<k$; no $tP^<k$



(A note on abbreviation:

$P^<$ holds between root nodes, which formally must be members of a denumerably infinite set of discrete elements (like Natural numbers). Here, I use ' k ', ' a ', ' t ' to refer to the discrete elements that are associated to the features for $[k]$, $[æ]$, $[t]$: i.e. $\{1P^<2, 1P^<3, 2P^<3\}$ and $\{1Rk, 2Ræ, 3Rt\}$, where R is the association relation.)

- (8) *Alternative proposal*

$P^<$ is irreflexive and asymmetric, but is *intransitive*.

- (9) *Implications in brief*

- (a) Accounts for significant gaps in constraint/rule types.
 (b) Requires reconceiving deletion and epenthesis.
 (c) Requires different approach to $P^<$ preservation.

2. Translating intransitive $P^<$

- (10) *Intransitively ordered [kat]*

$\{kP^<æ, æP^<t\}$; crucially there is no $\{kP^<t\}$

- How is such an output translated into phonetic/temporal order?

- (11) *Interpretive principles ($<$ is the phonetic ordering relation)¹*

- If $xP^<y$ then $x<y$ (basic conversion)

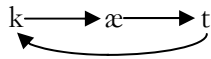
(a) If $x<y$ and $y<z$ then $x<z$ (imposition of transitivity)

(b) If $x<y$ then $\neg(y<x)$ ((re)imposition of asymmetry)

¹ Connectedness also needs to be imposed: For all x,y , $x<y$ or $y<x$. Connectedness may be imposed on the *phonological* relation, at either input or output, or the phonetic relation. Different levels of imposition have different consequences.

(12) *Problem with intransitivity*

- Without transitivity, an output could ‘curl back’²



- Here, $kP^<aP^<tPk(P^<aP^<t\dots)$
- This output crashes when it’s $P^<$ relation is converted into a linear order:
i.e. (11a) introduces the relation $k<t$, so the relation is no longer asymmetric (11b) because $t<k$.

(13) *Legibility, or why it doesn’t matter*

(a) Intransitivity allows for outputs with potentially fatal $P^<$ orderings – i.e. $P^<$ orderings that cannot be translated into temporal order.

(b) However, it does not *disallow* outputs with interpretable $P^<$ orderings. For example, the output $\{k<\text{æ}, \text{æ}<t\}$ can be generated, and it is unambiguously translatable into a linear order $\{k<\text{æ}, \text{æ}<t\}$.

(c) So, the problem really is: what happens to outputs that somehow end up with a ‘contradiction’ (e.g. a temporal curling-back or disconnectedness)?

A₁: Crash/Derivation failure. Such outputs are illegible at the Phonology-Phonetics interface (after most work in rule-based derivational theories).

A₂: Elimination. Such outputs are rejected at the Phonology-Phonetics interface; the ‘next best’ output is taken (de Lacy to appear).

(d) In short, because of crash/elimination, it doesn’t matter if *some* phonological outputs fail. As long as *some* are phonetically legible, the grammar will work.

3. Evidence

(14) *Places to look*

Two places to look for evidence for the formal properties of relations:

- The lexicon
- Constraints/rules

² See Raimy (2000) for use of such an order. Raimy proposes that such an ordering relation can be transitional in the derivation, and triggers a particular repair (reduplication). But no such ‘curling back’ order exists in phonological outputs.

3.1 Constraints

- (15) A typical constraint: $*_{xy}$: x *immediately precedes* y . (x precedes y and x is adjacent to y).
- (a) With intransitive precedence: $*\{xP^<y\}$ “ x must not immediately precede y ”
- (b) With transitive precedence: $*\{xP^<y, xAy\}$, “ x must not both precede and be adjacent to y .”
- (i) A is the adjacency relation.
- (ii) The alternative, define ‘immediately precede’ through negation:
 $xP^<y$ and there is no z s.t. $xP^<z$ and $zP^<y$; this approach introduces the power of a negation operator into constraint definitions)
- (16) *Non-existing constraint types*
- (a) Long distance:
 $*xP^<y$ “ x must not precede y ; x is not necessarily adjacent to y .”
- (b) Mirror-image:
 $*xAy$ “ x is adjacent to y ; no precedence implied.”

3.1.1 Long distance

- (17) *Assuming transitive phonological precedence, why don't we get constraints of the form*
 $*\{xP^<y\}$ “ x must not precede y (x and y aren't necessarily adjacent)”
 (rule equivalent: $x \rightarrow z / _ w_0 y$, where w_0 is any number of segments.)
- (18) *A pathological constraint*
 $*NP^<C$ [anta], [anuta], [anulat], [nadalowap],
 cf. [atna], [tana], etc. etc.
- (19) *Plausibility?*
- (a) Strict formalist viewpoint: such constraints could exist because they're formally definable.
- (b) Functional motivation: Perhaps $*xP^<y$ constraints don't exist because there's no functional motivation for them?
- Argument: if there were some perceptual benefit to having two segments x, y in a word no matter where they were.
- (i) Onnis et al. (2005): improved segmentation performance if a word begins with a plosive *and* there's a phonological similarity between the first and third segment.
- (ii) More generally: infants are aware early on of non-adjacent dependencies (for syntax; may indicate understanding of hierarchical structure).
- (iii) Generally, it's not clear how aware learners are of non-adjacent dependencies.

(20) *Long-distance effects: Vowel harmony*

Q: Can't harmony be expressed as $*X^{\alpha F}P^<X^{-\alpha F}$?

A: No. Harmony is fundamentally iterative: X_n depends on X_{n-1} , not on X_{n-2} or X_1 , etc. In contrast, $*V^{\alpha F}P^<V^{-\alpha F}$ is fundamentally non-iterative – truly long-distance.

(a) *Blocking*

Suppose [a] blocks round harmony: [putati] cf. *[putaty].

How could this be captured with a true long-distance precedence constraint?

(b) *Iterativity in blocking*

The reason that blocking occurs is because V_3 can't ignore V_2 's feature specification (i.e. 'iterativity'): i.e. in *[putaty], [y] can't ignore the fact that there's a [-round] [a] between it and [u].

(c) *Bizarre effect #1*

$*V^{\alpha \text{ROUND}}P^<V^{-\alpha \text{ROUND}}$

[putati] = 2; [putaty] = 2!

[putatite] = 3; [putaty \emptyset] = 3!; [putatyte] = 3!

(d) *Bizarre effect #2*

$*V^{+\text{ROUND}}P^<V^{-\text{ROUND}}$

[putati] = 2; [putaty] = 1 = always wins.

[putatite] = 3; [putatyte] = 3; [putatit \emptyset] = 2; [putaty \emptyset] = 1.

(e) *Alternatives*

Gafos (1996) argues that all vowel harmony is local. Formally motivated by constraints of the $*\{x^{\alpha F}P^<y^{-\alpha F}, xAy\}$ sort.

(21) *Long-distance effects: Consonant harmony*

Argued by Rose & Walker (2000) and others that long-distance C harmony is agreement through non-local correspondence relations.

(a) No constraints of the $xP^<y$ type.

(22) *Dissimilation*

(a) Not $*xP^<y$, but rather $*xP^<x$.

(b) Suzuki (1998) seems to advocate a constraint of this type:

$*X\dots X$

(c) General approach: avoidance a domain that contains more than one x .

(d) Alderete (1997); Ito & Mester (1996): local conjunction within a domain:

$*[x\&x]_{\text{DOMAIN}}$

(e) Struijke (2001): preservation of just one feature value within a domain; neutralization of others.

(f) In blocking cases, it's clear that $*X\dots X$ means $*\{X$ followed by the next available X -like element). e.g. Latin /l...l/ \rightarrow [l...r] is blocked by an intervening [r]: /nav-alis/ \rightarrow [navalis]; /sol-alis/ \rightarrow [solaris]; /litor-alis/ \rightarrow [litoralis], *[litoraris]; cf. /vulg-

al-iter/ → [vulgariter], *[vulgaliter]. (Also Akkadian: *-m* dissimilation is blocked by intervening round vocoids).

3.1.2 Mirror image constraints/rules

- (23) Is adjacency separate?
 Not necessarily?
 $x < y$ and there is no z s.t. $x < z < y$
 or see adjacency as a primitive: $xAy = x < y$ *or* $y < x$
- (24) A mirror image rule: $x \rightarrow y / z_ \text{ or } _z (x \rightarrow y / z^o_)$ (Anderson 1974, Bach 1968:4.)
- (25) Mirror-image rules were proposed primarily to allow rule simplification.
 Rule simplification allowed a different calculation for the evaluation metric.
 (a) A mirror image rule like $x \rightarrow y / z^o_$ could be the interaction of two rules $x \rightarrow y / z_$ and $x \rightarrow y / _z$.
 (b) In OT, there's no evaluation metric that is measured in terms of the number of symbols in the rule component. So, $*xAy$ could be $*xP^<y$ and $*yP^<x$ together.
 (c) A convincing mirror-image rule would be one in which a constraint $*xAy$ is motivated, but not $*xP^<y$ and $yP^<x$.
- (26) *Faroese* (Anderson 1974)
 $\emptyset \rightarrow \text{glide}^{[\alpha\text{round}]} / \mathbf{V}^{\text{HIGH}, \alpha\text{round}} _ _$
 e.g. [mæawur] 'man', [si:jur] 'custom'
 But when there's a choice: copy from the left.
 (i) $\emptyset \rightarrow \text{glide}^{[\alpha\text{round}]} / \mathbf{V}^{\text{HIGH}, \alpha\text{round}} _ _$
 (ii) $\emptyset \rightarrow \text{glide}^{[\alpha\text{round}]} / _ \mathbf{V}^{\text{HIGH}, \alpha\text{round}}$
- (27) *What's a true mirror-image rule?*
 → If $*xy$ then $*yx$.
 e.g. if $*tl$ then $*lt$ (cf English)
 • Sonority distance effects: clearly separable (Gouskova 2002)
- (28) *The coda mirror* (Scheer 2001, and other publications)
 • If x is allowed $\{\#, C\} _ _$, then it is also allowed $_ \{\#, C\}$
 • More accurately, the coda mirror defines environments for the application of particular processes, not phonotactic environments.

4.1 The lexicon

- (36) *If precedence is separate from adjacency, we could have precedence-underspecified lexical forms like /p<a, p<i/, where the order of [a] and [i] is left up to the grammar.*
- (a) Stressed á is preferable to stressed í, so with a penultimate-stress language:
[pái] cf. [piá-to].
- (b) This example looks reasonable: local metathesis brought about by stress-sonority constraints.
- (c) But it is not the *only* way to get such a change; metathesis could apply to forms with fully-specified input precedence relations.
- (37) *Floating segments*
- (a) /p<i<k, a/ → ‘floating segment’ [apik], [paik], [piak], [pika].
- (b) *String* metathesis /p<i, a<k/ → [piak] cf. [akpi]
- (c) Iterative metathesis /p<k, a<i/ → [apik], [paki]
- (d) Long-distance metathesis /a<f<i<t<o, p, k/ → [pafitok], [kafitop] (difference motivated by, e.g. local assimilation, dissimilation).
- (38) *General*
- GEN cannot add precedence relations between different segments of the same morpheme.
- (a) All the morphemes above involve introduction of a precedence relation between elements of the same morpheme.
- (b) Recall that if epenthesis is split, then /xy/ → [xwy] does not introduce a new precedence relation between w and z.
- (39) *Separable adjacency*
- Could we have /pAæ/?
- Comes out as [æp] or [pæ], depending on circumstances:
e.g. /t-pAæ/ → [tæp], but /pAæ-k/ → [pæk].
- (a) With intransitive precedence, no: there’s no adjacency relation.

4.2 Morpho-phonology

- (40) *Infixes?*
- /ab-xyz/ → [x-ab-yz] competes with [yz-ab-x], [z-ab-xy], etc.
- (41) *What is morphological precedence?*
- (a) With transitive precedence:
- If M_1 ‘precedes’ (asymmetrically c-commands, or whatever) M_2 , then every member of M_1 precedes every member of M_2
- Introduce a precedence relation between the rightmost element of M_1 and leftmost of M_2 (effectively, concatenate the strings).
- (b) With intransitive precedence
- If M_1 precedes M_2 then some member of M_1 precedes some member of M_2

(c) *M-span*

A morpheme's M-span is the contiguous string that minimally includes all members of that morpheme.

- (d) ANCHOR-LEFT-MSP If x is at the left edge of the M-Span in the input, then x' is at the left edge of the M-Span in the output.

(42) *Infixes and M-Spans*

$/ab-xyz/ \rightarrow$	$[x-ab-yz]$	ANCHOR-LEFT-MSP
	$[yz-ab-x]$	*ANCHOR-LEFT-MSP
	$[z-ab-xy]$	*ANCHOR-LEFT-MSP

(43) *Transfixes*

$/ia-kbt/ \rightarrow [kibat]$

- (a) ANCHOR-LEFT-MSP bans transposition of the vowels.
 (b) ANCHOR-LEFT-MSP bans everything but $[kibat] \sim [kitab]$
 (c) ANCHOR-RIGHT-MSP bans $[kitab]$.
 (d) Only $[kibat]$ is possible.

(44) *Larger transfixes*

$/iau-kbtp/ \rightarrow [kibatup]$

Should be impossible to rule out markedness-driven

$[kibatup]$ and $[kitabup]$.

- Any such cases?

(45) *Haplology*

What about morphological deletion?

$/xy-xy/ \rightarrow [xy]$?

- de Lacy (1999): All haplology is coalescence.

5. Summary

(46) *Formal properties?*

- (a) Useful to examine formal properties of relations: doing so may reveal conditions that are easy to overlook.
 (b) If Phonological Precedence is transitive, why do constraints only refer to immediate precedence?

(47) *The catches with intransitive precedence*

- (a) Requires a radically new view of deletion and epenthesis: i.e. there is none, only coalescence and split.
 (b) Requires little change to current conceptions of morphological order.
 (c) Makes testable predictions for root-and-pattern morphology with morphemes of more than 3 segments.
 (d) Restricts constraints to immediate precedence, and neither transitive precedence nor adjacency.

References

- Anderson, Stephen R. (1974) *The Organization of Phonology*. New York: Academic Press.
- Alderete, John (1997). Dissimilation as local conjunction. In Kiyomi Kusumoto (ed.) *Proceedings of NELS 27*. Amherst, MA, GLSA, pp.17-32.
- Alderete, John and Stefan Frisch (2007) Dissimilation. In Paul de Lacy (ed.) *The Cambridge Handbook of Phonology*. Cambridge University Press, pp. 379-398.
- Archangeli, Diana & Douglas Pulleyblank (2007) Harmony. In Paul de Lacy (ed.) *The Cambridge Handbook of Phonology*. Cambridge University Press, pp. 353-378.
- Bach, Emmon (1968) Two proposals concerning the simplicity metric in phonology. *Glossa* 2.128-149.
- de Lacy, Paul (1999). Haplology and Correspondence. In Paul de Lacy and Anita Nowak (eds.) *UMOP 23*. Amherst, MA, GLSA, pp.51-88.
- de Lacy, Paul (to appear). Interpretability, Freedom of Analysis, and the Loop. In Patrik Bye, Martin Krämer, and Sylvia Blaho (eds.). *Freedom of Analysis*. John Benjamins.
- Gafos, Adamantios (1996). The articulatory basis of locality in phonology. Doctoral dissertation, Johns Hopkins University.
- Gouskova, Maria (2002). Falling sonority onsets, loanwords, and syllable contact. *Rutgers Optimality Archive* 491.
- Ito, Junko and Armin Mester (1996). Constraint conjunction and the OCP. *Rutgers Optimality Archive* 144.
- Kornai, András (1994) *Formal Phonology. Outstanding Dissertations in Linguistics*. Garland Publishing.
- McCarthy, John (1989) Linear Order in Phonological Representation, *Linguistic Inquiry* 20, 71–99. [<http://people.umass.edu/jjmccart/research.html>]
- Onnis, L., Monaghan, P., Richmond, K. & Chater, N. (2005). Phonology impacts segmentation in speech processing. *Journal of Memory and Language*, 53/2, 225-237.
- Pater, Joe (1996). *NÇ. In Kiyomi Kusumoto (ed.) *Proceedings of NELS 26*. Amherst, MA, GLSA Publications, pp.227-239.
- Raimy, E. (2000) *The phonology and morphology of reduplication*. Studies in Generative Grammar 52. Mouton de Gruyter.
- Rose, Sharon and Rachel Walker (2004). A typology of consonant agreement as correspondence. *Language* 80: 475-531.
- Scheer, Tobias (2001) La Coda-Miroir. *Bulletin de la Société de linguistique de Paris*. 46.1: 107-152 [<http://www.unice.fr/dsl/tobias.htm> – 15 Jan 2007]
- Struijke, Caro (2001). Existential faithfulness: A study of reduplicative TETU, feature movement, and dissimilation. Doctoral dissertation, University of Maryland, College Park.
- Suzuki, Keiichiro (1998). A typological investigation of dissimilation, Doctoral Dissertation, University of Arizona.