The formal properties of phonological precedence

Paul de Lacy
Rutgers University
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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 morphophonological 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 æ, then æ can’t precede k.
   (ii) if k precedes æ, and æ precedes t, then k precedes t
   (iii) k cannot precede itself.

(7) Example of expected view
/kæt/ \{kP<æ, æP< 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’, ‘æ’, ‘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 [kæt]
\{kP<æ, æP< t\}; crucially there is no \{kP<t\}
• How is such an output translated into phonetic/temporal order?

(11) Interpretive principles (\(< is the phonetic ordering relation)\)
• 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 ¬(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:\(^2\)

  ![Diagram]

- Here, \( kP^x æP^tPk(P^x æP^t\ldots) \)
- This output crashes when it’s \( P^x \) 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 \( P^x \) orderings – i.e. \( P^x \) orderings that cannot be translated into temporal order.
(b) However, it does not **disallow** outputs with interpretable \( P^x \) orderings. For example, the output \( \{k<x, x<t\} \) can be generated, and it is unambiguously translatable into a linear order \( \{k<x, x<t\} \).
(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)?

  A\(_1\): Crash/Derivation failure. Such outputs are illegible at the Phonology-Phonetics interface (after most work in rule-based derivational theories).
  A\(_2\): 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:

(a) The lexicon
(b) Constraints/rules

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\(^2\) 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: \(^*\langle x, y \rangle \) \(x\) 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: \(^*\{xP<y, xA>y\}\), “\(x\) 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:

\(^*\langle xP<y \rangle\) “\(x\) must not precede \(y\); \(x\) is not necessarily adjacent to \(y\).”

(b) Mirror-image:

\(^*\langle xA>y \rangle\) “\(x\) 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

\(^*\langle NP<C \rangle\) [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 \(^*\langle xP<y \rangle\) 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 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 \( \ast X^{\alpha} P \gamma X^{-\alpha} \)?

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

(a) **Blocking**

Suppose \([a]\) blocks round harmony: \([\text{putati}]\) cf. \(*[\text{putaty}]\).

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 \(*[\text{putaty}]\), \([y]\) can’t ignore the fact that there’s a \([\text{–round}]\) \([a]\) between it and \([u]\).

(c) **Bizarre effect #1**

\( \ast V^{\text{ROUND}} P V^{-\text{ROUND}} \)

\([\text{putati}] = 2; \ [\text{putaty}] = 2! \]

\([\text{putatite}] = 3; \ [\text{putatyto}] = 3!; \ [\text{putatyte}] = 3! \]

(d) **Bizarre effect #2**

\( \ast V^{+\text{ROUND}} P V^{-\text{ROUND}} \)

\([\text{putati}] = 2; \ [\text{putaty}] = 2 = \text{always wins.} \]

\([\text{putatite}] = 3; \ [\text{putatyte}] = 3; \ [\text{putatito}] = 2; \ [\text{putatyto}] = 1. \]

(e) **Alternatives**

Gafos (1996) argues that all vowel harmony is local. Formally motivated by constraints of the \( \ast \{ X^{\alpha} P \gamma^{\alpha} X, X \gamma \} \) 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 \( xP_x \) type.

(22) **Dissimilation**

(a) Not \( \ast xP_x \), but rather \( \ast xP^x \).

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

\( \ast X \ldots X \)

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

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

\( \ast [x \& x]_\text{DOMAIN} \)

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

(f) In blocking cases, it’s clear that \( \ast X \ldots X \) means \( \ast \{ X \) followed by the next available X-like element\). e.g. Latin /l...l/ → [l...r] is blocked by an intervening [r]: /navalisis/ → [navalis]; /sol-alis/ → [solarìs]; /litor-alis/ → [litoralis], *[litoralìs]; 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?
\[ x<y \text{ and there is no } z \text{ s.t. } x<z<y \]
or see adjacency as a primitive: \( xAy = x<y \text{ or } y<x \)

(24) A mirror image rule: \( x \rightarrow y / z \_ \text{ or } _z (x \rightarrow y / z\%_\) (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 \( x \rightarrow y / z\%_\) could be the interaction of two rules \( x \rightarrow y / z\_) \text{ and } x \rightarrow y / _z\).
(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 \( *xP<y \text{ and } *yP<x \) together.
(c) A convincing mirror-image rule would be one in which a constraint \( *xAy \) is motivated, but not \( *xP<y \text{ and } yP>x \).

(26) Farnese (Anderson 1974)
\( \emptyset \rightarrow \text{glide}[\text{around}] / V_{\text{HIGH,around}}%), \_\)
e.g. [mæawur] ‘man’, [siːjur] ‘custom’
But when there’s a choice: copy from the left.
(i) \( \emptyset \rightarrow \text{glide}[\text{around}] / V_{\text{HIGH,around}} \)
(ii) \( \emptyset \rightarrow \text{glide}[\text{around}] / _V_{\text{HIGH,around}} \)

(27) What’s a true mirror-image rule?
\( \rightarrow \text{If } *xY \text{ then } *Yx. \)
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. Precedence Unfaithfulness

(29) **Challenges: Loss of order**

- What happens if the string is disturbed in the output?
  
  (a) /xP<y, yP<z/ → delete y: [xP<z], [zP<x] are equally faithful.
  
  (b) /xP<z/ → epenthesize w: [xwz], [zwx] are equally faithful.
  
  (c) /xyz/ → metathesis [xy], [yz] are equally faithful
  (cf transitive precedence:
  
  (d) /xP<y, yP<z, xP<z/ → delete y [xP<z], cf. [zP<x] is less faithful.)

(30) **Deletion:** All deletion is coalescence

/xi2y1z3/ → [xi1,2z3] 2P<3 is preserved; 1P<2 is not

[zi3w1,2] neither 2P<3 nor 1P<2 is preserved

- **LINEARITY-STRIC** “If xP<y in the input then x'P<y' in the output.”
- **LINEARITY-NONSTRICT** “If xP<y in the input then x'P<y' in the output unless x'≠y'.”

(31) **Epenthesis is splitting**

/xi2z3/ → [xi1y1z2] 1<2 is preserved.

(32) **Problems?**

- Q1: How can deletion be coalescence?  Shouldn’t the coalesced segment show features from both segments?
  
  A: No – vacuous coalescence.

- Q2: How can epenthesis be breaking?  Shouldn’t the broken segments have features from the underlying segment?
  
  A: No: Struijke (2001): ∃ IDENT[F] requires preservation of underlying features in only one location: /i/ → [ʔ], or /i/→[i] are both possible with split.

(33) **HoP-HoT**?

Q: What about cases where there is a choice between coalescence and deletion?

A: Such choices are rare. Such cases could be analyzed as visible coalescence and vacuous coalescence.

(34) **A hypothetical challenge**

(a) /am/ → [ a ]

(b) /am/ → [a]

- (a) shows that [+nasal] is preserved and that coalescence takes place.

If deletion is coalescence, shouldn’t /am/ → [ a ]?

(35) **Metathesis**

/x1y2/ → [x1,2y1,2] (simultaneous coalescence and split).
4.1 The lexicon

(36) If precedence is separate from adjacency, we could have precedence-underspecified lexical forms like /p<ä, p<i/, where the order of [ä] 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) Separa ble 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 M₁ ‘precedes’ (asymmetrically c-commands, or whatever) M₂, then every member of M₁ precedes every member of M₂
• Introduce a precedence relation between the rightmost element of M₁ and leftmost of M₂ (effectively, concatenate the strings).
(b) With intransitive precedence
If M₁ precedes M₂ then some member of M₁ precedes some member of M₂
(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/ → [x-ab-yz] ANCHOR-LEFT-MSP  
[yz-ab-x] *ANCHOR-LEFT-MSP  
[z-ab-xy] *ANCHOR-LEFT-MSP

(43) **Transfixes**

/ia-kbt/ → [kibat]  
(a) ANCHOR-LEFT-MSP bans transposition of the vowels.  
(b) ANCHOR-LEFT-MSP bans everything but [kibat]~[kitab]  
(c) ANCHOR-RIGHT-MSP bans [kitab].  
(d) Only [kibat] is possible.

(44) **Larger transfixes**

/iau-kbtp/ → [kibatup]  
Should be impossible to rule out markedness-driven  
[kibatup] and [kitabup].  
• Any such cases?

(45) **Haplogy**

What about morphological deletion?  
/xy-xy/ → [xy]?  
• de Lacy (1999): All haplogy 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
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