The role of distinctiveness constraints in phonology

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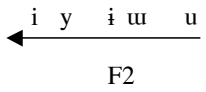
1. Distinctiveness constraints implement a preference to maximize the perceptual difference between contrasting sounds.
   - The less distinct a contrast is, the more distinctiveness constraints it violates.

Evidence for distinctiveness constraints

2. Example: Backness and rounding in vowels
   - Non-low vowels are generally front and unrounded or back and rounded (86% of vowels in the UPSID database of phonological inventories (Maddieson 1984)).

i u
e o
a

   - Perceptual explanation: Co-varying backness and rounding in this way maximizes the F2 difference between front and back vowels (Liljencrants and Lindblom 1972; Stevens, Keyser and Kawasaki 1986).
     - motivates distinctiveness constraints with the effect: *i-ɨ >> *i-ɯ, *y-u >> *i-u



   - Alternative analysis: Segment markedness constraints (markedness constraints against sound types):

*[front, +round], *[back, -round], *[central] >> *[-back, -round], *[+back, +round]
*ɨ, *y, *ɯ >> *i, *u

   - Segment markedness constraints imply that vowels like [ɨ] are inherently marked, distinctiveness constraints imply that is only backness contrasts involving [ɨ] that are problematic.

3. Although vowels with non-peripheral F2 values (ɨ, ʉ, ɯ, etc) are relatively uncommon in front-back contrasts, they are usual in the absence of front-back contrasts.
   - A number of languages, including Kabardian (Kuipers 1960, Choi 1991) and Marshallese (Bender 1968, Choi 1992) have short vowel inventories that lack front-back contrasts ('vertical' vowel inventories).
   - Vertical inventories consist of vowels whose backness and rounding is conditioned by surrounding consonants, resulting in vowels that vary contextually around central qualities [ɨ, ə] (Kabardian) or [ɨ, ə, a] (Marshallese).
   - There are no vertical vowel inventories containing invariant [i] or [u], vowels that are ubiquitous in inventories where backness is contrastive.
     - i.e. no vertical inventories such as [i, e, a] or [u, o, a].

4. Analysis in terms of distinctiveness constraints:
   - Central vowels are dispreferred in front-back contrasts because they yield less distinct F2 contrasts
   - In the absence of F2-based contrasts, distinctiveness in F2 is irrelevant and minimization of effort becomes the key factor governing vowel backness and rounding.
   - Least-effort vowel is essentially a smooth transition between preceding and following context (Colarusso 1988:307, Choi 1992) – often results in central vowel quality.
   - The same pattern is observed in English vowel reduction: when all vowel qualities are neutralized in unstressed syllables as in English, the result ('schwa') is a vowel that varies contextually around a high central quality (Flemming 2004, 2005).

5. The sensitivity of markedness to contrastive status cannot be accounted for in terms of segment markedness constraints.
   - The constraint ranking, *ɨ >> *u, *i , that would be required to account for the pattern of preferences observed with back contrasts incorrectly implies that if only one of these vowels appears, it should be [i] or [u], not a central vowel.

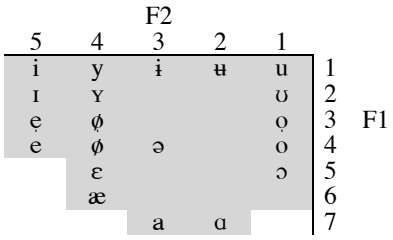
6. Constraints requiring contrasts to be perceptually distinct have substantial implications for the nature of phonology because they evaluate the difference between phonological forms, so words cannot be evaluated in isolation (cf. OO-Correspondence, Anti-Homophony, etc).
   - So it is important to ascertain the extent of the effects of distinctiveness constraints.

Overview:
- Formalize distinctiveness constraints
- Two further examples of the effects of distinctiveness constraints
- Evidence for significant limitations on their effects.

Preview of conclusions:
- Distinctiveness constraints do not interact freely with other phonological constraints.
- The proper model of distinctiveness constraints gives a central role to a revised conception of the phoneme inventory.

The Dispersion Theory of Contrast

7. Maximize the distinctiveness of contrasts.
   - Sound are located in a multi-dimensional perceptual space where perceptual distinctiveness corresponds to distance between sounds.



   - Preference to maximize distinctiveness is implemented in terms of a ranked set of constraints requiring a specified minimum perceptual distance between contrasting sounds.

MINDIST = F2:1 >> MINDIST = F2:2 >>... >> MINDIST = F2:4

8. Maximize the number of contrasts.
   - Opposes the tendency of MINDIST to favor a few maximally distinct contrasts.
   - Implemented as a positive constraint that selects the largest inventory of contrasts (that has not been eliminated by higher-ranked constraints).

9. The language-specific balance between these two constraints is modeled by specifying the ranking of MAXIMIZE CONTRASTS with respect to the MINDIST constraints.

		MINDIST = F2:3	MAXIMIZE CONTRASTS	MINDIST = F2:4
a.	☞ i-u		✓✓	
b.	i-ʉ		✓✓	*!
c.	y-u		✓✓	*!
d.	i-ɨ		✓✓	*!
e.	i-ɨ-u	*!*	✓✓✓	**

   - MINDIST constraints impose the preference for contrasts between front unrounded and back rounded vowels.
   - If there is no F2 contrast then these constraints are irrelevant (cf. vertical vowel inventories).
   - If MAXIMIZE CONTRASTS >> MINDIST=F2:3 then the inventory [i, ɨ, u] is selected.

Evidence for distinctiveness constraints: enhancement of stop voicing contrasts

10. Although prenasalized stops are often regarded as more marked than plain voiced stops, there is no implicational relationship between the two classes of sounds: a number of languages contrast pre-nasalized stops with voiceless unaspirated stops, but lack plain voiced stops.
    - E.g. Mixtec (Iverson and Salmons 1996), Southern Barasano (Smith and Smith 1971), Guaraní (Gregores and Suárez 1967), among others (see Herbert 1986:16ff).

11. San Juan Colorado Mixtec stops (Campbell, Peterson and Lorenzo-Cruz 1986):

p	t	t^j	k
^{m}b	^{n}d	$^n d^j$	

12. The preference for prenasalized stops over plain voiced stops is explained on the grounds that prenasalized stops are more distinct from voiceless stops (cf. Iverson and Salmons 1996)
    - One of the cues to voicing contrasts is the presence of voicing during closure (Stevens and Blumstein 1981).
    - Prenasalized stops are more strongly voiced than plain voiced stops because oral pressure is vented through the nose, and voicing is radiated from the nose.
    - In the terms of Stevens et al (1986), prenasalization *enhances* the stop voicing contrast.

13. Analysis:

- Strength of voicing

Voice:	0	1	2
	t	d	^{n}d

- Prenasalized stops are articulatorily marked:
  - *PRENASALIZED STOP >> *VOICED STOP
- Ranking for enhancement of voicing by prenasalization:

		MINDIST = VOICE:1	MINDIST = VOICE:2	MAXIMIZE CONTRASTS	*PRE-NASALIZED STOP	*VOICED STOP
a.	t-d		*!	✓✓		*
b.	☞ t-^{n}d			✓✓	*	
c.	t			✓!		

14. Prediction:

- Pre-nasalization is motivated by distinctiveness constraints, so if a voicing contrast is not maintained this enhancement is not expected to apply.
- For example, some languages have a single series of voiceless stops which are subject to voicing between vowels, e.g. Tümpisa Shoshone (Dayley 1989), Lenakel (Lynch 1974).
- We never find pre-nasalization as an 'enhancement' of these non-contrastively voiced stops.
- Analysis: in the absence of a voicing contrast, *PRENASALIZED STOP is unopposed by MINDIST constraints.

15. The generalization that enhancement only applies to contrasts cannot be accounted for in a theory without distinctiveness constraints.

Analysis of prenasalizing languages in terms of simple markedness constraints:

- Some constraint must favor prenasalized stops over voiced stops, e.g. PRENASALIZE 'voiceds stops must be prenasalized'.
  PRENASALIZE >> *PRENASALIZED STOP
- Problems arise where this ranking is combined with constraints deriving intervocalic voicing: *VTV 'No voiceless stops between vowels'
  *VTV >> IDENT[voice]
- A combined ranking can derive the unattested pattern of intervocalic prenasalization of voiceless stops:

i.

	/ta/	*VTV	PRE-NASALIZE	*PRE-NASALIZED	IDENT [voice]
a.	☞ ta				
b.	da		*!		*
c.	^{n}da			*!	*

ii.

	/ata/	*VTV	PRE-NASALIZE	*PRE-NASALIZED	IDENT [voice]
a.	ata	*!			
b.	ada		*!		*
c.	!☞ a^{n}da			*	*

- Exactly the same issue arises with regard to implosives: larynx lowering is used as an enhancement of stop voicing, but only where there is a contrast with voiceless stops.

Distinctiveness constraints apply to surface realizations of contrasts

16. Phonology contains MINDIST and MAXIMIZE CONTRASTS constraints.

- The evidence so far has come from cases that essentially involve selection of segment inventories.
- Distinctiveness constraints also play a central role in accounting for restrictions on the distribution of contrasts. So MINDIST constraints must apply to the surface realization of contrasts in context.

<u>Positional neutralization: 'Licensing by cue'</u>

17. Steriade (1995, 1999): different types of contrast have different characteristic environments of neutralization

- Obstruent voicing contrasts are permitted only before sonorants
  (e.g. German, Lithuanian, Russian, Sanskrit).
- Major place contrasts (labial vs. coronal vs. dorsal) are permitted only before vowels
  (e.g. Japanese, Luganda, Selayarese).
- Retroflexion contrasts (retroflex vs. apical alveolar) are permitted only after vowels
  (e.g. Gooniyandi, Miriwung, Walmatjari).

In each case, the contrasts are neutralized first in environments where 'the cues to the relevant contrast would be diminished' (Steriade 1997).

18. Formulation in terms of Dispersion Theory: contrasts are neutralized in contexts where they cannot satisfy a MINDIST constraint that ranks above MAXIMIZE CONTRASTS.

19. Example: neutralization of obstruent voicing

VOT:	0	1	n/a	n/a
	dV	tV	d#	t#

- In final position, there is no VOT because there is no onset of voicing after the stop.

i.

	_V	MINDIST = VOT:1	MAXIMIZE CONTRASTS	*[+voice, -son]
a.	☞ dV-tV		✓✓	*
b.	dV		✓!	*
c.	tV		✓!	

ii.

	V_#	MINDIST = VOT:1	MAXIMIZE CONTRASTS	*[+voice, -son]
a.	Vd#-Vt#	*!	✓✓	*
b.	Vd#		✓	*!
c.	☞ Vt#		✓	

20. On the basis of evidence of this kind, I concluded in earlier work that MINDIST & MAX CONTRASTS interact freely with other markedness constraints to derive the well-formed words in a language ('free interaction' model) (Flemming 1995, 2002, 2004).
Problems:
- Presents analytical difficulties: Wellformedness of a word depends on whether it is adequately distinct from its neighbors, so we have to determine what its neighbors are, but those words in turn have to be adequately distinct from their neighbors, and so on.
- Predicts unattested phenomena: contextual reorganization of inventories, positional enhancement.
- Indicates that distinctiveness constraints play a more restricted role in phonology.
- A model that accounts for these limitations also appears to be more tractable.

Languages have segment inventories

21. If MINDIST & MAX CONTRASTS interact freely with contextual markedness constraints to derive well-formed words, then contrasts should be optimized for their context – select the maximum number of sufficiently distinct contrasts, given the contextual constraints.

22. Example: Contextual reorganization of vowel inventories
Attested pattern: Cantonese
- Contrastive front rounded vowels

  i y u
  e ø o
  a

- Front rounded vowels not permitted adjacent to labials (Kao 1971, Yip 1988)
  *py, *pø, *my, *fø, *yp, *øp etc.

Predicted but unattested variant: A language with front rounded vowels, except where front rounded vowels are marked (adjacent to labials), where central vowels are selected instead.
- Absence of central vowels in a language like Cantonese is explained in part by acoustic similarity of front rounded and central vowels (i-y, y-u > y-ɨ).
- If front rounded vowels are excluded from some context then front round-central contrasts cease to be a problem and central vowels may be able emerge (favored by MAXIMIZE CONTRASTS).
- Resulting inventory is attested (e.g. Romanian), but not in complementary distribution with Cantonese inventory.
  Romanian:
  i ɨ u
  e ə o
  a

23. Attested contextual modifications of inventories:
- Only a subset of the inventory may appear in a given context (neutralization).
  - e.g. Cantonese: i-y neutralized adjacent to labials.
- The precise realization of the contrasts may vary according to context (allophonic variation).
  - e.g. vowels are allophonically nasalized adjacent to nasals (many languages).
- But the inventory is not restructured in more radical ways to maximize the number or distinctiveness of contrasts in each context, contrary to the predictions of a model in which MINDIST and MAXIMIZE CONTRASTS interact freely with contextual markedness constraints.

24. Why it makes sense to have an inventory:
    - An inventory of contrasts can be thought of as a division of the perceptual space of speech sounds into categories.
    - If the system of contrasts varies according to context, then the boundaries between categories have to be altered according to context.
    - This makes accurate perception dependent on correctly identifying context, which means perceptual errors can propagate.
    - So it makes sense to try to minimize contextual variation in the division of perceptual space into contrastive categories.
        - it is preferable to stick to a consistent inventory of contrasts.
        - loss of categories (neutralization) is preferable to rearranging the inventory.

25. Two desiderata imposed on phonology by the nature of speech perception:
    - Maximize distinctiveness of contrasts
    - Use the same contrasts in all contexts

    Implementation: Phonology has three sub-components:
    - Inventory – specifications for a set of contrasting segments
    - Realization – maps strings of segments drawn from the inventory onto their phonetic realizations.
    - Evaluation of Surface Contrasts – contrasts that are insufficiently distinct are neutralized.

    The role of distinctiveness constraints:
    - The basic role of distinctiveness constraints lies in deriving an inventory of contrasting segments.
    - Contrasts must also satisfy distinctiveness requirements on the surface – i.e. distinctiveness constraints apply to surface forms as a check that contrasts are adequately realized in context.
    - Distinctiveness constraints do not interact with contextual markedness constraints (in Realization),

26. Inventory selection: a basic inventory of contrasting segment types is selected based on a ranking of MINDIST, MAXIMIZE CONTRASTS, and segment-internal articulatory markedness constraints, but no contextual markedness constraints.
    - Yields a set of contrasting segments and their specifications in terms of perceptual targets.
    - NB these targets specify cues for distinguishing one segment from another, so if no contrasts are realized on a particular dimension, then sounds lack perceptual targets on that dimension – e.g. if there is no voicing contrast, then stops lack targets for voicing, if there is no F2 contrast, then vowels lack targets for F2.

27. Deriving backness and rounding contrasts in Cantonese
    - Primary difference between front unrounded and central vowels is in F2.
    - Primary difference between front unrounded and rounded vowels is in F3.

F2:	5	4	3	2	1
	i	y	ɨ	~~ʉ~~	u

F3:	4	3	2	1
	i	ɨ	y, u	~~ɪ~~

    - Equivalent perceptual differences on different dimensions are specified by disjunctive MINDIST constraints, e.g. MINDIST = F2:2 or F3:2

		MINDIST= F2:2 or F3:2	MAXIMIZE CONTRASTS	MINDIST= F2:3 or F3:3	MINDIST= F2:4
a.	i ɨ u		✓✓✓	**!	**
b.	☞ i y u		✓✓✓	*	**
c.	i y ɨ u	*!	✓✓✓✓	***	*****
d.	i y ~~ʉ~~ u	*!	✓✓✓✓	***	*****
e.	i u		✓✓!		

    - Given this ranking, front rounded vowels are preferred over central vowels because [i-y] (F3:3) is more distinct than [i-ɨ] (F2:2, F3:2).
    - Contrasts between front rounded and central vowels are insufficiently distinct (c).

28. The goal is to faithfully realize the full inventory of vowels in all contexts
    - Inputs are all sequences of segments from the inventory.
    - The distinctiveness of contrasts is evaluated in context (Evaluation of Surface Contrasts), but distinctiveness in context depends on the details of how the segment sequence is realized.
        - In Cantonese, the contrast between [i] and [y] is neutralized adjacent to labials because coarticulation with the labial makes the contrast insufficiently distinct.
    - These effects are derived in a separate Realization component.

- Maintains separation between MINDIST/MAXIMIZE CONTRASTS and contextual markedness constraints.

29. Realization:
    - Maps a string of segments drawn from the inventory onto its phonetic realization.
        - Assigns stress, syllabification, gestural overlap, coarticulatory effects, etc.
    - Realization involves a conflict between Correspondence constraints that require faithful realization of the perceptual targets of the input segments and markedness constraints (e.g. articulatory effort constraints, metrical constraints).
        - Distinctiveness constraints do not apply here, so no interaction with contextual markedness constraints.

30. Cantonese: No front rounded vowels adjacent to labials
    - LABIAL COARTICULATION – a vowel adjacent to a labial consonant is produced with approximation of the lips or lip-rounding.
        - Requires partial assimilation of a vowel to the constriction of an adjacent labial consonant.
        - lip approximation is transcribed with [$^{\beta}$].
    - Acoustic consequences of lip approximation – similar to lip rounding, but lesser in degree since rounding involves protrusion also: F3 of front and central vowels is lowered.
    - Conflicts with correspondence constraints IDENT(F2) and IDENT(F3) which require faithful realization of input F2 and F3 specifications.

        /pin/ → [pi$^{\beta}$n] (see tableau (i))
        /pyn/ → [pyn]
        /pun/ → [pun]

31. Evaluation of surface contrasts: The outputs of Realization are evaluated by the same ranking of MINDIST constraints that derives the inventory to check that the contrasts as realized in context are sufficiently distinct.
    - A target input must be evaluated with reference to a set of minimally contrasting inputs.
    - The candidates specify the fates of the members of this contrast set
        - An input form may be realized or neutralized with a neighboring form.
        - Phonetic realizations are supplied by the Realization component.
    - *MERGE penalizes neutralizations (merged inputs).
    - MINDIST constraints evaluate the distinctiveness of the contrasts between output forms.

F3:	4	3	2	1
	i	ɨ	y, u	ɹ
		i$^{\beta}$	ɨ$^{\beta}$	

F2:	5	4	3	2	1
	i	y	ɨ	ʉ	u

i. Realization:

/pin/		*LABIAL COARTICULATION	IDENT(F2)	IDENT(F3)
a.	pin	*!		
b. ☞	pi$^{\beta}$n			*
c.	pɨ$^{\beta}$n		**!	***

ii. ESC:

pyn$_1$, pin$_2$, pun$_3$		MINDIST= F2:2 or F3:2	*MERGE	MINDIST= F2:3 or F3:3	MINDIST= F2:4
a.	/pyn$_1$, pin$_2$, pun$_3$/ pyn$_1$ pi$^{\beta}$n$_2$ pun$_3$	*!		*	**
b. ☞	/pin$_{1,2}$, pun$_3$/ pi$^{\beta}$n$_{1,2}$ pun$_3$		*		
c.	/pyn$_{1,2}$, pun$_3$/ pyn$_{1,2}$ pun$_3$		*		*!

Avoids the problematic predictions of the free interaction model:
- A non-low central vowel cannot appear in input since it is not part of the basic inventory.
- Realization will not map a front rounded vowel onto a central vowel because that would constitute an unmotivated violation of faithfulness.
- Violations of MINDIST constraints can only be avoided by neutralizing a contrast, not by reorganizing contrasts.

32. In the free interaction model, vowel contrasts after labials would be selected subject to the contextual markedness constraint LABIAL COARTICULATION
    - Problematic prediction: since front rounded vowels are unacceptable, central vowels can emerge instead.

		LABIAL COARTIC.	MINDIST= F2:2 or F3:2	MAXIMIZE CONTRASTS	MINDIST= F2:3 or F3:2
a.	pi py pu	*!		✓✓✓	*
b.	pi^{β} py pu		*!	✓✓✓	*
c.	!☞ pi^{β} $pɨ^{\beta}$ pu			✓✓✓	**
	pi^{β} pu			✓✓!	

33. Deriving limited contextual variation in inventories:
    - The maximal inventory of contrasting sounds is defined by the Inventory component.
    - Realization of words is constrained to be faithful to this underlying inventory, new inventories cannot be derived.
    - Surface contrast evaluation can only neutralize contrasts, it cannot rearrange the inventory.
    - No direct interaction between distinctiveness constraints and contextual markedness constraints.

34. Richness of the Base
    - The proposed model appears to violate the principle of 'Richness of the Base' – all languages have the same set of inputs – since the inputs to Realization are constructed from a language-specific inventory.
    - But the model retains the fundamental hypothesis that all cross-linguistic differences in phonology derive from differences in constraints since the inventory is derived by a ranking of universal constraints and all languages draw on the same space of sounds.

Limits on positional enhancement

35. The cases of enhancement analyzed above (back/round, prenasalization of voiced stops) are analyzed in the same way in the inventory-based model.
    - These derivations take place in the Inventory component.
    - In fact, the model predicts that enhancement effects should only arise via the Inventory.
    - Prediction: no positional enhancement (cf. positional neutralization).

36. Positional enhancement: If MINDIST constraints interact freely with other constraints, there should generally be two types of repair to avoid violating a MINDIST constraint:
        - neutralize (give up on the contrast)
        - enhance (take measures to improve the contrast).
    - So we would expect the typologies of positional neutralization and positional enhancement to correspond: environments where a contrast is more prone to neutralization should also be environments where that contrast is more likely to be subject to enhancement.

    Inventory model:
    - MINDIST constraints apply in ESC, but the only repair for violation is neutralization – no positional enhancement.
    - Contextual variation in the realization of contrasts is derived in Realization from the interaction between Faithfulness to perceptual targets and markedness constraints.

    - The evidence supports the Inventory model: there is a striking asymmetry between positional neutralization and positional enhancement.
    - Evidence from patterns of epenthesis.

37. Epenthesis as positional enhancement?
    - If MINDIST/MAXIMIZE CONTRASTS can motivate epenthesis, then we expect to find patterns where epenthesis applies precisely where contrasts would otherwise be neutralized. This is not the case.

38. Example 1: obstruent voicing neutralization (Steriade 1997, 2001)
    - Many languages neutralize obstruent voicing contrasts in word-final position due to the inconsistent availability of VOT cues (above).
    - The contrast could be made adequately distinct by epenthesizing a following vowel (/tab/ → [tabə]), but this pattern is unattested: the only attested repair to eliminate final voicing contrasts is neutralization by devoicing (Lombardi 2001, Steriade 2001).

39. Example 2: major place assimilation.
    - In VC_1C_2V, C1 may assimilate in place to C_2 (neutralizing place contrasts in C_1 position).
    - Implicational universal: if stops in C_1 are targets of assimilation, then so are nasals (Jun 1995, Mohanon 1993).

- Jun argues that this asymmetry arises because place contrasts between post-vocalic nasals are less distinct than place contrasts among post-vocalic stops
  - post-vocalic nasal place contrasts violate higher-ranked MINDIST constraints than equivalent stop contrasts, and so are more subject to neutralization.

- Malayalam (Mohanon and Mohanon 1984)
  - Nasals undergo assimilation:

/peɳ-kuʈi/	peŋkuʈi	'girl (female child)'	cf. peɳɳə	'female'
/miin-tʃaɲṯa/	miiɲṯʃaɲṯa	'fish market'	cf. miin	'fish'

  - Stops do not undergo assimilation:

uṯkarṣam	'progress'
sapṯam	'eight'

- Korean (Jun 1995) – stops and nasals undergo assimilation:

/mit-ko/	[mikko]	'believe and'
/ip-ko/	[ikko]	'wear and'
/cinan-pam/	[cinampam]	'last night'
/nam-kɨk/	[naŋkɨk]	'the South Pole'

40. Again, we do not find any patterns of positional enhancement to parallel these generalizations about positional neutralization.
  - E.g. free interaction of distinctiveness constraints would lead us to expect patterns whereby epenthesis breaks up nasal-stop clusters, but not stop-stop clusters.
    /anba/ → [anəba] but: /atpa/ → [atpa]
  - This pattern is unattested. Theories of environments of epenthesis imply that nasal-stop clusters are actually disfavored locations for epenthesis (Fleischhacker 2002, Rose 2000).

41. In the inventory model, epenthesis arises in Realization so MINDIST and MAXIMIZE CONTRASTS cannot motivate it.

    What does motivate epenthesis?
  - Some cases involve faithfulness to consonant transitions. Many cues to consonant contrasts are realized in transitions to adjacent vowels e.g. formant transitions (place), change in intensity (manner).
  - If a consonant is not adjacent to a vowel, no transition is realized (cf. Côté 2000, Wright 1996).
    - MAX TRANS: realize at least one transition per consonant.
    - MAX RELTRANS: realize release transition of a consonant.
  - MAX TRANS >> DEP V derives epenthesis into –CCC- clusters (cf. Yawelmani, Egyptian Arabic, Lenakel, etc).

Conclusions

- Phonology includes constraints on the distinctiveness of contrasts.
- But the effects of distinctiveness constraints are limited:
  - attested effects:
    - 'context-free' enhancement
    - positional neutralization
  - Unattested:
    - context-dependent inventory selection
    - positional enhancement
- These limitations can be understood in terms of a model that gives a central role to a revised conception of the phoneme inventory
  - Distinctiveness constraints play a role in deriving an inventory of contrasting segments.
  - They also evaluate the distinctiveness of surface contrasts to check that distinctiveness requirements are met in context.
  - But do not interact directly with contextual markedness constraints.

- The resulting model is more tractable.
  - In a 'free interaction' model, it is difficult to evaluate the well-formedness of individual words.
  - In the inventory-based model, it is still necessary to evaluate a word with reference to a set of minimally contrasting neighbors, but the potential neighbors are fixed by the inventory, and the evaluation of surface contrasts only has to determine whether to retain or neutralize a contrast – there is no positional enhancement.

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