

Overall ‘similarity’ of representations = distance between points in multidimensional space is inherent in most work on **perception**.

Categorical Perception: a percept is interpreted as an instance of the nearest category

Liljencrants and Linblom’s (1972) **Dispersion Theory:**

vowel inventories maximize Euclidean distance
$$d(\mathbf{x}_i, \mathbf{x}_j) = \left[\sum_{k=1}^m (x_{ij} - x_{jk})^2 \right]^{1/2}$$

Repp (1982):

perceptual cues for consonants hold ‘**trading relations**’ (their sum total is what counts)

Kuhl and Iverson (1995):

a phonemic category constitutes a ‘**perceptual magnet**’ (attraction over distance)

Newman, Sawush and Luce (1997):

phoneme identification in a non-word is influenced by **lexical neighborhood** of the non-word

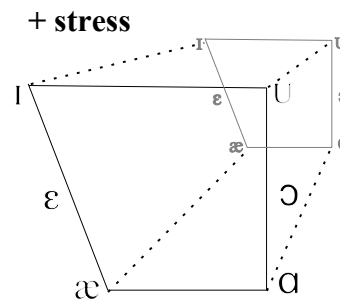
Notion of perceptual distance has entered into perception-based OT phonology

Flemming (1995) incorporates Dispersion Theory into OT

Steriade (1994), (1997): perceptual cues control neutralizations

Steriade’s (2001) P-Map: perceptual distances translate into rank of FAITH constraints in OT

Wilson’s (2000) ‘Targeted Constraints’ expressing weakness of contrast yield ‘opacity’ effects (like derivations)



Q: Is the role of summation and continuous (as opposed to discrete) mathematics limited to phonetics and the phonetics-phonology interface?

A: No. The effects of distance are also present in patterns of allomorphy (morpho-phonology).

Allomorphic changes tend to cluster:

lárɪnx ⇒ *lárɪnx-es* (same stress, same segments)/ *larýng-es* (different stress, different segments)
compáre ⇒ *compár-able* (same stress, same semantics)/ *cómpar-able* (diff. stress, diff. semantics)

Clustering is symptomatic of the phenomenon called ‘**Non Derived Environment Blocking**’

A specific change occurs only if some other change has occurred.	(surfacey) Input	Stress change	<i>CiV</i> -lengthening
	rémédy-able ⇒	remédi-able ⇒	remé:di-able
	lévy-able		*lé:vi-able

Certain allomorphic changes are thus sensitive to other changes: distance.

Distance is also involved in the phenomenon called ‘**Lexical Conservatism**’ (Steriade 1999)

Expected repair neutralizes with independently existing allomorph –a ‘neighbor’ by definition.	Input	repair induced by ONSET	Independent allomorph
	nouv[ɔ] ami ⇒	nouv[ɔ]C ₇ ... ⇒	nouv[ɛ]l ...

Baayen (2003). Choice of linking element for a new compound in Dutch is only predictable in terms of the **similarity relation** to existing compounds.

schaap- en -bout	‘leg of mutton’
schaap- -herder	‘shepherd’
schaap- s -koi	‘sheepfold’

Burzio (2002a,b) **Representational Entailments Hypothesis** (REH):

⇒	A	B	C
A	1	1	1
B	1	1	1
C	1	1	1

Mental representations of linguistic expressions are sets of entailments.

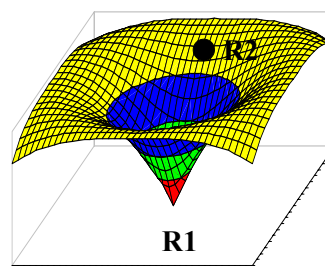
Entailment matrix for a representation ABC: 1= entailment

Each of A, B, C can be phonemes in a sequence, features within a phoneme, or other.

Yields attraction over distance

Entailments violated by ¬C in some R2, given an R1= A B C:

A⇒C	
B⇒C	A⇒C
A	A
B	¬B
¬C	¬C



Varying the structure of R2:

Take-over of OT FAITH constraints ~~IO-FAITH~~ Attraction: Non-Derived Environment Blocking
~~OO-FAITH~~ Attraction: Lexical Conservatism

Attraction also handles:

Syncretism in Morphology

* enhances the similarity relation, yielding neutralization

gli	gli + lo*	⇒ glielo
le	le + lo*	

Perceptual effects (categorical perception/ perceptual magnet): percept attracted to category

Dispersion Theory: Maximal distance = maximal harmony (minimal attraction)

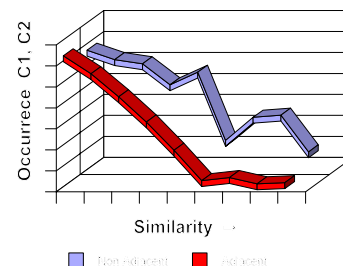
The REH also yields a theory of **surface-to-surface morphology**. Entailment summation across the lexicon yields subcategorization frames like **-al** ⇒ /N __

Extending attraction by extending the scope of ‘similarity’:

In a sequence ABC, A and B are sequentially similar, as are B and C.

Empirical evidence:

Frisch et al. (2004): trade-offs between feature-similarity and sequential proximity in **OCP effects in Arabic** (chart based on their Table IV, p. 203).



C_αV_α: Assimilations of Cs to adjacent Vs are common (palatalizations, spirantizations, voicing), and seem to require some independent similarity C_βV_β. E.g. Spanish spirantization: Cu[β]a/ co[p]a (same voicing ⇒ same continuancy).

***C_α X V_α**: Comparable long distance assimilations are unattested.

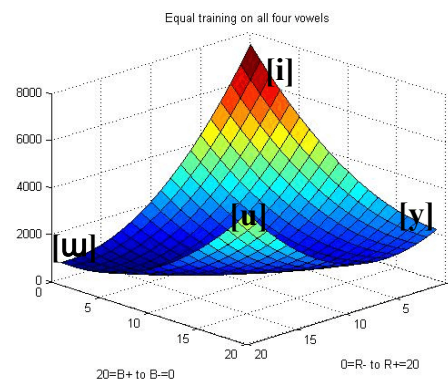
C_α X C_α: Long distance assimilations between Cs are attested, but only under strong similarity: Rose and Walker (2004). Cf. also Vowel harmony, often ‘parasitic’.

↑ ↑		Generalized Similarity			restrictions ↗
		Max: within Cs or Vs	Dispersion Theory (inventories)	LongDist. effects: Rose and Walker	
featural proximity	Min: across C, V	no restriction	full inventory	Local Assim./Dissim.	
	freedom ↖	Zero: in the same language	Min: in the same sequence	Max: adjacent/ articulatorily local	
sequential proximity →→					

$\alpha R \otimes \alpha R$	Outer product of αR with itself (each internal component of αR entails the others)
$\beta B \otimes \beta B$	Outer product of βB with itself (each internal component of βB entails the others)
$\alpha R \otimes \beta B$	Outer product of αR with βB (the vector αR entails the vector βB)
$\beta B \otimes \alpha R$	Outer product of βB with αR (the vector βB entails the vector αR). Same as above.

The REH-based representation of each of the four vowels: the total set of entailments (weight matrix) for an αR co-occurring with a βB , equals the sum of the four weight matrices.

The predicted clustering of backing and rounding would now consist of some **greater harmony** of the sum matrices for $+R$, $+B$ ($=[u]$) and $\sim R$, $\sim B$ ($=[i]$) compared with the matrices for the other two vowels.



Indeed:

The proof generalizes to other cases (the specific acoustic features a1-a8 are arbitrary and only serve to implement some degree of similarity/ dissimilarity).

Hence: **The ontology of units (phonemes/ morphemes) is inferrable from the binding of subunits under generalized similarity.**

Conclusion: The resources of continuous mathematics, that include the ability to perform summations are no more dispensable in the study of morpho-phonology than they are in the study of perception. Summation is inherent in the notion of distance in multidimensional space, which in turn is critical to understanding a broad range of effects that include: Non-Derived Environment Blocking, Lexical Conservatism, morphological syncretism, and the nature of both segmental inventories and inventories of morphemes.

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