

A Model Of Metathesis As Attraction At A Distance*

Adam Wayment¹ • awayment@jhu.edu • Department of Cognitive Science • Johns Hopkins University

0. Abstract

- As part of an ongoing investigation of the interaction of proximity and feature-based similarity in assimilatory phenomena (Wayment, in preparation), this poster explores a predicted set of metathesis repairs to the same family of attraction constraints which can drive harmony and assimilation more generally.
- Predicted Repair # 1: Harmony metathesis** occurs when phonological segments exchange their linear order, placing an attracted target closer to a source.
 - Language data from Hiligaynon, an Austronesian language of the Central Philippines, provides an attested case of harmony metathesis.
- Predicted Repair #2: Disharmony (OCP) metathesis** occurs when segments exchange their linear order, placing an attracted target farther from a source.
 - Disharmony metathesis is attested in Lithuanian.
- These attested repairs provide additional confirming evidence that
 - Proximity is correctly viewed as a kind of similarity on par with more conventional feature-based similarity.
 - The system of linguistic representations is organized to minimize violations of attraction relations between segments.

1. Overview

- This poster is outlined as follows:
 - §2 introduces the attraction framework.
 - §3 discusses how attraction predicts harmony metathesis.
 - §4 presents harmony metathesis in Hiligaynon.
 - §5 shows how attraction can be implemented in Optimality Theory
 - §6 briefly discusses disharmony metathesis in Lithuanian.
 - §7 concludes.

2. Attraction with Entailments

- The Attraction framework (Burzio 2002a,b) hypothesizes that linguistic representations are attractors in a multidimensional space.
 - In the picture at the right (photo credit: Andy Washnik), the metal filings which are close to the magnet are fully attracted, but more distant filings are only perturbed.
 - As with the illustrated magnet, in a representational attractor system, representations attract other representations with a force inversely related to the distance between them.
 - The strength of this attraction force may be depicted in gravity-well diagrams as in **Figure 1**. Here, the force of attraction is related to the slope of the surface, so the representation **S** attracts **X** more strongly than **Y**.

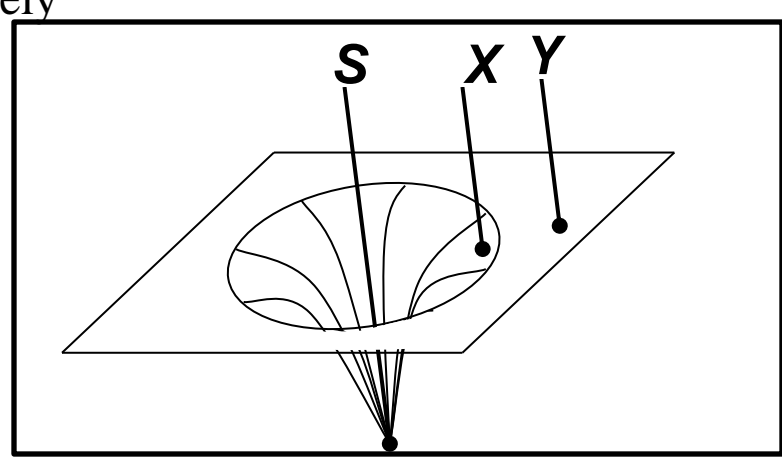
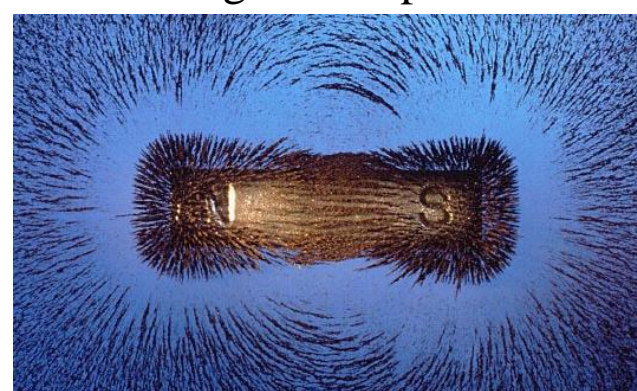


Figure 1

- Attraction landscapes may be derived from the Representational Entailment Hypothesis (REH; Burzio 2002a,b), which maintains that each representation has an associated set of entailments among its constituents.
 - For example, if the phoneme /i/ consists of the features [-cons] and [+hi], then /i/ corresponds to the set of (logical) entailments in (1).
- (1)
- | | |
|-------------------|-----------------|
| [-cons] → [-cons] | [-cons] → [+hi] |
| [+hi] → [-cons] | [+hi] → [+hi] |
- Previous work on entailment theory (Wayment et. al. 2007) has shown that
 - The REH is a restatement of associationist (Hebbian) learning in a fully-connected connectionist network.
 - The strength of an entailment depends on the similarity of the antecedent and consequent.
 - Entailments derive a force of attraction by maximizing Harmony over entailment constraints; height in a landscape is the degree to which a representation violates entailments.

* I would like to acknowledge the thoughtful discussion and encouragement of Luigi Burzio, Robert Frank, and Paul Smolensky. I am solely responsible for any errors or shortcomings.
 1. This material is based upon work supported under a National Science Foundation Graduate Research Fellowship. Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author and do not necessarily reflect the views of the National Science Foundation.

3. Attraction in Non-local Phonology

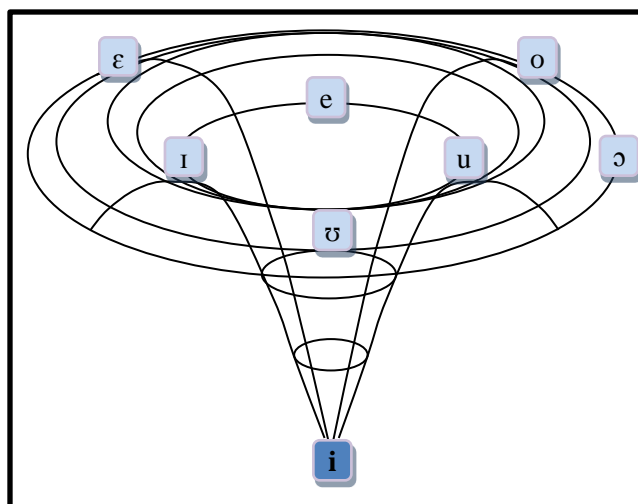


Figure 2. The source /i/ attracts /e/-targets more than /o/-targets because /e/ is more similar to /i/.

- Wayment (in prep.) accounts for long-distance assimilation by positing an attraction relation between sources and potential targets.
 - The entailments of a source are induced on potential targets. This is tantamount to placing potential targets on the attraction landscape of the source and letting targets “roll” to minima.
 - Of course, faithfulness, markedness, or attraction from another source may ultimately affect whether or not a potential target assimilates.
 - Figure 2** is a representative source attraction landscape.
- The hallmarks of an attraction phenomena are
 - Some amount of similarity between a source and target is prerequisite to the application of an assimilatory rule.
 - Greater similarity is the result of that rule.
- For example, in Inseño Chumash (Hansson 2001), targets which are already coronal and continuant are attracted to the rightmost coronal fricative and assimilate to further agree in [±anterior] (2).

(2) surface form	underlying form	gloss
a. [apitʰolit]	/s-ʌpi-tʰo-it/	‘I have a stroke of good luck’
b. [sistisijepus]	/s-ijʌ-tij-je-p-us/	‘they (2) show him’
c. [haxintilawaf]	/ha-s-xintila-waf/	‘his former Indian name’

(2c) confirms that the prerequisite similarity requirement for anterior agreement is both coronal and continuant, since non-coronal fricatives [x] and non-continuant coronals [t] fail to undergo agreement.

- Data from a variety of assimilatory phenomena support the notion that sequential proximity may contribute to the prerequisite necessary for the application of a phonological rule, according to the following typology in (3):
- | (3) Prerequisite Similarity Typology | Prerequisite similarity includes features | Prerequisite similarity excludes features |
|---|--|--|
| Prerequisite similarity includes proximity | Disharmonic languages allowing local assimilations | Spreading nasal harmony; Vowel Harmony with blocking |
| Prerequisite similarity excludes proximity | Long-distance Consonant Agreement; Vowel Harmony with transparency | No attested languages |
- This typology suggests that proximity is a kind of similarity on par with feature-based similarity.
 - If true, this would make the prediction that there exists a plurality of possible repairs to attraction tensions: segments might undergo feature assimilation in response to attraction pressures, but segments might also exchange their linear order in response to those same pressures.
 - I.e., **a process might yield greater overall similarity by bringing similar segments in closer proximity.**

4. Harmony Metathesis in Hiligaynon

- Hiligaynon (Ohio State Database 2007, original data from Wolfenden, 1971) provides what I will argue is an attested case of harmony metathesis.
 - Hiligaynon exhibits a process where certain affixes cause a stress shift and the deletion of the stem final vowel that originally carried stress as in (4).
- (4) a. /sakít/ + /-an/ → [sáktan] ‘to hurt someone’
 b. /lagás/ + /-on/ → [lágson] ‘chase’
- In the derived environment that lacks the stem final vowel, the adjacent consonants may exchange linear order as in (5). Here, stress marking is omitted.
- (5) a. /inom/ + /on/ → inmon → [imnon] ‘to drink something’
 b. /tanom/ + /an/ → tanman → [tamnan] ‘to plant a field’
 c. /sulod/ + /an/ → suldan → [sudlan] ‘to enter a place’
 d. /qilis/ + /an/ → qilsan → [qislan] ‘to change a thing’
 e. /balos/ + /an/ → balsan → [baslan] ‘to repay’

- The range of possible metatheses exhibited by (5) may be summarized as **nm** → **mn** (5a,b), **ld** → **dl** (5c), and **ls** → **sl** (5d,e).
- These exchanges resist analysis under traditional diachronic views of metathesis (Hume 2005; Blevins & Garrett 2004) which appeal to perceptual misperception followed by a restructuring of the exchanged segments in more salient position.
 - nm** → **mn**, **ls** → **sl** offer no improvement in saliency, since the exchanged segments are equally suitable as onsets and codas. **ld** → **dl** goes against the saliency grain: codas tend to have a sonorant preference and the stop burst associated with onset is more salient than the unreleased coda position.
 - These exchanges cannot be explained away as generalization since (4) exhibits cases where metathesis fails; thus perceptual optimization fails to explain the metathesis in (5).
- In contrast, under an analysis that views the nasal in the affix as attracting the segments in the derived environment these exchanges are naturally accounted for.
 - From this perspective the analytic burden is to
 - Define prerequisite similarity conditions that exclude the segments in (4) from attracting to the nasal.
 - Explain why the exchanges in (5) increase overall similarity.
- The prerequisite similarity conditions for Hiligaynon harmony metathesis are that the target be a sonorant consonant.
 - No sonorants occur in non-alternating forms; every alternating form has a sonorant which exchanges. Thus, sonorant consonants fall within the attraction basin of the source nasal, while non-sonorants do not.
- Under the hypothesis that proximity counts as a kind of similarity, each of the exchanges in (5) increases similarity through metathesis.
 - CVldVn has lower overall similarity than CVd|Vn because a sonorant is in closer proximity to the sonorant source. Like reasoning explains **ls** → **sl**.
 - CVnmVn has lower overall similarity than CVm|Vn because a homorganic nasal is closer in proximity to the coronal nasal source.
- Hiligaynon is an instance of metathesis in response to source attraction, which was predicted to exist by allowing proximity to count toward similarity.

5. Harmony Metathesis in Optimality Theory

- Implementing attraction in Optimality Theory (Prince & Smolensky 2004) requires carefully managing the strengths of the entailments associated with a source.
 - Some entailments must be stronger than some lower-ranked FAITHFULNESS in order to drive alternation, but those same entailments must be weaker than some higher-ranked FAITHFULNESS in order to prevent absolute neutralization.
- As usual the lowest-ranked FAITHFULNESS constraint corresponds to the repair; for Hiligaynon metathesis this constraint is
 - LINEARITY (McCarthy & Prince 1995), which penalizes output segments which occur in an order different from the input.
 - Complete neutralization in Hiligaynon would require that targets become adjacent to the source. Evidently, this is not permitted in Hiligaynon because of
 - MORPHEMECONTIGUITY (Lubowicz, 2008), which penalizes the intersplicing of morphemes; only surface forms in which all members of each morpheme are contiguous remain unmarked.
- SOURCEATTRACTION is an output-to-output correspondence constraint which is sensitive to the feature content and string position of the source, φ.
 - The gradient entailments which implement source attraction in Hiligaynon are
 - [φ sonorant, φ cons.] → position(φ) and [φ coronal, φ nasal] → position(φ)
 - [φ sonorant, φ cons.] → position(φ) is violated when an output segment is [φ sonorant, φ cons.], but not in position(φ).
 - [φ coronal, φ nasal] → position(φ) is violated when an output segment is [φ coronal, φ nasal], but not in position(φ).
- IO-FAITH must be higher ranked than SOURCEATTRACTION because no feature changes are permitted. All other SOURCEATTRACTION entailments are low ranked.
- (8) below shows the ranking which gives the attraction of a homorganic nasal to the source in Hiligaynon harmony metathesis (5a,b).

(8)	/inom/	IO-Faith	Morpheme Contiguity	SourceAttraction [φ cor., φ nas] → position(φ)	SourceAttraction [φ son., φ cons] → position(φ)	Linearity
	a. inmon			*!(n)	** (n)*(m)	
☞	b. imnon			*(n)	*(n)**(m)	*
	c. imnon		!*			
	d. innon	!*		** (n)*(n)		

- (8b) wins over (8a) because the stem-/m/ differs from the source in proximity and place of articulation, while the stem-/n/ only differs from the source in proximity. Therefore, distal stem-/n/ violates more source entailments than distal /m/.
- (9) illustrates that this same ranking gives the attraction of liquids and transparency of non-sonorant consonants needed for (5c-e).

(9)

/gilsan/	IO-Faith	Morpheme Contiguity	SourceAttraction [φ cor., φ nas] → position(φ)	SourceAttraction [φ son., φ cons] → position(φ)	Linearity
a. gilsan				*!(l)	
☞ b. gislan				*(l)	*
c. gilsan		!*			
d. gisan	!*			*	

6. Disharmony Metathesis

- As **Figure 3** demonstrates, attraction tension can be resolved in two ways.
 - Targets can give in to attraction and become more similar to source.
 - Targets can also lessen the attraction tension by becoming less similar.

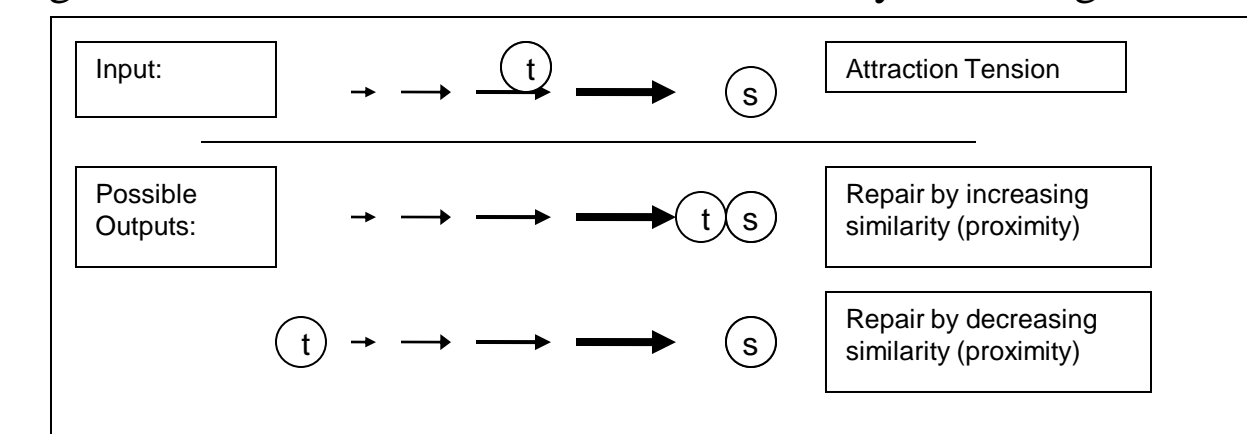


Figure 3. Attraction framework. S: the source of attraction tension. T: target. The size of arrows indicates the strength of the tension.

- This predicts that in addition to harmony metathesis there should also exist instances of *disharmony* or (*OCP*) *metathesis*, in which targets favor dissimilation instead of neutralization.
- In Lithuanian (OSU Metathesis database, 2007), ST₁T₂ sequences metathesize to T₁ST₂, e.g. [mezge] ‘knit’ 3rd pst. alternates to [meksk] ‘knit’ imper. sg.
- A sound perceptual optimization account of this alternation exists (Hume 2000, Steriade 2000): T₁ would be less perceptible between consonants than adjacent to a vowel or liquid where transition formants are more readily perceived.
- However, this alternation could also be formally driven by an OCP-style repair to a source attraction constraint that could only be satisfied by fusion (gemination) or dissimilation.
- High-ranking MAX and UNIFORMITY constraints could prohibit the fusion alternative, forcing a violation of a lower-ranked linearity constraint.

7. Conclusion

- This poster has argued that some metathesis phenomena can be successfully analyzed with a synchronic explanation that does not appeal to perceptual optimization.
- More importantly, this work has explored an additional set of repairs predicted by treating proximity on par with feature-based similarity in an attraction system.
- Hiligaynon and Lithuanian provide evidence that these repairs are indeed attested.

References

Blevins, J. and A. Garrett. 2004. The evolution of metathesis. In *Phonetically-based phonology*, eds. B. Hayes, R. Kirschner and D. Steriade, 117-156. Cambridge: Cambridge University Press.

Burzio, L. 2002a. Surface-to-Surface Morphology: when your Representations turn into Constraints. In *Many Morphologies*, ed. P. Boucher, 142-177. Cascadilla Press.

Burzio, L. 2002b. Missing Players: Phonology and the Past-tense Debate. *Lingua* 112:157-199.

Hansson, G. 2001. *Theoretical and Typological Issues in Consonant Harmony*. Dissertation. UC-Berkeley.

Hume, E. 1998. The Role of Perceptibility in Consonant/Consonant Metathesis. In *WCCFL XVII Proceedings*, eds. B. Susan, E. Kim, and K. Shahin. 293-307. Stanford: CSLI

Hume, E. 2004. The Indeterminacy/Attestation Model of Metathesis. In *Language* 80: 203-237.

Lubowicz, A. 2008. Infixation as Morpheme Absorption. In *Phonological Argumentation: Essays on Evidence and Motivation*, ed. S. Parker. London: Equinox.

McCarthy, J. and A. Prince. 1995. Faithfulness and Reduplicative Identity. In *Proceedings of the Utrecht Workshop on Prosodic Morphology*, eds. R. Kager, H. van der Hulst, W. Zonneveld. The Hague: Mouton.

Steriade, D. 2000. Directional asymmetries in place assimilation: a perceptual account. In *The Role of Speech Perception in Phonology*, eds. E. Hume and K. Johnson. New York: Academic.

Wayment, A., L. Burzio, D. Mathis, R. Frank. 2007. Harmony versus Distance in Phonetic Enhancement. In *Conference Proceedings of NELS 37 at the University of Illinois at Urbana-Champaign*.

Wayment, A. in preparation. *Subsymbolic Phonology: An Attraction-based Perspective on Long-distance Interaction*. Dissertation. Johns Hopkins University. Ms. Draft 2007.

Wolfenden, E. 1971. *Hiligaynon Reference Grammar*. University of Hawaii Press, Manoa.