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# Directionality in Vowel Harmony

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This paper presents an account of directionality in vowel harmony using Turbid Spreading (Finley, 2008, in preparation), a theory of vowel harmony for use with Optimality Theory (Prince and Smolensky, 1993/2004). In this theory, vowel features are represented on three levels of representation: an underlying form, a hidden abstract projection representation, and a phonetic surface form. These three levels capture the abstract nature of vowel harmony, which is induced by a directional SPREAD constraint. This SPREAD constraint captures both general directional spreading (e.g., SPREAD-R[$\alpha$F]) and dominant-recessive spreading (e.g., SPREAD[+ATR]), which can be either directional or non-directional.

## 1. Introduction

In this paper, I extend previous work on Turbidity Theory (Goldrick, 1999, Goldrick, 2001) with a novel proposal for representations in vowel harmony. These representations can be used to account for various types of directional processes in vowel harmony, including feature-specific (dominant-recessive) non-directional harmony processes and directional feature-general spreading processes. The paper is structured into three parts. In the first part, I present the proposed theory of representations for Turbid Spreading, presenting the requirements on GEN that constrain the representations. In the second part, I present the constraints that induce the optimal representations for vowel harmony, including the constraints that derive both directional non-directional vowel harmony. Finally, I demonstrate the implementation of vowel harmony using the proposed constraints. This includes an account of non-participating (opaque and transparent) vowels.

## 2. Turbid Spreading

representations for vowels are concentrated to the value for the harmonic feature value (e.g., [HIGH] for height harmony, [ATR] for ATR harmony)[1]. The feature value for each segment is represented in terms of a triple: underlying form: projection form: surface form. All segments have a projection value (with the exception of some epenthetic vowels). The projection is interpreted differently from Goldrick's (1999, 2001) original formulation, in which each vowel feature has a pronunciation representation, and must also be licensed by a projection. In Turbid Spreading, all features have a projection for each feature value, which are each represented on a separate tier. This creates three levels of representation: the underlying form, the surface/phonetic form, and an intermediate, projection/phonological level, described in (1) below.

(1) Three Levels of Representation

/[+ATR]/ Underlying Form

[+ATR]

(3) Projection from the Projection Level form

| | |
|---|---|
| /[+ATR]/ | Underlying Form |
| [+ATR] " [+ATR] | Projection/Phonological Level |
| [+ATR] | Pronunciation/Surface Level |

The surface/phonetic is also a potential source for the projection value, representing a phonetically induced change to the abstract representation, depicted as an up arrow ($) in (4).

(4) Projection from the Pronunciation/Surface Level

| | |
|---|---|
| /[+ATR]/ | Underlying Form |
| [+ATR] | Projection/Phonological Level |
| $ | |
| [+ATR] | Pronunciation/Surface Level |

A feature at the projection/phonological level must only have one projection, and all segments with an underlying representation must have a projection (epenthetic segments need not be projected). In (5), the medial vowel's [ATR] feature is projected by multiple segments, which is not produced by GEN.

(5) Banned Projection: Multiple Projections

| | | |
|---|---|---|
| * /[+ATR] [–ATR] [+ATR]/ | | Underlying Form |
| ! ! | | |
| [+ATR] # [+ATR] " [+ATR] | | Projection/Phonological Level |
| [+ATR] [+ATR] [+ATR] | phonolgmhi h | |

/– – –/ ⇒ [+ + +]). The structure in (7) is banned because the underlying feature value of the initial vowel is [+ATR], but projects [–ATR] without spreading.

(7) Banned Representation

| * / [–ATR] | [–ATR]/ | Underlying Form |
|---|---|---|
| [ | | |

left-to-right spreading occurs from

There are two ways for a segment to fail to participate in harm

Max[ATR] (Archangeli and Pulleyblank, 2002, Orie, 2001, Orie, 2003), ID[+ATR], ID[ATR] & *[–ATR] (Bakovic, 1999, Bakovic, 2000)). In dominant-recessive harmony, the dominant feature value of the harmonic feature is included in the spreading constraint. This is essentially the same as the SPREAD constraints that do not specify a specific feature value. The difference here is that the spread constraint only applies if there is a [+F] feature value in the projection level, and all vowels in the domain of the constraint are required to be [+F]. These are defined in (18) and (19) below.

(18) SPREAD-R[+F]:
For all non-initial vowels, for each feature value [+F] on the phonological level, assign one violation if there is not a rightward-pointing projection representation originating at that feature value belonging to a rightward adjacent vowel.

(20) RECIPROCITY (REC):
Assign one violation for every feature value [αF] that does not have a corresponding value [αF] at the phonetic level.

RECIPROCITY is evaluated as e

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(30) Interaction of SPREAD-R and SPREAD-L

| I | | | | | |
|---|---|---|---|---|---|
| (a.) / + – / ! ! + – [ + – ] | *! | | $*_1$ | $*_2$ | |
| (b.) / + – / ! ! + + [ – – ] | | *! | $*_1$ | $*_2$ | |
| (c.) / + – / ! + # + [ – + ] | | *! | | $*_2$ | * |
| (d.) ☞ / + – / ! – " – [ – – ] | | | $*_1$ | | * |

In (30) the only candidate that can satisfy SPREAD also violates high-ranked W n /Cs1 cs 0 0

(31) Pronunciation-Level Projection

| /e/ | | | *[+ATR, –HIGH] | REC | ID[ATR] |
|---|---|---|---|---|---|
| (a.) | / | + / | *! | | |
| | | ! | | | |
| | | + | | | |
| | [ | + ] | | | |

representation: an underlying form, a projection (abstract) form and a phonetic (surface) form. These three levels interact such that spreading is initiated by an underlying form and applies through the projection level. Because the pronunciation representation need not share the same feature value as the projection level, vowels may undergo spr

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