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On the Direction of Assimilation Rules*

1. Assimilation involves two separable aspects, viz. a particular *surface phonetic constraint* and a dominance relation of one (class of) segment(s) over another. In this paper, we will discuss one factor that influences the "direction" of the dominance relation. We suggest that, under conditions yet to be examined more closely, this direction is such that the affix of a morphologically structured word is affected whereas the stem remains constant. And we imply that morphological notions such as 'stem' and 'affix' have more relevance for phonology than has recently been admitted¹.

Regularities in the direction of assimilation have been discussed before, but emphasis has generally been on the phonological nature of such regularities. For instance, it has been claimed that regressive assimilation is more natural than progressive assimilation. Harkamer and Aissen (1974) is an attempt to substantiate this claim. On the basis of data from Pali — a middle Indic dialect — they conclude that the direction of assimilation is determined by the nature of the consonants involved. Given a sonority hierarchy beginning with stops and increasing toward *r*, they propose the following rules (132):

- (1 a) the consonant lower on the hierarchy (toward *r*) assimilates in all features to the consonant higher on the hierarchy (toward stops)
- (1 b) if the consonants are of equal rank on the hierarchy, the assimilation is regressive (the first assimilates to the second)

Rule (1 a) would explain a fair number of assimilations, both progressive and regressive. But it remains unexplained why regressive assimilation is preferred whenever (1 a) is not applicable. Hooper (1976: 204) discusses a second factor that is involved in the direction of assimilation, and states a principle that we may substitute for (1 b), above:

- (2) if the two consonants that come together are of the same strength, the first, the syllable-final C, assimilates to the second, the syllable-initial C

Principles (1 a) and (2) appear to be hierarchically ordered: position in the syllable is relevant only when the segments involved are of equal rank on the sonority scale (or on the strength scale). It is not our purpose to discuss these principles here in more detail. Instead we will suggest a third supplementary principle:

* We thank Michael Moortgat for critical comments.

¹ A notable exception is Kooij (1979).

- (3) if two consonantal segments are separated by a morpheme boundary such that one segment is part of the stem and one segment is part of the affix, the segment that is part of the affix assimilates to the segment that is part of the stem.

One result of the application of (3) is that the basic form of a paradigm is kept constant. In that respect, (3) is reminiscent of notions such as *paradigm pressure* or *paradigm uniformity* that have been used to explain certain changes in the form or the ordering of phonological rules. We should stress, therefore, that (3) is not meant as an explanation of diachronic changes. It is primarily introduced to explain certain assimilations that squarely contradict either (1a), or (2), or both. Ultimately, it is intended as a contribution to the development of a theory that predicts the way in which phonological regularities find expression in phonological rules on the basis of universal principles. From that, it naturally follows that (3) does not stand on its own but interrelates with (1a), (2) and other factors that determine the direction of assimilation. Also, we should add that we do not maintain that all assimilation can be explained on a universal basis: as ever, a balance will have to be struck between universal principles and language-specific complexities (compare section 2. on voicing assimilation in Dutch). Finally, we stipulate that we restrict ourselves in this paper to assimilation in heterosyllabic sequences, and that (3) does not predict that assimilation *will* take place under the conditions mentioned, but only predicts the direction of assimilation when it *does* take place.

Before we turn to the Dutch examples that illustrate the relevance of (3), we quote three examples from the literature that also underscore the rôle of the stem and of the integrity of the stem in the application of phonological rules.

In Miller (1976) we found the following suggestion:

- (4) linguistic theory must recognize roots since, among other things, it is not uncommon to have rules operating from the root outward

In his forthcoming book on historical linguistics, Vennemann discusses dissimilation and formulates the following generalization (ch. 5 sect. 5.3.2.1.):

- (5) We see, further, that where dissimilation applies across a stem-affix boundary, the dissimilation hits the affix; i.e. we find anticipatory dissimilation with prefixes and perseverative dissimilation with suffixes

The third quotation is from Clements (1977: 112) where he sums up a number of generalizations concerning vowel harmony:

- (6) In most known systems, vowel harmony in suffixes is determined by the harmonic category of the root, rather than vice-versa

For the moment, this may suffice to show that our interpretation of certain assimilations in Dutch can be generalized to a wider class of phenomena that affect the identity of phonological segments in morphological environments.

2. Consider, first of all, the following fairly standard analysis of the formation of Dutch diminutives²:

(7)	stem ends in	diminutive	gloss
(a)	[-cns]	zeetje	sea
(b)	[+cns] [+son]	balletje	ball
(c)	[+cns] [+son]	raampje	window
(d)	[+cns] [-son]	baantje kruisje kusje	track cross kiss

Taking *tje* as the basic allomorph, we need the following three rules to derive the other forms of the diminutive suffix (the rules are stated informally):

$$(8i) \quad \emptyset \rightarrow \emptyset \quad / \quad \left[\begin{array}{l} \text{V} \\ -\text{tns} \\ +\text{stress} \end{array} \right] \quad + \quad \left[\begin{array}{l} +\text{cns} \\ +\text{son} \end{array} \right] \quad + \quad \text{---} \quad \text{tje}$$

$$(8ii) \quad \text{t} \rightarrow \left[\begin{array}{l} \alpha \text{ cor} \\ \beta \text{ ant} \end{array} \right] \quad / \quad \left[\begin{array}{l} \text{V} \\ +\text{tns} \end{array} \right] \quad + \quad \left[\begin{array}{l} +\text{cns} \\ +\text{son} \\ \alpha \text{ cor} \\ \beta \text{ ant} \end{array} \right] \quad + \quad \text{---} \quad \text{tje}$$

$$(8iii) \quad \text{t} \rightarrow \emptyset \quad / \quad \left[\begin{array}{l} +\text{cns} \\ -\text{son} \end{array} \right] \quad + \quad \text{---} \quad \text{tje}$$

If the stem ends in a sonorant consonant, either a schwa is inserted between stem and suffix (rule (8i)) or the suffix-initial *t* changes its place of articulation (rule (8ii)), the choice depending on the preceding vowel. After obstruents, the suffix-initial *t* is deleted (rule (8iii)). Put differently: the suffix-initial *t* after consonants is either "saved" (by epenthesis), or it loses part or all of its identity. All three rules are morphologically governed because none of the three processes they describe is obligatory elsewhere in the phonology of the language. For a discussion of schwa insertion see Kooij (1977).

The rule that concerns us here is rule (8ii). Actually, the rule is more complicated than stated above, because assimilation also occurs when the stem-final sonorant is preceded by an unaccented non-tense vowel: *kóning* — *kóninkje*, 'king'. One will notice that (8ii) is a peculiar rule. This is not due to the phonetic output constraint that it serves. Assimilations by which sequences of obstruent

² The two cases of allomorphy from Dutch that we will discuss would, in the framework of Hooper (1976), be handled by a disjunctive lexical representation combined with lexical distribution rules. Cf. her treatment of English plural formation, (p.130—1) and our fn. 4. With respect to such a theory our principle would tell us when a phonological regularity finds expression in a lexical distribution rule.

and nasal become homorganic are extremely common across languages. The peculiarity of rule (8ii) resides in the direction of the assimilation. On the basis of both (1 a) and (2), above, one would expect the nasal to give up its identity, and not the obstruent. The assimilation that one would expect *does* occur elsewhere in Dutch word formation:

- (9) on + bepaald ombepaald 'indeterminate'
in + komen inkomen 'come in'

Regressive nasal assimilation across boundaries only affects the alveolar nasal, and is therefore more limited than nasal assimilation in many other languages.

While the facts in (9) are in conformity with both (1 a) and (3), the facts in (7 c) and the corresponding rule (8ii) can be explained only by principle (3): the suffix-initial segment is weaker than the stem-final segment is.

We now turn to our second example, the formation of the Dutch regular or 'weak' past tense. Consider the following data:

- | (10) | verb | past tense | gloss |
|------|---------|------------|-------|
| (a) | breien | brei + de | knit |
| (b) | rijmen | rijm + de | rhyme |
| (c) | hollen | hol + de | run |
| (d) | leven | leev + de | live |
| (e) | stappen | stap + te | step |

Obviously, *-de* is the basic form of the past tense suffix. In order to derive the forms exemplified by (10 e), we would need the following rule

$$(11) \begin{bmatrix} +cns \\ -son \\ -cns \\ +ant \\ +cor \end{bmatrix} \rightarrow [-vee] / \begin{bmatrix} +cns \\ -son \\ -vee \end{bmatrix} + \text{---} e \begin{bmatrix} +V \\ +Past \end{bmatrix}$$

But if we look at the facts of voicing assimilation across boundaries elsewhere in the language, the following generalizations hold:

- (12) (a) If the second of two adjacent consonants separated by a boundary is a fricative, it assimilates to the first consonant. The first consonant is either inherently voiceless or has become voiceless through application of final devoicing. The result is a [-vee] [-vee] sequence.
(b) If the second of two adjacent consonants separated by a boundary is a voiced plosive the first consonant assimilates to the second consonant. Previous application of final devoicing is suspended by an ordering principle called *stijfening* (for a detailed discussion and for the formulation of the rules involved, see Van der Hulst 1980). The result is a [+vee] [+vee] sequence.

Below, we give a few examples that illustrate the foregoing:

- (13) (a) huis # vuil 'garbage'
huis # vuil (through final devoicing)
huisvuil (through regressive assimilation)
- (b) was + baar 'washable'
wazbaar (through regressive assimilation)
- (c) rijk + dom 'richness'
rijgdom (through regressive assimilation)
- (d) stap + de 'stepped'
stapte (through (11))

The assimilation in (13 b) is in accordance with principle (1 a) under the assumption that any plosive is stronger than any voiceless fricative. But the assimilation in (13 c) does not obey principle (1 a), and it obeys principle (2) only under the assumption that differences in strength among explosives are neutralized in rules like (12 b). This seems to be an altogether reasonable assumption in view of the fact that the assimilations exemplified by (13 b) and (13 c) are widespread. The assimilation in (13 a) can be viewed as an illustration of principle (1 a) under the assumption that voiced fricatives are weaker than voiceless fricatives. We have reasons to believe, however, that this particular assimilation in Dutch is due to a historical accident. But what concerns us here is the assimilation in (13 d) which clearly contradicts the facts of regressive voicing assimilation as informally stated under (12 b). We suggest that this is not an accidental phenomenon, but an assimilatory process that receives a natural explanation on the basis of (3).³

3. It would be naive to conclude that a principle like (3) alone explains the direction of assimilation. As mentioned above, it will have to be established what the interrelationships are between morphological principles like (3) and phonological principles like (1 a) and (2). A brief look at the data mentioned in Hankamer and Aissen (1974) suffices to conclude that, in Pali, (3) hardly plays a role at the level of assimilatory processes. And data from Kambata (Hudson 1980: 105) and from Catalan (De Cesaris, this volume) also indicate that the role of morphological factors in the shaping of phonological rules can be strikingly different across languages. As a matter of fact, there may even be differences within the same language. As the example under (13 b), above, shows, the suffix-initial *b* of the suffix *-baar* does not assimilate to a preceding voiceless obstruent. And while the facts exemplified in (9), above, appear to be in accordance with both (1 a) and (3), a formulation like *toon + baar* 'presentable', shows (optional) assimilation of the final segment of the stem (*toombaar*), in accordance with (1 a) but not with (3).

³ We therefore take exception to statements to the effect that rules of this type are the 'unnatural' result of a gradual process of 'morphologization' (see, e.g., Wurzel, this volume). Such a development is possible, but it is by no means a necessary prerequisite in the evaluation of rules that are phonologically marked.

This, actually, gives us an opportunity to sharpen the formulation of our principle. Apparently, two additional factors are involved. It appears, first of all, that (3) affects unaccented affixes more easily than other affixes. Secondly, the relevance of (3) appears to be larger in word formations that are *stem*-based than in word formations that are *word*-based. Dutch exhibits both types of word formation: inflection is stem-based while most but not all derivational rules are word-based.

Thus, while the interaction of principles (1 a), (2), and (3) and their language-specific relevance will have to be investigated on a much larger scale, we believe that we have shown even by these few Dutch examples that paradigmatic factors can have a direct influence on the direction of assimilation, and, more generally, on the way in which phonological regularities find their expression in phonological rules⁴. That influence may, as we have seen, result in phonological rules that are at variance with rules elsewhere in the language though not at variance with phonetic output constraints of the language. From a morphological point of view, it means that stems in paradigms may be dominant not only lexically, but also phonologically.

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⁴ It appears to us that the rules for the allomorphy of plural formation and of past tense formation of English are governed by the same principle.