ON THE FORMULATION OF PHONOLOGICAL RULES

Harry van der Hulst

0. Introduction

An important principle governing the formulation of linguistic rules has always been that the rules have to generalize over as many facts as possible, provided that no false generalizations result. The quest for maximal generalizations has been translated, within generative grammar, in a quest for maximal formal simplicity. In cases where, according to the linguist's intuition, generalizations are missed despite maximally simple analyses, abbreviatory devices must be invented to overcome this difficulty[1]. In this connection two problems have been raised. First, it is not at all obvious that maximal simplicity leads to true or valid generalizations and second, abbreviatory devices tend to have Frankenstein-like properties. The literature on constraining abbreviatory devices is therefore as abundant as that on the validity of formal simplicity. In this paper I will explore the possibility of a constraint on the formulation of rules, which both reduces the importance of formal simplicity and diminishes the opportunity to use abbreviatory devices:

(1) PRINCIPLE I
Phonological rules only contain independently motivated subrules

I will demonstrate the effect of Principle I on the formulation of voice assimilation rules in Standard Dutch[2]. In this connection I will suggest yet another principle:

(2) PRINCIPLE II
Rules involving different domains should not be collapsed

This paper is organized as follows. In section 1 the Dutch facts are introduced together with a standard SPE-like analysis. In section 2 rules which are consistent with Principle I will be given. In section 3 additional Dutch facts are presented which at first sight support the standard analysis. However, it will be argued that if we adhere to Principle II an important phonological generalization can be expressed, which would be obliterated if we returned to the standard analysis. Finally in section 4 some non-standard notational devices are shortly discussed.

1. Voice assimilation in obstruent clusters

The Dutch facts concern word-internal voice assimilation in obstruent clusters[3]. Like most languages Dutch has a surface constraint to the effect that members of obstruent clusters are either all [+voice] or [-voice]:

(3) Surface Constraint

$$\begin{bmatrix}+\text{obs}\\ \alpha\text{vce}\end{bmatrix}\ (\#)\ \begin{bmatrix}+\text{obs}\\ -\alpha\text{vce}\end{bmatrix}$$

At the phonological level, however, violations of (3) may arise due to word formation processes. The following list of compounds contains all possible combinations of different obstruenttypes which may arise. The clusters which surface are added in parentheses[4]

(4)
a. stof # zak [fs]
slaap # zak [ps]

b. huiz # vuil [sf]
heb # zucht [ps]

c. as # bak [zb]
zak # doek [gd]

d. kas # boek [zb]
bed # bank [db]

e. leez # fout [sf]
kaaz # kop [sk]
brood # fabriek [tf]
braad # pan [tp]

f. bos # fee [sf]
was # kaars [sk]
pop # festival [pf]
pak # paard [kp]

Similar violations may arise through derivational rules[5]. Several rule systems that mediate between the phonological and the phonetic level have been proposed[6]. Especially appealing seems to be the following Regressive Voicing rule (REVO):

(5) $[+\text{obs}] \rightarrow [\alpha\text{vce}] \ / \ \underline{\quad} \ \ \# \ \begin{bmatrix}+\text{obs}\\ \alpha\text{vce}\end{bmatrix}$

In other languages which have the same surface constraint and the same violations this rule may be sufficient, i.e. there are languages in which voice assimilation always is regressive[7]. In this case, however, rule (5) could only handle the facts in c, d, e and f. (It would apply vacuously in d and f.) But suppose we choose as underlying only forms with initial voiceless fricative:

(4')
a. stof # sak
slaap # sak

b. huiz # fuil
heb # sucht

This would be consistent with the strong version of the Alternation Condition[8]. Rule (5) could then be applied to these remaining cases too (vacuously in case a). Of course, under such an analysis we would need a rule to voice the fricatives in non-assimilatory position. It turns out that this rule is so abundantly complex that one can only guess at what Meys (1968) tried to gain by handling all the facts by one assimilation rule[9]. However, if we do not follow Meys, how then are we going to account for the facts under b ? At the phonological level there is no violation of (3), but nonetheless the surface clusters show the effect of a change. An alternative solution would be the following. Instead of having voiceless fricatives at the underlying level we could create an intermediate level where voiced fricatives are made voiceless in C_2:

(6) $\begin{bmatrix}+\text{obs}\\ +\text{cnf}\end{bmatrix} \rightarrow [-\text{vce}] \ / \ [+\text{obs}] \ \# \ \underline{\quad}$

Rule (6) is not an assimilation rule, since it makes fricatives in C_2 voiceless both if they are preceded by a voiced and by a voiceless obstruent. I would call

this a crazy rule[10]. There is however no need to tolerate this crazy rule (or to put it more precise: to tolerate its crazy effects, cf. below), since yet another rule is involved whose effect makes it possible for rule (6) to be a genuine assimilation rule. This new rule is Final Devoicing (FIDE). The following examples show that obstruent in C_1 are devoiced even when there is no voiceless obstruent in C_2:

(7) leez # oog [s]
braad # oven [t]

FIDE can be formulated as follows (Kooij 1978):

(8) [+obs] → [-vce] / —— $

($ stands for syllable boundary). At the edge of compounds we are always dealing with a syllable boundary (determined by the strong grammatical boundary #). Therefore in C_1 we only have to reckon with voiceless obstruents. This means that subsequent devoicing of fricatives in C_2 can be interpreted as an assimilation phenomenon. I will therefore refer to this rule as Progressive Voicing (PROVO). This interpretation of rule (6) has no consequences for its formulation. We do not have to add [-vce] to its SD. The presence of FIDE will ensure that PROVO will only devoice obstruents in C_2 which are preceded by a voiceless obstruent in C_1, that is, when we order FIDE before PROVO. However, given this simpler notation of PROVO there is no actual need to order FIDE before it; both (9a) and (9b) lead to a correct output:

(9) a. /heb # zucht/
FIDE p
PROVO s
hepsucht

b. /heb # zucht/
PROVO s
FIDE p
hepsucht

It will be clear that (9b) is a suspicious derivation if we want to maintain that PROVO is an assimilation rule. Does this mean that we have to complicate PROVO after all ? If we do, FIDE will have to be applied before PROVO. What other ordering relations hold between REVO, PROVO and FIDE ? First FIDE must be ordered before REVO. Crucial derivations are the following:

(10) a. /bed # bank/
FIDE t
REVO d
bedbank

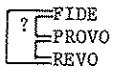
b. /bed # bank/
REVO (d)
FIDE t
*betbank

(where '(d)' means that the application is vacous). Note that (10a) involves an A-B-A derivation[11]. Second PROVO must precede REVO:

(11) a. /heb # zucht/
FIDE p
PROVO s
REVO (p)
hepsucht

b. /heb # zucht/
FIDE p
REVO b
PROVO s
*hebsucht

All this means that the following ordering relations hold:

(12)


(The lines indicate that ordering arguments have been provided). A last move to simplify the analysis will be the collapse of PROVO and REVO:

(13) [+obs] → [αvce] / { [+obs, αvce] # [+cnt, ——] } (a)
{ —— # [+obs, αvce] } (b)

This schema together with the FIDE rule constitutes the simplest rule system to account for the facts in (4). Note that collapsing the two assimilation rules solved our 'problem' with the formulation of PROVO: we had to introduce the feature [vce] in its SD to be able to collapse.

2. An alternative analysis

The aim of this section is to present an analysis which is consistent with Principle I. The above analysis is inconsistent with this principle since the following three subrules, contained in the formulation of (13), are superflous for the description of Dutch assimilation facts:

(14) [+obs, +cnt] → [+vce] / [+obs, +vce] # ——
(15) [+obs] → [-vce] / —— # [+obs, -vce]
(16) [+obs] → [+vce] / —— # [+obs, +cnt, +vce]

Rule (14) is superfluous since PROVO never involves transfer of a plus value. Rule (15) is superfluous since devoicing in C_1 will be achieved via FIDE, a rule we need anyway. Rule (16) is not only superfluous, it specifies a change which is precisely opposite to what actually happens in strings which meet its SD. Principle I then disqualifies the standard analysis. Consistent with this principle are only the following two rules:

(17) PROVO (reformulated)
[+obs, +cnt] → [-vce] / [+obs, -vce] # ——

(18) REVO (reformulated)
[+obs] → [+vce] / —— # [+obs, -cnt, +vce]

The two rules have two notable properties. First they state the facts in a rather direct surface oriented way. The rules are generalizing but not overgeneralizing[12]. In doing this they correspond rather closely to the traditional handbook formulations of the Dutch assimilation facts. Second the rules are no longer ordered among themselves. Of course it is usually the case that extrinsic ordering can be circumvented by complicating the rules. Such a strategy does not necessarily lead to better rules in any principled sense. It should be noted, however, that the rules (17) and (18) were not formulated to avoid extrinsic ordering at all. The rules resulted from a principle which limits the use of abbreviatory devices.
One could also object that the present analysis still uses the device of ad hoc extrinsic ordering, because FIDE must be withheld from applying after REVO.

This objection could be countered. The ordering relation that holds between FIDE and REVO is of a particular kind. Suppose we would replace the word boundary in REVO by a syllable boundary. This is a legitimate move since in all cases where there is a word boundary there also is a syllable boundary. On the other hand, there are cases where there is a syllable boundary, but no word-boundary and where the assimilation rules still are valid:[13]

(19) abdij : [bd]
advocaat : [tf]

It can now be noted that FIDE and REVO stand in a particular formal relation called proper inclusion:

(20) | [+obs] | → [-vce] / | —— $ |
| [+obs] | → [+vce] / | —— $ | [+obs, -cnt, +vce]

In all cases where two rules refer to the same input string, the more specific rule has application precedence. Koutsoudas et al (1974) formulated a universal principle to achieve precisely that. The examples they use involve rules that are mutually bleeding. Our two rules however are mutually feeding. This means that giving applicational precedence to REVO will still not do, because the output of REVO meets the SD of FIDE. We will therefore formulate the following principle:[14]

(21) If a string R meets the SD of two rules A and B than B will not apply if the SB of B is properly included in the SD of A

This means that the derivation of /bed # bank/ which appeared to involve an A-B-A derivation (cf. (10) plus comment) actually involves little or no derivation at all. FIDE is properly included in REVO. Therefore it will not apply. Only REVO will (vacuously) apply.

It seems then that little is lost if we adhere to principle I; the rules become only slightly more complex. As to what is gained opinions will differ. I would positively evaluate the fact that we lost ad hoc extrinsic ordering and that our rules constitute surface generalizations[15]. I am aware of the difficulties that are involved when we compare analyses of rules which resulted from different axiomatic commitments. My goal at this point is to show that there is a reasonable alternative to the commitment to simplicity, viz. the commitment to surface generalizations.

3. Additional facts

Consider the following facts:

(22) a. wederzijd + s [ts]
slaag + s [xs]
heb + t [pt]
graav + t [ft]

b. geloov + d [ft]
beheb + d [pt]

These facts differ from the facts in (4) in at least two ways: first the triggering consonant may be a fricative; sofar fricatives only were affected by assimilation. Second, regressive assimilation may involve the transfer of the minus value; sofar we only saw cases in which the plus value was transferred. The following rule would adequately describe the facts in (22):

(23) [+obs] → [-vce] / —— [+obs, -vce]

(In the (22b) cases FIDE applies first to devoice the obstruent in C_2). Within a standard analysis we would be forced to collapse this rule with the REVO rule we already established, viz. (17). Collapsing would result in something very close to rule (4):

(24) [+obs] → [αvce] / —— (#) [+obs, αvce]

Apparently then this rule is no overgeneralization at all. Given the need for this rule, we must return to the standard analysis more or less completely since we will be forced again to order PROVO and REVO. However, I will not give up so easily. At this point I will appeal to principle II, repeated here:

(2) Principle II

Rules involving different domains should not be collapsed

There is a difference between the facts in (4) and (22) which I didn't mention yet: in (4) we observe assimilation phenomena across syllable boundary, but in (22) we observe assimilation inside a syllable. There are important differences between both domains which are reflected in the rules:

(25)

tautosyllabic	heterosyllabic
(- → +) / + → -	- → +
C_2 = [-cnt] / C_2 = [+cnt]	C_2 = [-cnt]

In this schema the tautosyllabic transfer from the plus value stands within parentheses, since sofar no facts have been adduced to illustrate this case. At this point there are differences among speakers of Dutch. Blancquaert (1962) mentions the following pronounciation of the word herfstblad 'autumn-leave':[16]

(26)
	h	e	r	f	s	t	b	l	a	d
1st application						d				
2nd application					z					
3rd application				v						
	h	e	r	v	z	d	b	l	a	d

hervzdblad

The syllable boundary is between the t and the b, so the "1st application" is an instance of the heterosyllabic rule in my view, the second and the third application however are instances of the tautosyllabic rule. Crucial is that in the latter cases [-voice] is changed into [+voice]. What I will suggest on the basis of (25) is this. There are important differences between tautosyllabic and heterosyllabic assimilation both with regard to scope and to generality. If we collapse both rules we might save ink, but we would obscure the following phonological generalization:[17]

(27) Phonological rules tend to be more general to the extent that their domain is more restricted

In other words instead of using similarities as an argument to collapse I will use differences as an argument not to do so. So again the commitment of simplicity must give precedence to another commitment, viz. Principle II.

4. Toward a suprasegmental treatment of voice assimilation.

In this last section I will try to express the differences between the tauto- and heterosyllabic rule even more. At this point a few alternative approaches are briefly compared.
First we might follow Vennemann (1978) in his reformulation of FIDE:

(28) Obstruents are voiceless in coda's

This reformulation would deal with all the facts in (22). For those Dutch speakers that pronounce herfstblad as herfstblad (without any assimilation at all) we will then need no additional rules at all to handle the alleged tautosyllabic assimilation. Of course to prevent regressive voicing of clusters in C_1 position we would have to complicate REVO slightly[18]

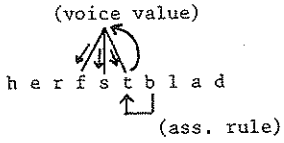
(29) $[+obs] \rightarrow [+vce] \;/\; [+son] \;\_\_\; \$ \begin{bmatrix}+obs\\-cnt\\+vce\end{bmatrix}$

Alternatively for heryzdblad speakers we could not only adopt Vennemann's FIDE rule, but also a notational convention proposed in Guerssel (1978):

(30) $[+obs]_1^n \rightarrow [+vce] \;/\; \_\_\_ \; \$ \begin{bmatrix}+obs\\-cnt\\+vce\end{bmatrix}$

The subscript-superscript notation means 'one or more'. Guerssel suggests that the sub- and superscript is predictable here and that we could adopt as a convention that assimilation rules like REVO always involve clusters rather than single segments, provided that at least one of the features that indicates the SC are contained in feature matrix indicating the environment[19].
What all this shows is that tautosyllabic assimilation is a matter of convention rather than rule. The convention would be something like this: tautosyllabic (string adjacent) obstruents agree in voice, therefore if for external reason one of the obstruents must change its voice value all obstruent must be adjusted. Graphically the working of this convention could be represented as follows:

(31)



The convention would be valid for syllable initial clusters too, but I will not go into that here. Recently several approaches to similar phenomena have been proposed under the heading of 'metrical phonology' (Halle and Vergnaud 1978). A more full exploration of the Dutch facts within such frameworks will be the subject of another paper.

Notes

1. Bach (1968) can serve as a characteristic example.
2. This principle is in the spirit of Geil and Vennemann (1979) who argue against the use of Greek variables in cases where these variables do not generalize over independently motivated subrules.
3. I will not discuss external sandhi phenomena, nor assimilations where sonorants are involved.
4. I will not give phonetic transcriptions, except for the relevant segments. I will refer to the position occupied by the first obstruent as C_1 and the other position as C_2. I have omitted glosses since these are irrelevant.
5. In the formation of preterite forms constraint (3) is relevant too. There are pecularities there which I will not discuss here. See Van der Hulst (to appear).
6. Especially Meys (1968), Hubers and Kooij (1973), Tops (1974) and Brink (1978).
7. For a discussion of voice assimilation phenomena across different languages see Ralph (1974).
8. There are Dutch dialects that have only voiceless initial fricatives at the surface. For those dialects rule (5) would suffice. However in Standard Dutch fricatives are initially voiced (though less than occlusives).
9. Meys' analysis is discussed in Hubers and Kooij (1973) and Tops (1974). The point of Kooij and Hubers' analysis is that assimilation in Dutch involves in the first place only the value for the feature voice. Values for the feature tense are adjusted by the following rule:

   $[+obs] \rightarrow [+tns] \;/\; \begin{bmatrix}+obs\\+tns\end{bmatrix} \; \# \; \_\_$

   Brink (1978) argues for the fact that the 'adjustment' rule involves voice, while the assimilation rule involves tense. Whatever the truth may be in this matter, it will not affect what I am doing in this paper. Kooij and Hubers' rule can be added to my analysis too and the switch from voice to tense (and vice versa) in all rules will not affect the formal relations between the rules. For a more thorough discussion of the various views on facts and rules see Van der Hulst (to appear). Tops' analysis comes close to the standard analysis that is presented in this section.
10. A similar rule is in Brink (1978). He argues that such a rule is not unnatural given the fact that it resembles the so called Notker's Anlautgesetz.
11. For such derivations see Pullum 1976.
12. The need to rule out overgeneralization is discussed in Chrothers and Shibataini (1975). See also Van der Hulst (1979), p. 234, fn. 20, with reference to Hooper (1976) on this matter.
13. I do not assume that the obstruents in C_1 are in fact underlying /b/ or /d/. The point is that the surfacing clusters are in agreement with the REVO rule for the same reason as the relevant clusters in (4).
14. The relevance of Proper Inclusion Presence for an almost identical case is also acknowledged in Ringen (1975).
15. Cf. references in fn. 13.

16. This example is given in Tops (1974), who uses it to prove that REVO applies iteratively.

17. A similar point could be made with reference to nasal assimilation in Dutch.

18. In such cases it could be claimed that only the adjustment rule which refers to tense operates. Cf. Hubers and Kooij (1973).

19. Herfstblad - speakers and Brink (1978) however , seem to falsify Guerssel's claim.

Bibliografie

BACH, E.
1968 Two Proposals Concerning The Simplicity Metric in Phonology. Glossa 2, 127-49

BLANCQUAERT, E.
1962 Praktische uitspraakleer van de Nederlandse Taal. Antwerpen

BRINK, D.
1978 Voice Assimilation in Dutch: Some Refinements. ALH 21

CROTHERS, J. and M. Shibatani
1975 On some Fundamental Concepts in Phonology. In: D. Goyvaerts and G. Pullum (eds.) Essays on the Sound Pattern of English. Ghent 1975, 505-537

GEIL, G. and Th. VENNEMANN
1979 Ueber den Gebrauch von Variabelen in Phonologischen Regeln. In: G. Drachmann (ed.), Salzburger Beiträge zur Linguistiek 3 : Akten der 2. Salzburger Frühlingstagung für Linguistiek. Tübingen, 179-195

GUERSSEL, M.
1977 Constraints on Phonological Rules. LA 3, 267-305

HALLE, M. and J.R. VERGNAUD,
Metrical Structures in Phonology. MS

HOOPER, J.
1976 An Introduction to Natural generative phonology. New York

HUBERS, G. and J. KOOIJ
1973 Voice Assimilation in Dutch, ALH 16, 25-34

HULST, H. van der
1979 Recent Developments in Phonology. Lingua 49, 207-38

HULST, H. van der
(to appear) Stemassimilatie in obstruentclusters: synchrone en diachrone aspecten

KOOIJ, J.
1978 Morpheme Boundaries and Syllable Boundaries: A Case for Natural Phonology. GLOT 1, 27-50

KOUTSOUDAS, A., G. NOLL and G. SANDERS
1974 On the Application of Phonological Rules. Lg 50, 1-28

MEY, J.
1968 A Case of Assimilation in Modern Dutch. ALH 11, 123-45

PULLUM, G.
1976 The Duke of York Gambit. JL 12, 83-102

RALPH, B.
1974 Constraining Predictiveness in Phonology. Gothenburg papers in Theoretical Linguistics 26

RINGEN, C.
1975 Vowel Harmony: Theoretical Implications. Ph. D. diss. Indiana University

TOPS, G.
1974 Assimilation of Voice in Dutch. A Generative Approach. Leuvense Bijdragen 63, 1-14

VENNEMANN, Th.
1978 Universal Syllabic Phonology. Theoretical Linguistics 5, 175-215