Final Devoicing

Principles and Parameters

Wiebke Gertrud Brockhaus

University College London

University of London

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ABSTRACT

This thesis addresses the problem of how to deal with the phonological event of final obstruent devoicing (FOD) in a theoretical framework based on principles and parameters rather than rules. The data used comes almost exclusively from German *(Hochlautung).*

The first chapter presents the 'raw facts' of FOD. Its purpose is to provide an outline of the sort of data to be accounted for in the remainder of the thesis.

Previous treatments of FOD in German are discussed and evaluated in the second chapter. All of them are shown to be associated with a number of problems, many of which are artifacts of inadequate theoretical frameworks.

The third and fourth chapters address the questions of what FOD is and where it occurs. The proposed answer is couched in the framework of Government Phonology (Kaye, Lowenstamm & Vergnaud 1985, 1990), a phonological theory whose basic tenets are introduced in the course of the discussion. The conclusion drawn is that FOD is an instance of autosegmental licensing, where the laryngeal element L^- requires licensing by a nuclear position with phonetic content.

Chapter 5 explores the question of why FOD should exhibit the particular properties that it does. Both physical factors which are responsible for the general tendency of (final) obstruents to exhibit some degree of devoicing and the cognitive benefits which FOD can bring to speech recognition are investigated.

The final chapter takes a new look at the concept of neutralisation in the context of FOD in German. It highlights Trubetzkoy's and Kiparsky's views of neutralisation and discusses some of the experimental work which has examined FOD as a putative process of neutralisation over the past decade. It is shown that apparent problems for phonological theory raised by the experimental studies can be resolved by Government Phonology.

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ABBREVIATIONS AND NOTATIONAL CONVENTIONS

1. Abbreviations

acc.	accusative
C	consonant
coll.	colloquial
dat.	dative
DP	Dependency Phonology
fam.	familiar form
fem.	feminine
FOD	final obstruent devoicing
gen.	genitive
GP	Government Phonology
imper.	imperative
masc.	masculine
MHG	Middle High German
N	nucleus
NHG	New High German
nom.	nominative
NSG	Northern Standard German
OCP	Obligatory Contour Principle
O	onset
OHG	Old High German
pl.	plural
pol.	polite form
R	rhyme
RP	Received Pronunciation
SD	structural description
sg.	singular
so.	someone
SSA	Syllable Structure Algorithm
TOT	tip-of-the-tongue
UG	Universal Grammar
V	vowel
VOT	voice onset time

2. Transcription

Throughout this thesis, I have made transcriptions no narrower than necessary. Aspiration, for example, is never indicated, although frequently present. The phonetic symbols used have their IPA values, with the exception of [r], which does not represent an alveolar trill, and that specified at the bottom of this paragraph. The meaning of the symbol [r] is explained in Chapter 1 (1.2.2.1).

Exception to IPA: [ɪ] = lax congener of [ɨ]

Transcriptions within quotes contain the symbols used by the author of the source of the quotation.

This thesis addresses the problem of how to deal with the phonological event of final devoicing in a theoretical framework based on principles and parameters rather than rules. The data being used comes almost exclusively from German.

The first chapter presents the 'raw facts' of final devoicing and voicing restrictions on obstruent clusters. Its purpose is to provide an outline of the sort of alternations and distributional restrictions that are to be accounted for in the remainder of the thesis.

Previous treatments of final devoicing in German are discussed and evaluated in the second chapter. This chapter shows that all of them are associated with a number of problems, many of which are artifacts of inadequate theoretical frameworks.

The third chapter addresses the question of what final devoicing is. The proposed answer is couched in the framework of Government Phonology, a relatively recent phonological theory the basic tenets of which are introduced gradually in the course of the discussion. The conclusion drawn is that final devoicing is a phonological weakening process involving the loss of the element L^-.

This is followed (in the fourth chapter) by an investigation of the trigger of final devoicing, which is identified as a licensed empty nuclear position. The analysis presented in the third chapter is modified to accommodate some of the insights gained in the fourth chapter. Specifically, final obstruent devoicing is reinterpreted as an instance of autosegmental licensing, where the laryngeal element L^- requires licensing by a 'strong' nuclear position, that is, a nuclear position with phonetic content.

On the basis of the findings of Chapters 3 and 4, Chapter 5 explores the question of why final devoicing should exhibit the particular properties that it does. For this purpose, I adopt a two-pronged approach. On the one hand, I investigate articulatory factors which are responsible for the general tendency of (final) obstruents to exhibit some degree of devoicing. On the other hand, I explore the cognitive benefits which final obstruent devoicing can bring to speech recognition. In particular, I show that it can aid parsing by helping the hearer locate a domain-boundary, and I discuss a proposal which argues that voiceless obstruents are perceptually more salient, so that recognition at the segmental level is improved through the application of FOD.

The final chapter takes a new look at the concept of neutralisation in the context of final devoicing in German. It briefly highlights two different views of neutralisation, those of Trubetzkoy and Kiparsky, and discusses some of the experimental work which has examined final devoicing as a putative process of neutralisation over the past decade. It points out that some of the findings of this work pose problems for the phonological theories which first inspired the experimental research activity in this area. The Government Phonology analysis of final devoicing presented in Chapters 3 and 4 is then confronted with these problems. It is shown that the apparent problems for phonological theory raised by the experimental studies can be resolved by Government Phonology.

THE 'FACTS' OF FINAL OBSTRUENT DEVOICING

1.1 Introduction

Some loss of voicing in final obstruents (usually in *word*-final position, especially when the word is utterance-final) is attested in a vast number of languages. English is probably the most well-known language to exhibit this apparently physiologically conditioned property. Phonologically speaking, however, this loss of voicing is not significant, as the affected segment is still perceived and interpreted as the voiced member of a pair of obstruents. It is for this reason that minimal pairs such as *nib - nip*, *bed - bet* and *lag - lack* can exist in certain dialects of English (e.g. RP, also known as Southern British Standard).

By contrast, there is a sizeable group of other languages all over the world where the loss of voicing is magnified to such an extent that native speakers typically perceive a final obstruent as phonologically voiceless, i.e. as the voiceless member of a pair of obstruents. It is not possible for, say, German hearers to reliably distinguish the noun *Bund* ([bʊnt], 'league') from the adjective *bunt* ([bʊnt], 'colourful') when the two are spoken in isolation. This apparent lack of phonological opposition, however, cannot be observed if the relevant segment is in an inflected form, such as *Bunde* (['bʊndə], 'league', dat. sg.) vs. *bunte* (['bʊntə], 'colourful', fem. nom. sg.). The phonological event which consists in this loss of voicing is most frequently referred to as *final devoicing*[1] and, occasionally, as *terminal devoicing*[2]. German-language

[1]For example, by Vennemann (1968: 161, 1972a: 12), Hyman (1975: 71f.), Kenstowicz & Kisseberth (1979: 337), Kaye (1989: 59) and Rubach (1990).

[2]For example, by King (1969: 47), Escure (1975: 33) and Dinnsen (1980).

publications[3] know it as *Auslautverhärtung*, while I shall refer to it as *final obstruent devoicing* (or FOD for short) in this thesis, to distinguish it from other alleged final devoicing processes, such as so-called final sonorant devoicing in Icelandic, Russian or Angas (Chadic; Nigeria)[4], for example. The term *final devoicing* will be used where I deliberately want to leave it open whether I am referring to phonologically significant devoicing or simply physiologically conditioned loss of voicing. In what follows, *voicing* is to be understood in its broad traditional sense[5].

Phonologists working in a variety of different theoretical frameworks have taken an interest in final obstruent devoicing[6] for a number of reasons, some of which will become apparent in Chapter 2, where I discuss several analyses put forward over the past twenty-odd years. Apart from these, three of the most obvious reasons for FOD's popularity, as far as I can see, are the following.

Firstly, final obstruent devoicing is found in one of the most thoroughly-studied languages of the world, German.

Secondly, it is a phonological event that crops up all over the world, not just within the Germanic group of Indo-European languages (e.g. German and Dutch). It also occurs in Balto-Slavic languages, such as Russian, Polish and Czech, as well as Romance languages like Catalan. In fact, it is amply attested outside the Indo-European family. Completely unrelated languages, such as

[3]E.g. Wurzel 1970, Kloeke 1982a, b and Vennemann 1982a.

[4]See, for example, Escure 1975 (pp. 165f.), Barry 1989 and Halle & Clements 1983 (p. 45). I will return to this process, albeit briefly, in Chapter 3.

[5]The traditional use of the term and its implications will be discussed in detail in Chapter 3.

[6]See the following chapters for detailed references.

Wolof (West Atlantic; Senegal, Gambia), Ojibwa (Macro-Algonquian; central and eastern Canada, northern central United States) and Turkish (Altaic; Turkey, Bulgaria), for example[7], also exhibit FOD.

Thirdly, there seems to be something 'deep-seated' about it, which makes researchers feel that an understanding of FOD may be a particularly useful key to phonology. This deep-seatedness manifests itself in the fact that languages apply FOD to foreign loan words with the same regularity as they do to indigenous words and that individual speakers - with few exceptions - carry FOD from their mother tongue over into other languages they may be learning or may have learnt as adults. In fact, even speakers of so-called CV languages, with no final obstruents, apply FOD in other languages. Carrying FOD over into another language is particularly noticeable where that other language does not itself exhibit FOD. So, the use of FOD is one of the hallmarks of a German accent of English, for example. Another aspect of the 'deep-seatedness' of FOD is that, during the process of first-language acquisition, children tend to go through a phase of applying FOD (usually when obstruents are first acquired), even in languages where adult speakers don't (see Stampe 1969).

In this chapter, I will try and present the 'facts' of FOD. As pointed out by Popper (see Magee 1982, ch.2), however, it is not really possible to present pure facts without reference to theory, or, as Magee (1982: 33) puts it, 'observation as such cannot be prior to theory as such', hence the quotation marks around *facts*. All I can do is to offer those facts which are relevant to the phenomenon on the broadest theoretical basis possible (i.e. a combination of my own analysis with those put forward by others), while, at the same time, turning

[7]See, for example, Crystal 1987 (pp. 436ff.) or Maddieson 1984 (pp. 174ff.) for details of the classification of the world's languages.

down the colour that this theoretical basis adds to these facts, as far as humanly possible. When I introduce some actual approaches to FOD (including my own) in Chapters 2, 3 and 4, the 'facts' will appear in much sharper focus; some of them will turn out to be irrelevant and others will need to be looked at more closely than can be done in this introductory chapter. So, this chapter provides no more than a broad overview of the sort of facts that have been, and still are, thought to be relevant to FOD.

This means that I will present data sets which illustrate the sort of alternations FOD gives rise to. I will show that FOD is not necessarily restricted to word-final position. I shall also comment, very briefly, on voicing assimilation (or, more precisely, voicing restrictions in obstruent clusters), which, on occasion, has been linked with FOD (see, for example, Hayes 1984 and Mascaró 1987a).

From cross-language studies such as Mascaró 1987a and even the most superficial inspection of other FOD languages, such as Catalan[8] or Polish[9], for example, one can tell that there is some variation between languages regarding the environments where FOD occurs. Clearly, the nature of this variation can reveal a great deal about the special properties of FOD, as can looking at FOD in the context of voicing assimilation processes (which are practically non-existent in German). Ideally, then, a study of FOD should be a cross-language study, pooling data from a range of languages in the manner of Mascaró 1987a.

This is, in fact, what I set out to do when first embarking on the research for this thesis. However, when trying to get to grips with FOD in German (my

[8]See, for example, Wheeler 1979, 1983, 1986 for relevant data.

[9]See, for example, Rubach 1982 (pp. 120ff.), 1984 (pp. 206f.), Kenstowicz & Kisseberth 1979 (pp. 418ff.), Jassem & Richter 1989, Slowiaczek & Dinnsen 1985 and Booij & Rubach 1987 for relevant data and some discussion.

mother-tongue), working within the framework of Government Phonology, I came across so many interesting issues and problems which had to be dealt with in the context of FOD that I was eventually faced with a choice between a superficial, incomplete and generally unsatisfactory account of several languages or an analysis of FOD in German only. I chose the latter, partly for reasons of space, time and funds and partly because it seemed more sound from a methodological point of view. I made this choice in the hope that I will be able to tackle some of the languages which had to be neglected for the purposes of the present thesis in future research projects. In spite of the fact that most of what follows will be confined to a discussion of German only, I feel that the present study can still make a contribution to the quest for a better understanding of UG by raising issues which are relevant universally (see especially Chs. 3, 4 and 5).

Having got these preliminaries out of the way, I will now turn to the 'facts' of FOD in German.

1.2 FOD in German

1.2.1 Historical development

Detailed and reliable information on the emergence of phonologically significant final devoicing is almost impossible to come by. Most historical works on German[10] mention this process only in passing, while focusing on the more dramatic changes affecting the language at that time. Researchers whose main interest is final devoicing, on the other hand, tend to make what little hard facts are available fit their particular theories, none of which seem entirely

[10]E.g. Priebsch & Collinson 1958, Bach 1961, Chambers & Wilkie 1970, Penzl 1975 and, in parts, König 1978.

convincing to me[11]. So, this section will have to remain fairly skeletal, and any attempts to put flesh on the bones of the few uncontroversial facts will have to be put off until Chapter 5, where I examine some hypotheses on why final devoicing should exist.

Final devoicing found its way into most German dialects (there was no unified and widely-spoken standard pronunciation at that time) as one of the numerous changes which took place during the transition from Old High German (c. AD 750-1050) to Middle High German (c. AD 1050-1350; see Walshe 1974: 2). *High German* (as in the terms *Old High German* and *Middle High German*), in this context, does not refer to a non-regional standard variety (as it does today) but to those mainly Upper German dialects (i.e. Alemannic and Bavarian-Austrian) which were spoken by the authors of the literary manuscripts from which most of our knowledge of the language of that period is derived[12]. What is clear from these sources is that final *b, d, g* became *p, t, k*, as indicated by MHG spellings such as *lîp* ([li:p], 'body'; gen. sg. *lîbes* ['li:bəs]) and *tac* ([tak] 'day'; gen. sg. *tages* ['tagəs])[13]. There is less agreement, however, on whether fricatives became subject to this process at the same time, although some researchers suggest that this was, in fact, the case[14].

[11]King (1969: 52ff.), for example, by implication treats the emergence of final devoicing as rule addition, but is unable to say what exactly would cause such a complication of the grammar. Parker (1981) tackles the very issue of why final devoicing should have arisen historically, but his account breaks down at the point where the loss of final schwa becomes crucial. Contrary to his claims, wholesale historical schwa-apocope is not attested in Standard German. In the absence of clear evidence, I will not pursue this aspect of Parker's work any further, although other areas of it will feature in Chapter 5.

[12]See Walshe 1974 (pp. 2ff.) for further details of this classification.

[13]See König 1978 (p. 73).

[14]Priebsch & Collinson (1958: 119) quote *hof* ('court'; gen. *hoves*) as an examples of final devoicing of fricatives. See Chapter 5 for further discussion of this point.

This is how far the very meagre undisputed history goes. Let me now turn to the rather more richly documented present.

1.2.2 The application of FOD in present-day German *Hochlautung*

1.2.2.1 Introduction

Before dealing with the details of FOD in German, let me first of all identify the kind of German that is to be investigated. This study is concerned mainly with the variety of German which corresponds roughly to what Wells (1982: 279ff.) labels mainstream RP or, perhaps, even near-RP (Southern British Standard pronunciation) for British English. In the most recent edition of the authoritative DUDEN *Ausspracheworterbuch*[15] (Mangold *et al.* 1990), this variety is referred to as *Standardlautung*. It is free from regional characteristics and, therefore, suitable for use by radio and television announcers. It is also the variety taught to foreign learners. I will refer to it as *Hochlautung* (rather than Standardlautung), since I believe that most readers will be more familiar with this traditional term.

My account of German *Hochlautung* deviates from the DUDEN standard in three respects. The first is a matter of personal preference, the second of phonological cautiousness and the third a combination of personal preference and phonological insight based on this preference. In my own dialect, which contains a small number of elements of Northern Standard German (NSG), I do not have the long vowel [ɛ:], which corresponds to orthographic *ä* in a word like *Käse* (['kɛ:zə], 'cheese), although I do have its short congener [ɛ]. Instead,

[15]The DUDEN is renowned in Germany as *the* authoritative reference publication on the German language. Its most important manifestations today are the 10-volume DUDEN, where each volume covers a particular area such as grammar, etymology, pronunciation or orthography and the six-volume *Großes Wörterbuch der deutschen Sprache*, which combines information on all of the above aspects (as well as usage) in an alphabetically arranged dictionary of over 500 000 entries.

I use the NSG alternative to this vowel, [e:]. So, my pronunciation of *Käse* is ['ke:z ə]. This is reflected in the transcriptions contained in the remainder of the thesis. It is not relevant to my discussion of FOD, but still worth noting.

The second deviation from *Hochlautung* concerns the pronunciation of tautosyllabic /ə/ + /m/, /n/ or /l/. What normally happens is that the schwa is not realised and the sonorant becomes the syllable peak (as in certain pronunciations of English *bottle* and *button*). The behaviour of schwa in German is an extremely complex issue and cannot be dealt with satisfactorily in the present study. It is for this reason that I have opted for the *Bühnenaussprache*[16] alternative in these cases and represented words containing these sequences as schwa followed by the relevant nasal or lateral[17]. The only exception to this rule (in the non-technical sense!) involves /ə/ + /r/ sequences, which do exhibit behaviour which has to be dealt with in the context of the present investigation of FOD.

This brings me to the third point where my transcriptions systematically deviate from those which can be found in the DUDEN pronouncing dictionary. According to this (Mangold *et al.* 1990: 46ff.), orthographic *r* is realised consonantally before long and short vowels as well as diphthongs, and after short vowels (where *r* itself may be either word-final or precede another consonant).

Four different types of *r*-realisation are recognised for *Hochlautung*, viz. an alveolar trill [r], an alveolar tap [ɾ], a uvular trill [ʀ] and a uvular fricative [ʁ].

[16]*Bühnenaussprache* is the standard pronunciation for classical theatre. It is not used in everyday conversation, where it would be perceived as stilted and unnatural.

[17]I will deviate slightly from this usage in 2.3.4, in order to capture the predictions made by the analysis (Rubach 1990) to be discussed there.

These four are essentially in free variation[18], with the uvular fricative being the realisation normally chosen by trained speakers. In what follows, I will simply use the symbol [r], which is not intended to represent an alveolar trill, but any one of the four different consonantal *r*-realisations just described.

So, according to the DUDEN pronouncing dictionary, we find prevocalic [r] in words such as *Raum* ([raʊm], 'room, space') and *Karre* (['kar ə], 'barrow') and postvocalic [r] in, for example, *dürr* ([dʏr], 'arid') and *Wort* ([vɔrt]; 'word'). After long vowels (and, in rare cases, diphthongs, e.g. in proper names such as *Meir* [maɪɐ]) orthographic *r* is realised as an unrounded central vowel between open-mid and open (according to the 1989 IPA classification), i.e. [ɐ]. This is true both word-finally (e.g. in *Bier* [bi:ɐ], 'beer') and before a consonant (e.g. in *Pferd* [pfe:ɐt], 'horse').

Unlike *Hochlautung*, my dialect has *r*-vocalisation both after long vowels ***and*** after short vowels, regardless of what follows. So, consonantal [r] is restricted to the sort of prevocalic positions just described, and words such as *dürr* and *Wort* are pronounced [dʏɐ] and [vɔɐt] rather than [dʏr] and [vɔrt]. This fact will be reflected in transcriptions (and analysis) throughout the thesis.

In later chapters, varieties other than *Hochlautung*, especially Northern Standard German, will also be referred to. But now for the details of FOD in German *Hochlautung*.

[18]Free variation here means that, although it is possible for a single speaker to switch between these four types, they tend to be associated with certain regions. The uvular fricative, for example, tends to be favoured in the North of Germany, while apical realisations are more common in the South.

German *Hochlautung* has traditionally been considered to have seven simple obstruents[19] (not counting *h*), viz. three stops and four fricatives. All of the stops and two of the fricatives come in pairs, with one voiceless and one voiced member each, viz. [b/p], [d/t], [g/k], [v/f] and [z/s]. The remaining fricatives ([ʃ] and [x/ç]) are exclusively voiceless. One of the aims of this thesis is to provide a principled account of the distribution of these obstruents with regard to voicing. I intend to deal both with the dynamic and the static sides of this coin. In other words, I will investigate alternations *and* distributional restrictions. What exactly these alternations and restrictions are will be discussed in the following sections.

1.2.2.2 Voicing alternations

As already mentioned at the beginning of the present chapter, the application of FOD may give rise to voicing alternations, depending on whether the relevant obstruent occurs in word-final position or not. To see that we are not dealing with an intervocalic voicing process, consider the minimal pair *Rade* - *Rate* (['ra:də], 'wheel', dat. sg. - ['ra:tə], 'council', dat. sg.). The occurrence of intervocalic [t] excludes this possibility.

In (1) below, there is a list of words illustrating the effect of FOD for all stops and for the alternating fricatives. A detailed explanation of the arrangement of the data, as well as of the term *Fremdwörter* and of the notational conventions used immediately follows this list.

[19]It has been suggested by Jonathan Kaye (p.c.) that what is usually treated as a labio-dental fricative in German is in fact a glide. There does appear to be some evidence which suggests that [v] behaves like a hybrid, with properties of both a fricative and a glide. Similar observations have been made regarding Russian [v] by Jakobson (1978) and Hayes (1984; see also Kiparsky 1985 and Mascaró 1987a for further discussion). This issue, however, is not immediately relevant to the present discussion. The same goes for affricates, which, due to their controversial status, have been excluded from this superficial count of obstruents. See also the discussion of [v/f] in 1.2.2.2.

(1) FOD in word-final position

a. Indigenous words

Dieb	[di:p]	['di:b+ ə]	'thief'
Rad	[ra:t]	['ra:d+ ə]	'wheel'
Tag	[ta:k]	['ta:g+ ə]	'day'
brav	[bra:f]	['bra:v+ ə]	*'good; well-behaved'*
fies	[fi:s]	['fi:z+ ə]	'nasty'
Haus	[haʊs]	['haʊz+ ə]	'house'
König	['kø:nɪç]	['kø:nɪg+ ə]	*'king'*
halb	[halp]	['halb+ ə]	'half'
Wald	[valt]	['vald+ ə]	'forest'
Balg	[balk]	['balg+ ə]	'brat'
Calw	[kalf]	['kalv+ ɐ]	*(place name)*
Hals	[hals]	['halz+ ə]	'neck'
Korb	[kɔɐp]	['k ɔɐb+ə]	'basket'
Bord	[bɔɐt]	['b ɔɐd+ə]	'shelf'
Berg	[bɛɐk]	['b ɛɐg+ə]	'mountain'
Kurv'	[kʊɐf]	['ku ɐv+ə]	*'bend; curve'*
Vers	[fɛɐs]	['f ɛɐz+ə]	'stanza'
Hemd	[hɛmt]	['h ɛmd+ə]	*'shirt'*
Gems'	[gɛms]	['g ɛmz+ə]	*'chamois'*
Bund	[bʊnt]	['bund+ ə]	'league'
Gans	[gans]	['g ɛnz+ə]	'goose'
Smaragd	[sma'rakt]	[sma'rakd+ ə]	*'emerald'*
Magd	[ma:kt]	['me:kd+ ə]	*'maid'*

b. *Fremdwörter*

Cherub	['çe:rup]	[çe:ru'bi:nən]	'cherub'
Snob	[snɔp]	[sno'bɪsmʊs]	'snob'
rapid	[ra'pi:t]	[ra'pi:də]	'rapid'
Monolog	[mono'lo:k]	[mono'lo:gə]	'monologue'
Verb	[vɛɐp]	['vɛɐbən]	'verb'
Ford	[fɔɐt]	---	'Ford car'
Chirurg	[çi'rʊɐk]	[çi'rʊɐgən]	'surgeon'
kursiv	[kʊɐ'zi:f]	[kʊɐ'zi:və]	'italic'
konfus	[kɔn'fu:s]	[kɔn'fu:zə]	'confused'

The first two columns show roots ending in obstruents which are subject to FOD. With the exceptions of *Gems'* and *Kurv'* all these roots are citation forms. The two exceptions constitute colloquial pronunciations with an apocopated final schwa[20], in this case representative of the unproductive feminine suffix *-e* (see Fleischer 1975: 132ff.). Although loss of inflectional word-final schwa is virtually obligatory in rapid/casual speech for German verbs, this does not apply to the same extent for noun endings. The forms *Gems'* and *Kurv'* are considered as poetic or non-standard.

The third column contains the same root as the preceding columns (in transcription), but with a suffix added. These suffixes appear as *-e* or *-en* in the orthography and constitute mainly dative or plural suffixes[21]. The palatal fricative in *König* is a spirantised reflex of a devoiced [g], that is, it can be interpreted as a [k], which is in fact how it appears in Bavarian-Austrian. This spirantisation will be discussed in Chapter 6 (and briefly in Chapter 3).

[20]An apocopated final schwa is usually indicated by an apostrophe which replaces the lost *e* in the orthography.

[21]The addition of the suffix *-e* gives rise to umlaut in *Gans* and *Magd*, causing the vowel to be raised and fronted. See Lodge 1989 for a more detailed statement of the facts.

Fremdwörter are defined in the DUDEN *Großes Wörterbuch der deutschen Sprache* (Drosdowki *et al.* 1976-1981) as foreign borrowings which have not been fully assimilated into the borrowing language with regard to pronunciation, inflection or spelling. As shown by Scholz (1972: 23ff.), there are a considerable number of cases where native speakers are not at all sure whether they are dealing with a *Fremdwort* or an indigenous Germanic word. These borderline cases are of no particular interest to me here, whereas those which native speakers judge to be *Fremdwörter* with a high degree of consistency and certainty are. The way FOD is applied to these forms reveals a good deal about its properties. Recent borrowings (especially from English, a language without FOD) are particularly useful here, since the pronunciation of the loan word in the source language is still accessible, so that comparisons between it and the 'German version' can easily be drawn. In the remainder of the thesis only 'obvious' foreign borrowings will be referred to as *Fremdwörter*.

In (1) and elsewhere in this thesis, stress is indicated by an apostrophe at the beginning of the syllable which bears the main stress.

A first inspection of (1) suggests that FOD can apply to an obstruent following more or less any vowel or sonorant, but following only one particular obstruent (a velar plosive, e.g. in *Smaragd* and *Magd*). This holds both for indigenous words of Germanic origin and for *Fremdwörter*. To be able to see better what segments are involved, let me abstract away from (1) and isolate the relevant clusters, as in (2) below, which shows all possible sound sequences involving alternating (FOD) obstruents. Each row represents a particular segment (or segment type) preceding the FOD obstruent which, in turn, serves as a column label. For reasons of exposition, I have used the column labels **b d g v z**, rather than **b/p d/t g/k z/f z/s**. V: stands for both long vowels and diphthongs, while V represents a short vowel.

(2)

		b	d	g	v	z
Vowels:	**V:**	V:b	V:d	V:g	V:v	V:z
	V	--	--	*Vg*	--	--
Sonorants:	**l**	lb	ld	lg	*lv*	lz
	r	rb	rd	rg	*rv*	rz
	m	--	*md*	--	--	*mz*
	n	--	nd	--	--	nz
	ŋ	--	--	--	--	--
Obstruents:	**b**	--	--	--	--	--
	d	--	--	--	--	--
	g	--	*gd*	--	--	--

Before discussing the gaps in (2), I will take a closer look at the clusters (and corresponding words in (1)) which are italicised in (2). All of them have special properties which suggest that they should be treated differently from the majority of FOD clusters. What is most striking about them is their rarity. A machine-readable dictionary of 115, 000 entries, for example, came up with only two words ending in *md*, *Hemd* and *fremd* ([frɛmt], 'strange'). Remarkably, both of them were pronounced with a schwa separating the nasal from the plosive in MHG[22] (i.e. ['h ɛmədə] and ['fr ɛmədə] respectively). It seems, then, that we may not actually be dealing with a true cluster here. The fact that the nasal and the plosive are not homorganic further supports this view. It will become clear in Chapters 3 and 4 that these sort of odd cases do not, in fact, pose any problems for my analysis. What I have just said about the [md] cluster also holds for the apparent [mz] cluster in *Gems'*. I will return to both in 3.4.3.2.3.

[22]Most of the historical information in this chapter comes from Drosdowski *et al.* (1976-1981).

Word-final [v] is another problematic case. After a sonorant, it could only be found in a place name (*Calw*, which is so unusual in its spelling that some of my informants were unsure how to pronounce it) and in relatively recent Romance borrowings (e.g. *Salve* ['zalv ə], 'volley; round'), virtually all of which are felt to be foreign in some way. Again, it causes no actual problems for my analysis of FOD, so I propose to simply note the fact that [v] is rare and behaves differently from other fricatives in certain ways which will be made more explicit in Chapter 3 (see also footnote 19), and leave it at that. For the purposes of my analysis of FOD, though, it behaves like an ordinary fricative when occurring postvocalically and, therefore, will be treated like one.

Obstruent clusters involving a voiced obstruent followed by an FOD undergoer are also doubtful to some extent. The only cluster that can be found is [gd], and the only other German word that contains it, apart from the two in (1), is *Jagd* ([ja:kt], 'hunt'). *Magd* appears as *maget* in MHG and *Jagd* as *jaget* or *jagat*, so there is some possibility that, again, we are not dealing with a true cluster here. The case of *Smaragd* is less clear (apparently, this was *smaragt* in MHG and *smaragdus* in OHG, from an identical Latin word), but it seems that one would do well not to assume the apparent obstruent clusters of this type are completely straightforward. I will discuss them in a little more detail in 4.2.1.

Finally, it is rather striking that FOD obstruents occur freely after long vowels and diphthongs, but only [g/k] is permitted after a short vowel, whereby the configuration V+[g/k] is restricted to words which are at least disyllabic. This huge gap is due to a historical development which involved a vowel lengthening process. More specifically, the transitional period between MHG and New High German (NHG), which Walshe (1974: 2) terms Early New High German (c. AD 1350-1650), was marked by, among other things, a lengthening process affecting stressed short vowels preceding voiced obstruents[23]. Thus, MHG ['tagə] ('days') eventually became NHG ['ta:gə]. The long vowel was then retained even in the monosyllabic nominative singular form with a devoiced final consonant, and [tak] became [ta:k] in German *Hochlautung*. The Northern Standard German form [tax], with a short vowel (and spirantised [k]) is presumably a more conservative reflex.

So it is what one can probably only call a historical accident which is responsible for the fact that, with the exception of some words of Low German origin (e.g. *Ebbe* ['ʔɛbə], 'low tide' and *Kladde* ['kladə], 'notebook'), voiced obstruents are always preceded by a long vowel or diphthong (or a sonorant consonant), whereas underlyingly voiceless obstruents impose no length restrictions whatsoever on the preceding vowel.

The relationship between obstruent voicing and the length of a preceding vowel is a topic which has received a certain amount of attention in the phonetic literature (e.g. Chen 1970, Kohler 1984), but still poses many unresolved problems, especially for phonological theory (see Harris 1986 for discussion). Again, the analysis to be presented in Chapters 3 and 4 does not depend on vowel length, so I will simply note these facts here without pursuing them further.

What I have said about historical vowel lengthening, however, still does not explain why there should be only a single V+FOD obstruent sequence in German, namely *-ig*. The vast majority of German words ending in *-ig* are adjectives, most of which are derived from nouns by adding the suffix *-ig*[24].

[23]See King 1969 (pp. 51ff.) and Russ 1982 (pp. 139-141) for more detailed accounts.

[24]See Fleischer 1975 (pp. 259ff.) for details of word formation with *-ig*.

There are only two exceptions to this, viz. *König* (see (1) above) and *Käfig* (['ke:fɪç], 'cage'), derived from MHG *künic* and *kevje* respectively. One may speculate that they acquired *-ig* as a kind of adjustment to the common adjectival ending. But why is it that *-ig* occupies this unique position in being the only V+FOD obstruent sequence in German? Why is there no *-id*, for example, such as in English *rabid* or *wicked* perhaps? I know of no evidence which bears on this question, which means that I will simply have to leave it open. It may be as well, though, to bear in mind that *-ig* appears to be in some way exceptional. As it poses no problems for the analysis to be presented in Chapters 3 and 4, however, I will not discuss it further.

Typical FOD environments (including those segment sequences which are likely to turn out to be genuine clusters) are, then, the following.

(3)

		b	**d**	**g**	**v**	**z**
Vowels:	**V:**	V:b	V:d	V:g	V:v	V:z
Sonorants:	**l**	lb	ld	lg	--	lz
	r	rb	rd	rg	--	rz
	n	--	nd	--	--	nz

So far, I have only discussed word-final FOD. FOD-conditioned voicing alternations, however, are not restricted to this position in German. They can also occur word-internally, in compounds and before certain suffixes. The suffixes which trigger FOD are listed in (4) below[25].

[25]See Fleischer 1975 for details of German word formation. Note that the boundaries between affixed forms and true compounds are sometimes blurred. Which is which is not crucial at this stage, however. Cases where it may be will be discussed in Chapter 3.

(4) Suffixes which trigger FOD in a preceding obstruent

a. Nominal

(i) Derivational

Suffix	**Example word**		
-ler	Häusler	['hɔɪslɐ]	'cottager'
-heit	Kindheit	['kɪnthaɪt]	'childhood'
-keit	Farbigkeit	['faɐbɪçkaɪt]	'colourfulness'
-ling	Liebling	['li:plɪŋ]	'darling'
-nis	Ergebnis	[ʔɛɐ'ge:pnɪs]	'result'
-sal	Labsal	['la:pza:l]	'refreshment'
-sel	Geschreibsel	[gə'ʃraɪpsəl]	'scribbling'
-schaft	Liebschaft	['li:pʃaft]	'love affair'
-tum	Herzogtum	['hɛɐtso:ktu:m]	'dukedom'
-chen	Hündchen	['hʏntçən]	'little dog'
-lein	Äuglein	['ʔɔɪklaɪn]	'little eye'
-de	Gelübde	[gə'lʏpdə]	'vow'
-bold	Tugendbold	['tu:gəntbɔlt]	'paragon of virtue'
-werk	Laubwerk	['laupvɛɐk]	'foliage'
-gut	Treibgut	['traɪpgu:t]	'flotsam'

(ii) Inflectional

Suffix	**Example word**		
-s	Urlaubs	['ʔu:ɐlaups]	'holiday', gen. sg.

b. Adjectival/Adverbial (derivational suffixes only)

Suffix	**Example word**		
-bar	lösbar	['lø:sbaɐ]	'soluble'
-los	farblos	['faɐplo:s]	'colourless'
-haft	glaubhaft	['glauphaft]	'believable'
-lich	kindlich	['kɪntlɪç]	'child-like'
-sam	kleidsam	['klaɪtza:m]	'becoming'

-kundig	schreibkundig	['ʃraɪpkundɪç]	'literate'
-mäßig	bildmäßig	['bɪltme:sɪç]	'by means of a picture'
-wert	preiswert	['praɪsve:ɐt]	'good value for money'
-lustig	schreiblustig	['ʃraɪplustɪç]	'keen to write'
-fest	schlagfest	['ʃla:kfɛst]	'shock resistant'
-wärts	abwärts	['ʔapvɛɐts]	'down'
-lings	blindlings	['blɪntlɪŋs]	'blindly'

c. Verbal (inflectional suffixes only)

Suffix	**Example word**		
-t	schreibt	['ʃraɪpt]	'(he/she/it) writes'
-st	schreibst	['ʃraɪpst]	'(you, sg.) write'
-te	liebte	['li:ptə]	'(he/she/it) loved'

Before concluding this subsection with some examples of compounds, I will contrast the list of suffixes which trigger FOD in (4) with a list of those which do not. They are shown in (5)[26], with foreign suffixes appearing in a separate (but unlabelled) group at the bottom of each section.

[26]Not *all* German suffixes which fail to trigger FOD are actually listed in (5). Only those were included where it was possible to find at least one word which exhibits a voicing alternation when combined with an FOD-triggering suffix (or as part of a compound) *and* which can also take one of the non-triggering suffixes. The suffix *-ant*, for example, as in *amüsant* ('amusing'), which is in fact a non-triggering suffix, was omitted because none of the stems which can take *-ant* can also be combined with suffixes which would trigger FOD, that is, they can never exhibit any voicing alternation at all.

(5) Suffixes which do not trigger FOD in a preceding obstruent

a. Nominal

(i) Derivational

Suffix	**Example word**		
-erei	Dieberei	[di:bə'raɪ]	'thieving'
-el	Hebel	['he:b əl]	'lever'
-er	Schreiber	['ʃraɪb ɐ]	'scribe'
-icht	Weidicht	['vaɪdɪçt]	'place where willows grow'
-ung	Färbung	['f ɛɐbuŋ]	'colouring'
-e	Binde	['bɪnd ə]	'band'
-in	Hündin	['hʏndɪn]	'bitch'
-ur	Glasur	[gla'zu: ɐ]	'glaze'
-ation	Delegation	[delega'tsio:n]	'delegation'
-ik	Motivik	[mo'ti:vɪk]	'motif'
-ität	Naivität	[naʔi:vi'te:t]	'naivety'

(ii) Inflectional

Suffix	**Example word**		
-es	Grabes	['gra:b əs]	'grave', gen. sg.
-en	Lieben	['li:b ən]	'loved ones'
-e	Herzoge	['h ɛɐtso:gə]	'dukes'
-er	Häuser	['h ɔɪzɐ]	'houses'
-ern	Häusern	['h ɔɪzɐn]	'houses', dat. pl.

b. Adjectival (derivational suffixes listed below, inflectional suffixes mostly identical with those of nouns)

Suffix	**Example word**		
-ig	leidig	['laɪdɪç]	'tiresome'
-isch	kindisch	['kɪndɪʃ]	'childish'
-en	seiden	['zaɪd ən]	'silken'
-ern	gläsern	['gle:z ɐn]	'(made of) glass'
-iv	impulsiv	[ʔɪmpul'zi:f]	'impulsive'
-ös	nervös	[nɛɐ'vø:s]	'nervous'

c. Verbal (inflectional suffixes only)

Suffix	**Example word**		
-en	schreiben	['ʃraɪb ən]	'to write'
-e	schreibe	['ʃraɪb ə]	'(I) write'
-ieren	rasieren	[ra'zi: ɐn]	'to shave'

The lists of those suffixes which trigger FOD and those which do not just presented suggest that it is only consonant-initial suffixes which are associated with FOD. Various forms of this simple hypothesis will be put through their paces in the remaining chapters. Before this can be done, however, I need to introduce some more data. Let me conclude the present subsection with some examples of uncontroversial compounds. To keep things as straightforward as possible, only two-term compounds are included in (6), with the two terms being separated by a dash. The obstruent which undergoes FOD immediately precedes that dash.

(6) Examples of compounds (all compounding triggers FOD if a suitable obstruent is available)

a. Nouns

Leib-wächter	['laɪpv ɛçtɐ]	'body guard'
Leib-eigener	['laɪp ʔaɪgənɐ]	'serf'
Lob-gesang	['lo:pg əzaŋ]	'song of praise'
Farb-stoff	['fa ɐpʃtɔf]	'colouring'
Schreib-tisch	['ʃraɪptɪʃ]	'desk'
Wald-brand	['valtbrant]	'forest fire'
Wald-ameise	['valt ʔa:maɪzə]	'red ant'
Rad-nabe	['ra:tna:b ə]	'hub'
Geld-beutel	['g ɛltbɔɪtəl]	'purse'
Bild-hauer	['bɪlthaʊ ɐ]	'sculptor'
Weg-weiser	['ve:kvaɪz ɐ]	'signpost'
Aug-apfel	[' ʔaʊkʔapfəl]	'eye-ball'
Berg-steiger	['b ɛɐkʃtaɪgɐ]	'mountaineer'
Berg-amt	['b ɛɐkʔamt]	'Mining Office'
Zweig-stelle	['tsvaɪkʃt ɛlə]	'branch'
Haus-tier	['hausti: ɐ]	'pet'
Haus-arzt	['haus ʔaɐtst]	'family doctor'
Hals-band	['halsbant]	'dog collar'

b. Adjectives

lob-abhängig	['lo:p ʔaphɛ ŋɪç]	'dependent on praise'
farb-echt	['fa ɐpʔɛçt]	'colour-fast'
schlag-empfindlich	['ʃla:k ʔɛmpfɪntlɪç]	'shock-sensitive'
flug-fertig	['flu:kf ɛɐtɪç]	'ready for flying'
haus-eigen	['haʊs ʔaɪgən]	'very own'
geld-orientiert	['g ɛltʔoriənti:ɐt]	'money-oriented'
trag-fähig	['tra:kfe:ɪç]	'strong'
leid-voll	['laɪtf ɔl]	'sorrowful'
schlag-artig	['ʃla:k ʔaɐtɪç]	'sudden'
sieb-förmig	['zi:pf œɐmɪç]	'sieve-shaped'
staub-frei	['ʃtaʊpfraɪ]	'dust-free'

wald-arm	['valt ʔaɐm]	'sparsely wooded'
halb-leer	['halple: ɐ]	'half-empty'
farb-echt	['fa ɐpʔ ɛçt]	'colour-fast'
...		

c. Verbs

blind-schreiben	['blɪntʃraɪb ən]	'to write without looking'
lob-preisen	['lo:ppraɪz ən]	'to praise highly'
gesund-pflegen	[gə'zʊntpfle:g ən]	'to nurse (someone) back to health'
übrig-bleiben	['y:brɪçblaɪb ən]	'to be left over'
wund-liegen	['vʊntli:g ən]	'to develop a bedsore'
wund-arbeiten	['vʊnt ʔaɐbaɪtən]	'to work (one's fingers) to the bone'
stand-halten	['ʃtanthalt ən]	'to stand firm'

The cases discussed in this subsection all involve voicing *alternations*. Some researchers (e.g. Vennemann (1978)), however, have put forward the view that not only alternations but also distributional constraints ought to be investigated in the context of final obstruent devoicing. The facts of these distributional constraints will be presented in the next section.

1.2.2.3 Distributional constraints affecting voicing

Apart from not occurring word-finally, at the end of a term in a compound or before the suffixes listed in (4), voiced obstruents are also absent from what has traditionally been referred to as syllable-final position[27]. According to the interpretation of the syllable on which this view is based[28], the words *Haus,*

[27]A very different kind of syllable will be introduced in Chapter 3, but for the purposes of this chapter the traditional view of the syllable will suffice.

[28]See, for example, Selkirk 1982 and Vennemann 1982a.

Rad and *Gans* consist of a single syllable, while others, such as *kind.lich* (['kɪntlɪç], 'child-like') and *kin.disch* (['kɪndɪʃ], 'childish') are considered as disyllabic, with the syllable break being represented by the full stop. It is before this syllable boundary that typically only voiceless obstruents can occur[29].

The list in (7) contains both indigenous and foreign examples of this constraint on syllable-final obstruents. The words included are not involved in voicing alternations under normal circumstances but other words with the same spelling of the FOD obstruent (i.e. that representing the voiced member of the obstruent pair) may be or may have had a voiced obstruent in their source language, if they are *Fremdwörter*. The prefix *aus*, for example, is spelt like the rhyme of the syllable *Laus* ([laʊs], 'louse'), which exhibits a voicing alternation affecting the coronal fricative when a suffix is added, e.g. in *Läuse* (['l ɔɪzə], 'lice') or *lausig* (['laʊzɪç], 'lousy'). In the source language (English), the *Fremdwörter* *Rugby* and *Badminton* have [g] and [d], rather than [k] and [t], as they do in German.

The particles *und* and *als* fit into this list of examples of syllable-final constraints because, in German (but not necessarily in other languages, see, for example, the literature on Catalan referred to in footnote 8), a word boundary implies a syllable boundary (but, of course, not vice versa). Syllable boundaries are marked with a full stop in (7).

[29]There are a number of interesting cases which constitute apparent exceptions to this generalisation, e.g. *Handlung* and *ebnen*. These will be introduced and discussed in Chapters 2 and 4.

(7) Examples of distributional constraints affecting voicing

a. Indigenous words

Ab.laß	[' ʔaplas]	'indulgence'
aus.laufen	[' ʔauslaufən]	'to leak'
los.gehen	['lo:sge: ən]	'to walk off; to go off
und	[ʔʊnt]	'and'
als	[ʔals]	'as'

b. *Fremdwörter*[30]

Ad.jektiv	[' ʔatjɛkti:f]	'adjective'
Ab.domen	[ʔap'do:m ən]	'abdomen'
Caryb.dis	[ça'rʏpdɪs]	'Charybdis'
Charis.ma	[ça'rɪsma]	'charisma'
Rug.by	['rakbi]	'Rugby'
Bad.minton	['b ɛtmɪntən]	'badminton'
Marxis.mus	[mar'ksɪsmʊs]	'Marxism'
Wig.wam	['vɪkvam]	'wigwam'
Simbab.we	[zɪm'bapve]	'Zimbabwe'
Wod.ka	['v ɔtka]	'vodka'
Us.beke	[ʔus'be:k ə]	'Uzbek'

To sum up, at first blush it seems that FOD applies to German obstruents word-finally, before consonant-initial suffixes (but not before vowel-initial ones), term-finally in compounds and syllable-finally (although, syllable-finally, no voicing alternation need be involved). The process applies both to fricatives and stops irrespective of their place of articulation. It is also extended to foreign words.

[30]Examples partly from Meinhold & Stock 1982, Kloeke 1982a and Vennemann 1978, 1982a.

Before concluding this chapter, I ought to mention that tautosyllabic obstruent clusters are voiceless throughout, e.g. [kt] as in *Akt* ([ʔakt], 'act'), but not *[gt] or *[kd]. Otherwise, there is no voicing assimilation in German *Hochlautung*.

1.3 Conclusion

In this chapter I have presented what amounts to little more than chunks of undigested data. It has been possible to break them down by morphological as well as phonological criteria, and certain hypotheses to pursue may have suggested themselves.

In the next chapter, I will discuss several ways in which some of the German data in this chapter has been dealt with by phonologists over the past twenty-odd years. Chapters 3 and 4 contain my own attempt at unravelling these data sets and showing how they can be accommodated in a set of universal principles and parameters of grammar.

> The proponents of a theory, in science or elsewhere, are obligated to support every link in the chain of reasoning, whereas a critic or skeptic may peck at any aspect of a theory.[1]

CHAPTER TWO

22 YEARS OF FOD: EARLIER APPROACHES FROM 1968 TO 1990

2.1 Introduction

A phenomenon as common and widespread as FOD is likely to attract considerable attention from linguists of many persuasions. Phonologists working in SPE-type frameworks have taken particular interest in it, not least because, certainly on a superficial level, it appears to be exceptionally amenable to a straightforward account involving a rewrite rule referring to only two features and one boundary. It is for this reason that FOD (usually presented in the context of German or Russian) has found its way into a considerable number of introductory textbooks on generative phonology[2]. Typically, the treatment of FOD presented there consists of some suitable example words followed by a simple obstruent devoicing rule (usually something like [– sonorant] → [– voiced] / __ #). The accompanying discussion tends to focus on some theoretical issue, such as neutralisation, for example, rather than on FOD itself. In other words, FOD, more often than not, is treated as a useful example of how a common process can be captured in a simple rule or as a convenient means of illustrating a theoretical construct, but as being of very little interest beyond that.

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[1]Macbeth 1974 (p. 5), quoted by Lass (1980: 4).

[2]See, for example, Hyman 1975 (pp. 91f.), Lass 1984 (e.g. p. 229), Kenstowicz & Kisseberth 1979 (e.g. p. 337), Schane 1973 (pp. 77f.), Katamba 1989 (pp. 142f.), Kaye 1989 (pp. 59f.) or Durand 1990 (pp. 182f.).

In this chapter I would like to show (a) that, once one takes a closer look at FOD and extends one's data set beyond the most straightforward cases, a number of interesting and challenging problems come to light and (b) that, in my view, none of even the most sophisticated analyses presented so far (both in the SPE-framework and in Lexical Phonology) have been able to capture the facts of FOD in a way which does not leave itself open to serious criticism.

For this purpose, I will discuss four detailed accounts of FOD (to my knowledge, the only ones which devote so much space to it), two of which are couched in the orthodox SPE-framework (Vennemann 1968 and Kloeke 1982 (1982a, b), which is similar to Wurzel 1970), the third in Vennemann's theory of Syllabic Phonology (Vennemann 1978) and the fourth in the framework of Lexical Phonology (Rubach 1990; similarly Wiese 1988, Hall 1989a).

There are two aspects of FOD which are dealt with in each of the analyses to be discussed. As all four of them use SPE-type rewrite rules of the form $A \rightarrow B / C \_\_ D$, these two aspects can be separated out very conveniently by dividing the rule at the slash. The first is the question of *what* FOD is, i.e. of what the changes which affect an obstruent when it devoices actually are. This is represented by what appears on the left of the slash in the rule. The second aspect is the issue of *where* FOD occurs. This is handled by the environment specification on the right of the slash in the rewrite rule. It could also be understood as an investigation of the *trigger* which sets off the devoicing process.

In the vast majority of treatments of FOD I am aware of, there is very little disagreement on *what* FOD is. This is due to the fact that all these accounts use binary features, which make [– son] → [– voice] the most obvious solution[3]. To my knowledge, there is no explicit and detailed analysis of FOD in a non-feature-based framework (such as Dependency Phonology[4] or Particle Phonology[5], for example) available - apart from my own, that is. All accounts I will deal with here consider FOD as a process which assigns the feature [– voice] to segments which would have the specification [+ voice] in other environments.

Where the four accounts really differ from one another is in their identification of the triggering environment. I will assess each solution individually, but before moving on to this, I would like to point out some of the disadvantages of dealing with FOD in a framework which uses SPE-type rewrite rules involving binary features. As already mentioned, this strategy is common to all accounts to be dealt with in this chapter.

2.2 What is FOD? Problems with SPE-type rewrite rules involving binary features

With the sole exception of Kloeke 1982a, none of the treatments of FOD I am aware of (not only the four to be discussed in this chapter) seriously address the question of what exactly happens to an obstruent when it undergoes this

[3]Kloeke (1982a) actually argues for [+ tns] rather than [– voice]. This will be discussed in 2.2. Note also that there are hybrid analyses of final devoicing (not necessarily focusing on German only), which, although making use of what appears to amount to a binary feature [± voice], deal with FOD in terms of loss of structure (e.g. Mascaró 1987a, Goldsmith 1989, 1990 (pp. 123ff.)).

[4]See especially Durand 1986b, Anderson & Durand 1987 and Anderson & Ewen 1987; also Den Dikken & van der Hulst 1988 for criticism.

[5]See Schane 1984.

process. Most of them are happy to simply state that an obstruent is [– voice] under certain circumstances[6].

Kloeke (1982a: 30ff.), however, feels that the phonological aspects of consonant voicing in German are more complex than other phonologists appear to think. He considers it necessary to establish a four-way distinction, involving the features [± tns] (tense) and [± stVC] (stiff vocal cords). This he justifies with minimal pairs such as those shown in (1).

(1)	Tan[tsb̥]ar	Tan[tsp]aar
	Forschung[sd̥]aten	Forschung[st]aten
	Sta[tg̥]asse	Sta[tk]asse

The right-hand obstruent inside the square brackets in the left-hand column is a voiceless lenis, specified as [– tns, + stVC], while the corresponding segment in the right-hand column is voiceless fortis, specified as [+ tns, + stVC]. Segments which have undergone FOD share the latter specification, i.e. [+ tns, + stVC]. So, the output in Kloeke's devoicing rule is [+ tns, + stVC]. Kloeke argues, however, that it is really only the feature [± tns] which is distinctive for obstruent pairs. The voicing feature [± stVC] is predictable. Only certain lenis segments can be specified as [– stVC]. These segments are defined as [– tns] segments occurring word-initially or immediately adjacent to other [– stVC] segments (i.e. vowels, glides or sonorant consonants). All other segments are [+ stVC], which means that voiced fortes (*[+ tns, – stVC]) are non-existent. Once the distribution of voiced lenes (i.e. segments which are [– tns, – stVC]) has been expressed in a rule which applies after the final devoicing rule, it is no longer necessary to refer to [± stVC] in the context of final devoicing.

[6]The detailed account in Mascaró 1987a may be something of an exception here, although it still operates with the feature [± voice].

Simply saying that [– son] → [+ tns] is sufficient, as the segment will automatically be interpreted as being [+ stVC]. The relevant rules are reproduced in order of application in (2) and (3).

(2) *Final Devoicing*

$$[-\text{ son}] \rightarrow [+\text{ tns}] \,/\, \_\_ \; [-\text{ segm}] \qquad \left\{ \begin{array}{l} [-\text{ segm}] \\ [+\text{ cons}] \\ [-\text{ son}] \end{array} \right\}$$

(3) *Voiced Lenis*

$$\begin{bmatrix} +\text{ cons} \\ -\text{ son} \\ -\text{ tns} \end{bmatrix} \rightarrow [-\text{ stVC}] \,/\, \# < X\, [-\text{ stVC}] > \_\_ < [-\text{ stVC}] >$$

Kloeke argues that, apart from the existence of the minimal pairs in (1), the fact that voiceless fortes (i.e. [+ tns, + stVC]), unlike voiceless lenes (i.e. [– tns, + stVC]), are aspirated supports the need for both features, [± tns] *and* [± stVC]. In other words, he uses phonological features to express phonetic properties. This is, of course, justified if it can be shown that these phonetic differences are phonologically significant. As far as I can see, there is, however, nothing in Kloeke's work to support the claim that this is so. Were it not for the phonetic properties which he feels need to be expressed, all his data could be handled with a simple two-way contrast involving just a single binary feature, e.g. by referring to [± voice], a fact which he himself implicitly acknowledges by referring to a single feature ([± tns] rather than [± voice]) as the distinctive feature *(ibid.)*. The relevant segments in the left-hand column of (1) would be [+ voice], and their congeners in the right-hand column [– voice]. The significant contrast would still be captured. I will return to this point in 2.3.3.2.

At present, though, it seems that Kloeke's proposal to treat voicing contrasts in terms of *two* features cannot be justified on the grounds of true phonological oppositions. The logical consequence of this would be to dispose of his lenis voicing rule (3) and to rephrase the devoicing rule (2) to read [– son] → [– voice], which would make it identical with that used by other phonologists.

This feature-specifying rule [– son] → [– voice], which, to my knowledge, was first introduced in Vennemann 1968, appeals to researchers within a wide range of SPE-derivative frameworks. It is attractive from the point of view of any flavour of Markedness Theory (e.g. SPE, ch. 9) and/or Underspecification Theory (e.g. Archangeli 1988, Anderson & Durand 1988a, b, no date), as it expresses the generalisation that the unmarked value of the feature [± voice] is [– voice] for obstruents.

What, however, does this rule mean for the *what* of FOD? What exactly happens to an obstruent when it devoices? Nothing, if one interprets the rule as strictly feature-specifying. After all, what it says is only that an obstruent *is* [– voice] under certain circumstances. And yet, if one insisted on thinking of FOD in terms of change, one could argue that the alternation between [b] and [p] in, say, *halbe* (['halbə], 'half', fem. sg.) and *halb* ([halp], 'half') involves some sort of change affecting an underlyingly voiced bilabial plosive. That change is [+ voice] → [– voice]. In principle, there is no objection to expressing final devoicing in these terms. In practice, however, the rule has to refer to two features in its input to prevent incorrect application to sonorants and vowels, all of which are [+ voice], too. This, at least, is the case within the orthodox SPE framework, where the relevant feature values will have been filled in by the time FOD applies. In other words, a feature-changing rule of final devoicing would have to look like this.

(4) $\begin{bmatrix} -\text{ son} \\ +\text{ voice} \end{bmatrix} \rightarrow [-\text{ voice}]$ (in some environment)

As a simpler rule (i.e. one with fewer features) which expresses the same facts is more highly valued[7], the rule which has only [- son] as its input was chosen instead. The fact that this rule is a feature-specifying rather than a feature-changing rule is perhaps not much more than a convenient accident from the point of view of the orthodox SPE framework. In principle, though, it is still possible to think of FOD as a change from [+ voice] to [– voice].

Having shown that the phonological changes occasioned by FOD are typically expressed in one and the same SPE-type rewrite rule, I would now like to comment on some of the problems associated with such a rule. I will begin with the nature of rewrite rules *per se* and their mode of application, and then move on to a critical examination of the binary features they refer to.

The first, and probably most serious, problem with SPE-type rewrite rules is their arbitrariness[8]. Such rules can be used to express virtually any process one cares to think of, and not just those which are actually attested. The over-powerful nature of SPE-type rules is further exacerbated by the fact that most SPE-derivative frameworks countenance extrinsic rule ordering. Extrinsically ordered rules further widen the scope for systematic over-generation, the foundations of which lie in the make-up of the rule formalism. The arbitrariness it allows also means that rules of this type have nothing to say about why things are the way they are. According to SPE, the phonological world could

[7]See, for example Kenstowicz & Kisseberth's (1979: 335ff.) discussion of the Conciseness Condition in the context of final devoicing.

[8]See Charette 1988 (pp. 106f.), Harris 1990 and Kaye 1989 for a more detailed discussion of this particular point, and, for example, Goyvaerts 1981a and Foley 1977 for criticism of the fundamentals of the SPE-framework.

be very different. This flaw is exacerbated when the rewrite formalism refers to binary features where pluses and minuses can in principle be combined at will.

The fact that a systematic relationship exists neither between the input to a rule and its output nor between input and output on the one hand and the environment on the other legitimises any conceivable combination of features and feature values in the same rule. This weakness of the SPE-framework can easily be illustrated to rather dramatic effect. There is no principle in SPE to prevent us from writing [– son] → [+ back] / __ [+ ant], for example. Such a process is unattested, and, intuitively, it is obvious why this should be so. Similarly, final obstruent devoicing could equally well have been final obstruent *voicing* ([– son] → [+ voice]) or, for that matter, final obstruent retraction ([– son] → [+ back]). As far as the SPE-formalism is concerned, these unattested processes are as plausible as the one we really encounter. This shortcoming of the theory is exposed in, for example, Kaye 1989 (p. 59), and, in fact, it is acknowledged by Chomsky & Halle (1968: 400) in SPE itself.

One could argue that Markedness Theory solves this problem by making 'unnatural' rules more costly. However, it does no more than try and patch up the *fundamental* flaw in the theory which allows 'unnatural' rules to be written in the first place. The fact remains that SPE-type phonology systematically overgenerates.

A by-product of being so unconstrained is that the SPE-theory makes very few strong testable predictions. As far as FOD is concerned, the theory has nothing to say about where, for example, we would expect the process to apply. Everything to the left of the slash is quite independent from the environment stated to the right of the slash in such a rule. By looking at the part of the rule which says [– son] → [– voice] we can get no clues as to what to expect in the environment specification. FOD could apply anywhere in a word, initially, medially or finally. To put it differently, we could encounter it in what has traditionally been referred to as a 'strong' position (initially) or in a so-called 'weak' position (medially, e.g. intervocalically, or finally). This is so because the feature-specifying SPE-rule [- son] → [- voice] leaves the question of what kind of process we are dealing with quite open.

If one looks at the change in the redundant features which accompanies this rule and interprets it as [+ voice] → [– voice], then one might venture the guess that FOD is some kind of strengthening process, since most (if not all) consonantal strength hierarchies[9] rank voiceless obstruents as being stronger than their voiced congeners. This, however, would be incompatible with the fact that FOD occurs finally, in a 'weak' environment, that is, at a typical lenition site[10]. Some researchers who have investigated final devoicing in these terms seem to be aware of the apparent contradiction this entails (e.g. Lass 1971). Escure (1977), however, may be unique in actually biting the bullet and accepting that either the strength hierarchy or the classification of the final environment as weak must be false. Faced with a wealth of evidence from uncontroversial lenition processes occurring in final position, she decides that it is the strength hierarchy which is at fault. Her solution to the problem is to stipulate that the relevant consonantal strength hierarchy has to be modified in such a way that, in final position only, voiceless obstruents are weaker than their voiced congeners. I shall have more to say on this point in Chapter 3.

[9]E.g. Lass 1984 (p. 177), Escure 1977, Hooper 1976 (ch. 10), Vennemann 1972a and Lass & Anderson 1975 (p. 159).

[10]See Escure 1975, 1977 and Harris 1990 for evidence.

Further evidence in favour of treating final devoicing as weakening comes from phonetic studies (e.g. Ní Chasaide 1989) which argue that final devoicing, like the uncontroversial weakening processes of spirantisation and sonorisation, is a result of target undershoot due to certain articulatory and aerodynamic factors which will be discussed in greater detail in Chapter 5.

In short, when considering the part of the rule intended to capture *what* final devoicing is ([– son] → [– voice]), we find practically no information on what type of process is involved and, hence, where FOD should occur. The one prediction one may be able to extract from it by invoking strength hierarchies turns out to be false. The fact of the matter is that what we can glean from the left-hand side of the rule contradicts what we find once we take into account the environment specification on the right-hand side (combined with relevant lenition studies). No part of the rule in itself makes any predictions about the nature of FOD. These can only be derived with reference to evidence completely outside the theory itself.

We have seen that the SPE-rewrite rule in its treatment of the *substance* of FOD is arbitrary and fails to capture some of FOD's properties (e.g. the fact that it constitutes segmental weakening; see Chapters 3 and 4 for further arguments). Let us now move on to the other side of the slash and see how the most detailed analyses of FOD available view what *triggers* FOD. I propose to deal with them in broadly chronological order.

2.3 Where does FOD occur? Four earlier analyses from 1968 to 1990

2.3.1 Vennemann 1968

2.3.1.1 Vennemann's analysis: obstruents devoice before a #-boundary

Faced with the question of where exactly FOD occurs, Vennemann (1968: 161-185) sets up a total of seven hypotheses which he confronts with data. The first, that FOD applies word-finally (i.e. __ ##), is immediately refuted by words such as *Liebling* (['li:plɪŋ], 'darling'), where FOD happens word-internally. The second, which identifies the formative boundary + as the crucial environment, fares no better 'as is clear from ... staubig [štaub+iç], Eises [aiz+əs]' and other examples. This, Vennemann concludes, leaves us with

(5) the option of attributing the cause to

- (i) the following voiceless consonant,
- (ii) or the following obstruent,
- (iii) or the following consonant,
- (iv) or the following formative boundary followed by the consonant,
- (v) or the following #-boundary.

Vennemann rules out the first four options one by one. (5i) falls because FOD also applies before voiced consonants, as in *sagbar* (['za:kba:ɐ], 'speakable'), while (5ii) is falsified by counterexamples such as *Liebling* (['li:plɪŋ], 'darling') and *Wagnis* (['va:knɪs], 'venture'), where FOD applies before a sonorant. The third option, by contrast, is too general, as it predicts alternations in paradigms such as *ärgern* (['ʔɛɐgɐn], 'to annoy'), *ärgre* (['ʔɛɐgrə], 'annoy!') and *schneidern* (['ʃnaɪdɐn], 'to tailor'), *schneidre* (['ʃnaɪdrə], 'tailor!'), where the velar and alveolar plosives both remain voiced, even when (apparently) preceding a consonant. The same set of (morphologically complex) items serves to disqualify option (5iv) as well, as witness the underlying representation proposed for *schneidre* /šnaid+r+ə/. Vennemann concludes that it is a following #-boundary which causes an obstruent to devoice.

The #-boundaries involved here are inserted by a convention put forward in SPE (Chomsky & Halle 1968: 366), which states that they

(6) are automatically inserted at the beginning and end of every string dominated by a major category, i.e. by one of the lexical categories 'noun', 'verb', 'adjective', or by a category such as 'sentence', 'noun phrase', 'verb phrase', which dominates a lexical category.

A morphologically complex noun, e.g. one derived from an adjective by suffixation, such as *Liebling* (['li:plɪŋ], 'darling'), is assigned the following bracketing and boundaries: $[\#[\#lib\#]_A liNg\#]_N$. Devoicing then applies after (among other rules) Nasal Assimilation and /g/-Deletion, generating the correct output ##li:p#lɪŋ#.

However, the proposed devoicing rule (7)

(7) $[-\text{son}] \rightarrow [-\text{voiced}] / \_\_ \#$

makes the wrong prediction for vowel-initial suffixes, as the data show FOD to be blocked before a vowel. Therefore, Vennemann introduces the pre-cyclic #-Deletion rule quoted in (8).

(8) A single internal #-boundary is deleted before a vowel.

This rule is supplemented by convention (9), which ensures that no single #-boundaries are left behind.

(9) When a #-boundary is deleted, so is its counterpart.[11]

Independent motivation for rule (8) comes from German stress. Vennemann claims that the noun *Schneider* (['ʃnaɪdɐ], 'tailor') differs from the noun *Liebling* (['li:plɪŋ], 'darling') in its stress pattern. The former exhibits [1 –], while the latter has [1 4]. As both of them share identical bracketing and #-boundaries ([#[#sneyd#]$_{V}$ir#]$_{N}$ and [#[#lib#]$_{A}$liNg#]$_{N}$ respectively) and stress is assigned by a rule making reference to #-boundaries[12], this difference in stress behaviour must be due to the deletion of a #-boundary from the former noun *(Schneider)*, as stipulated by rule (8), working in tandem with convention (9).

Vennemann's SPE-type analysis of FOD can then be reduced to the claim that obstruents are devoiced before a #-boundary, with the proviso that a single internal boundary of this type is deleted before a vowel.

Inflected forms and obstruent clusters not involving #-boundaries are not dealt with in the section on devoicing. The former, e.g. *glaubst* ([glaʊpst], '(you, sg. fam.) believe'), contain nothing stronger than a +-boundary, while the latter, e.g. *Jagd* ([ja:kt], 'hunt'), are considered to be without internal morphological structure[13]. They are handled by other voicing rules, in particular rule (10) (p. 73).

[11]For the purposes of this convention, Vennemann defines the counterpart of a #-boundary as the other member of each pair of #-boundaries specified in SPE-convention (6), which introduces #-boundaries.

[12]'Stress Placement Rule: Each string of units enclosed in #, but not containing #, receives exactly one stress, which falls on the first vowel.' (p. 165)

[13]None of this is stated explicitly in Vennemann's thesis, but I think it is safe to deduce it from what he does say.

(10) Obstruent Cluster Devoicing Rule

$$\underset{1}{[-\text{ son}]}\ \underset{2}{[-\text{ son}]}$$

$$\left\{ \begin{matrix} 1 \\ 2 \end{matrix} \right\} \rightarrow [-\text{ voiced}]$$

In this way Vennemann distinguishes between two types of devoicing processes. The first is triggered by a #-boundary and has no apparent phonetic motivation, while the second is basically an assimilation process, where two adjacent obstruents are specified as sharing the same value for the feature [± voice], i.e. [– voice].

This analysis enables Vennemann to account for a wide range of otherwise problematic data. Most notably, he can deal with a list of what he describes as 'controversial items'. While speakers of Standard German generally use FOD quite uniformly and consistently (with strong intuitions about its application), there is systematic variation in the pronunciation of these items between two groups of speakers concerning the application of FOD. I will use the term 'variable' rather than 'controversial' for items such as those in (11). For speakers in one group, FOD does not apply (Vennemann calls this group A), while speakers in the second group (Vennemann's group B) consistently devoice where Vennemann's analysis, as presented so far, would predict the *absence* of FOD. Vennemann's group A corresponds to speakers of *Hochlautung* and his group B to speakers of Northern Standard German (NSG).

(11)	(i)	a.	eignen	'to suit'
			Lügner	'liar'
			regnet	'(it) rains'
			Segnung	'blessing'

	b.	ebnen	'to level'
		Ebnung	'levelling'
	c.	ordnen	'to arrange'
		Ordnung	'order'
(ii)		Adler	'eagle'
		edler	'nobler'
		handle	'(I) act'
		Handlung	'act'
(iii)		duslig	'dizzy'

This difference in pronunciation Vennemann attributes to a difference in syllable division for the two groups of speakers. Where '"unpronounceable" clusters' ([gn bn dn dl zl]) would arise from treating both consonants as tautosyllabic, B-speakers insert a boundary to make them heterosyllabic. Formalising this process is problematic in the orthodox SPE-framework, as it does not recognise the syllable as a phonological unit and, hence, there is no means of referring to syllable-boundaries. In the absence of an actual syllable-boundary Vennemann uses the #-boundary instead. This is possible because, he claims, the presence of a #-boundary implies the presence of a syllable boundary (but not vice versa). All he needs to say, then, is that B-speakers (those who treat the two members of the 'unpronounceable' consonant clusters as heterosyllabic and have final devoicing in the words in (11)) insert a #-boundary to separate the two consonants. This boundary insertion is handled by a relatively late rule which only B-speakers have. This rule (p. 183) is reproduced in (12).

(12) Supplementary #-Introduction Rule

#-Boundary is introduced in post-stress position between the members of the 'unpronounceable' clusters /gn bn dn dl zl/.

According to this analysis, *radle* (['ra:d/tlə], '(I) cycle'), for example, is syllabified as *rad.le* by B-speakers, but as *ra.dle* by A-speakers. The difference in syllabification is due to the fact that B-speakers insert a #-boundary between the plosive and the lateral by applying a rule which is unique to the group of B-speakers (rule (12)). The derivation of *radle* would then go something like this. Both groups have the underlying representation $[[[\mathrm{rad}]_N \mathrm{Vl}]_V \mathrm{V}]_V$, which becomes $[\#[\#[\#\mathrm{rad}\#]_N \mathrm{Vl}\#]_V \mathrm{V}\#]_V$ (by convention (6)) and then $[\#[[\mathrm{rad}]_N \mathrm{Vl}]_V \mathrm{V}\#]_V$ (by rule (8) and convention (9)), and, ultimately, #ra:dlə#. B-speakers (but not A-speakers) now insert a #-boundary to split the 'unpronounceable' cluster. This insertion yields #rad:#lə#, which, finally, ends up as #ra:t#lə# (by (7)).

Vennemann seems to have killed two birds with one stone here. Firstly, he has found a way of expressing syllable divisions in terms of the syllable-denying framework of SPE and, secondly, the solution to that problem, the insertion of a #-boundary, also enables him to make the correct predictions for FOD.

Whether this approach is really as successful as it seems will be discussed in the next section.

2.3.1.2 Problems with Vennemann's 1968 analysis

2.3.1.2.1 Using a #-boundary to represent a syllable-boundary

In fact, it is Vennemann's apparently so ingenious way of expressing an apparently syllable-based process in terms of a syllable-denying formalism which causes his analysis to run into trouble. The benefits of using a #-boundary in place of a syllable-boundary are bought at considerable cost.

First of all, this solution mixes morphological categories (#-boundaries) and phonological categories (syllable-boundaries), a strategy which has rather interesting implications. The reason why these implications are not immediately apparent from Vennemann's thesis is that he fails to further examine the predictions made by (12).

Recall that SPE-convention (6) introduces #-boundaries to separate major categories from one another. In other words, nouns, verbs, adjectives, noun phrases etc. are each surrounded by a pair of #-boundaries. The prediction in a consistent framework would be that wherever a #-boundary appears there must be something belonging to one of the major categories immediately to its left or its right (unless, of course, there is another #-boundary intervening, which would be the case where two major categories meet). This prediction is borne out only in a small minority of the cases Vennemann cites.

To see this, consider the predictions made for the words in (11). The boundary insertion rule (12) implies that *eig-, lüg-, reg-, seg-, eb-, ord-, ad-, ed-, hand-* and *dus-* are the major categories from which the actual forms in (11) are derived by adding the suffixes *-nen, -ner, -net, -nung, -ler, -le* and *-lig*, or, more precisely, the suffix sequences *-n-en, -n-er, -n-et, -n-ung, -l-er, -l-e* and *-l-ig* respectively. We can investigate whether this claim is correct by looking into the behaviour of some of the suffixes involved here. Take the nominal derivational suffix *-ung* and the 1st sg. inflectional suffix *-e*, for example. Both of these suffixes can be attached immediately to the stem (which is identical with the root here), as witness the following forms.

(13) a.

Werb-ung	['v ɛɐbʊŋ]	'advertising'
Lad-ung	['la:dʊ ŋ]	'load'
Neig-ung	['naɪgʊ ŋ]	'inclination'
Les-ung	['le:zʊ ŋ]	'reading'

b.

werb-e	['vɛɐbə]	'(I) advertise'
lad-e	['la:də]	'(I) load'
neig-e	['naɪgə]	'(I) incline'
les-e	['le:zə]	'(I) read'

If we repeat the same exercise, but with the lexical items in (11), where suitable forms are available, we get the data shown below (transcriptions reflecting NSG).

(14) a.

Eign-ung	['aɪçnuŋ]	'suitability'
Segn-ung	['ze:çnuŋ]	'blessing'
Ebn-ung	['ʔe:pnuŋ]	'levelling'
Ordn-ung	['ʔɔɐtnuŋ]	'order'
Handl-ung	['hantluŋ]	'action'

b.

eign-e	['aɪçnə]	'(I) suit'
lüg-e	['ly:gə]	'(I) lie'
?regn-e[14]	['re:çnə]	'(I) rain'
segn-e	['ze:çnə]	'(I) bless'
ebn-e	['ʔe:pnə]	'(I) level'
ordn-e	['ʔɔɐtnə]	'(I) arrange'
[ver]edl-e	['fɛɐʔe:tlə]	'(I) refine'
handl-e	['hantlə]	'(I) act'
dusl-e	['du:slə]	'(I) get drunk'

The following conclusion can be drawn from the data in (13) and (14). Either the suffixes *-ung* and *-e* are attached to the simple stem (i.e. the root) itself, with no other suffixes intervening (as suggested by the data in (13)), or they can be attached to a complex stem comprising the root plus a morpheme *-l-* or *-n-*. The former interpretation would mean that *-l-* and *-n-* in (14) are part of the

[14]The ? indicates that this form is semantically anomalous.

root[15]. Vennemann's bracketing of *Radler* ($[[[\text{rad}]_N\text{Vl}]_V\text{V}]_V$) suggests that he adopts the opposite position, that is, that *-l-* and *-n-* are morphemes which separate the simple stem (i.e. the root) from suffixes such as *-ung* and *-e*.

If it can be shown that Vennemann's analysis of *Radler*, *mutatis mutandis*, works for the remaining items in (11) as well, then Vennemann doesn't really have a problem. On the contrary, this sort of bracketing seems to have distinct advantages, since it (a) expresses the relationship between *Rad* ([ra:t], 'wheel, bicycle') and *Radler* ('cyclist') and (b) allows the #-boundary insertion rule (12) to capture a valid fact about the morphological structure of these words. The same could be said for *Handlung*, although the semantic link between *Hand* ([hant], 'hand') and *Handlung* ('action') may be just a little more tenuous than between *Rad* and *Radler*. However, it seems that it is these two which are exceptional. None of the remaining items in (11) permit the same type of bracketing, as it would create stems for which no independent motivation can be found. There are no inflectional paradigms which can be shown to involve the stems *eig-*, *reg-*[16], *seg-*, *eb-*, *ord-*, *ad-*, *ed-*, and *dus-*. On the contrary, there is positive evidence which points towards final *-l* and *-n* being part of the simple stem itself. This evidence comes from the data set in (15).

[15](14b) indicates that the *-n-* in *Lügner* is not part of the stem. It seems, then, that whatever the special properties of *Lügner*, which make it behave similarly to the remaining variable items, may turn out to be, they are different from those which account for the special status of the other words in (11). I will deal with items like *Lügner* in more detail in Chapter 4.

[16]This claim may appear to be incorrect, as *reg-* is, in fact, attested, cf. *Reg-ung* ('movement') and *reg-e* ('(I) move'). This, however, is different from the stem associated with the meaning 'rain', and, therefore, no counterexample.

(15)	eigen	['ʔaɪgən]	'owned, peculiar to'
	Regen	['re:gən]	'rain'
	Segen	['ze:gən]	'blessing'
	eben	['ʔe:bən]	'level'
	Orden	['ʔɔɐdən]	'order' (religious)
	edel	['ʔe:dəl]	'noble'
	Handel	['handəl]	'trade'
	Dusel	['du:zəl]	'dizziness'

There is not a single form in the entire inflectional paradigms of the lexical items in (15) which lacks *-l* or *-n*. If, however, the lateral or the nasal did constitute a morpheme which is separate from the stem, then one would expect precisely such forms to exist[17].

The argument just put forward is based on the assumption that the #-boundaries inserted by the supplementary #-boundary insertion rule (12) have the same status and function as those inserted by convention (6), namely to mark out lexical categories. This, however, is not the case. Vennemann's rule (12) actually makes no claims about morphological structure at all. It may be inserting the same type of boundaries as convention (6), but their status is completely different in the context of rule (12). Here, they are not meant to have any implications for the morphology. Rule (12) is simply a readjustment rule, so that the morphological argument developed against it in the preceding paragraphs loses much of its force. However, the mere fact that Vennemann has to invoke readjustment rules such as (12) weakens his analysis, since, as Mohanan (1986: 132) observes, in a theory which makes use of ad hoc readjustment rules (such as (12) in this case), 'an attempt at principled

[17]*Lügner* may be an example of a case where such a morpheme is present, as witness *Lüg-e* ('lie') and *lüg-en* ('to lie'). In the nominative singular of the noun and in the infinitive form derived from the same stem, the *-n-* present in the agent noun *Lügner* is missing. By contrast, none of the words in (15) have such *-n*-less or *-l*-less forms, which can only mean that *-l* or *-n* are part of the stem.

boundary assignment as in [(6)] becomes entirely meaningless'. Boundaries quite generally become little more than diacritics.

Even if we accept that the supplementary #-boundary insertion rule (12) is simply a readjustment rule which makes no claims about morphological structure (which, as I have shown, would be incorrect anyway), it still has the considerable disadvantage of being an ad hoc device which, to make matters worse, deprives the original #-boundary insertion convention (6) of its meaning.

Having discussed the specific problems arising from the variable items, I will now turn to a much larger data set, that of vowel-initial suffixes.

2.3.1.2.2 Deleting a single internal #-boundary before a vowel

Consider the two adjectives *kindlich* (['kɪntlɪç], 'child-like') and *kindisch* (['kɪndɪʃ], 'childish'). Most phonologists (including Vennemann)[18] would syllabify these as *kind.lich* and *kin.disch* by the Maximal Syllable Onset Principle (see, for example, Selkirk 1982). According to this syllabification, FOD should apply in *kindlich*, but not in *kindisch*, provided, of course, that it is treated as a syllable-final process, which, after all, is the idea of Vennemann's 1968 account. This is exactly what we find.

Given, however, that the SPE-formalism prevents Vennemann from directly referring to syllable-boundaries and forces him to use #-boundaries instead, he has to get rid of the #-boundary, introduced by convention (6), in *kindisch* (but not in *kindlich*, where FOD applies) in some way.

[18]This, I believe, can be inferred from several of the observations he makes in Vennemann 1982a.

The relevant derivations would go roughly like this. The underlying representations[19] $[[\text{kind}]_N\text{lich}]_{Adj}$ and $[[\text{kind}]_N\text{isch}]_{Adj}$ are converted to $[\#[\#\text{kind}\#]_N\text{lich}\#]_{Adj}$ and $[\#[\#\text{kind}\#]_N\text{isch}\#]_{Adj}$ respectively by convention (6). The devoicing rule (7), which applies before a #-boundary can apply to *kindlich*, but its application to *kindisch* would generate the wrong output. It is for this reason that Vennemann needs a rule which deletes an internal #-boundary before a vowel. This is done by rule (8), repeated here as (16) for convenience.

(16) A single internal #-boundary is deleted before a vowel.

It is undeniable that this rule makes it possible for the correct output to be generated. Its most obvious shortcoming is that it is not particularly well motivated. For one thing, it lacks phonetic plausibility[20]. Phonetic implausibility by itself, however, is not necessarily a damning indictment for any rule, as witness the abundance of phonetically implausible rules in SPE itself. It only really becomes a problem if there is no independent motivation[21] for the rule, that is, if the sole motivation of that rule appears to be that it can make a particular analysis work.

Such independent motivation, Vennemann claims, comes from German stress facts. He presents a set of stress assignment, reduction and adjustment rules to support his analysis of FOD (including the #-boundary deletion rule in (16)). In my view, this set of stress rules makes wrong or dubious predictions - even

[19] I have used orthographic rather than phonological representations here, as I am not entirely certain what Vennemann's chosen representations would be in these cases, and I do not wish to accidentally misrepresent his views.

[20] See, for example, Hyman 1975 (pp. 97f.) for discussion.

[21] See, for example, Kenstowicz & Kisseberth 1979 (pp. 150-153) for a discussion of this concept.

for some of the words quoted by Vennemann himself. Here are but two examples to illustrate my point.

Firstly, his analysis requires the deverbal suffixed noun *Labsal* (['la:pza:l], 'refreshment') to be derived identically to the true (nonce) compound noun *Labsaal* (['la:pza:l], 'refreshment hall') for the stress patterns to be correct, i.e. identical. The difference in morphological structure makes this impossible, as the stress rules refer to morphological bracketing. To see what happens consider the underlying representations involved, viz. $[[\text{lab}]_V\text{sal}]_N$ (*Labsal,* i.e. *lab-* 'to refresh' plus the nominal suffix *-sal*) and $[[\text{lab}]_V[\text{sal}]_N]_N$. These become $[\#[\#\text{lab}\#]_V\text{sal}\#]_N$ *(Labsal)* and $[\#[\#\text{lab}\#]_V[\#\text{sal}\#]_N\#]_N$ *(Labsaal)* respectively by convention (6). Vennemann's stress rules would generate the stress pattern [1 4] for *Labsal,* but [1 3] for *Labsaal.* Vennemann considers these non-identical stress patterns as incorrect, though, which is why he attempts to rectify the situation with the help of the #-introduction rule shown in (17).

(17) #-Introduction Rule

> A #-boundary is introduced before the suffixes *-sal, -sam,*
> *-bar, -los, ...*

This rule generates a stress pattern for *Labsal* which is identical to that of *Labsaal,* but this appears to be its only *raison d'être,* as Vennemann is unable to provide independent motivation for it.

To sum up my first point of criticism regarding the stress rules intended to underpin the rules required for FOD, these rules make incorrect predictions and have to be patched up with rescue-rules, such as (17), for which no independent motivation can be found.

My second point is that, in other cases, the stress rules make false predictions which force Vennemann to treat certain suffixes as exceptional. The deverbal noun *Labung* (['la:buŋ], 'refreshment' - derived from *lab-*, but this time with the suffix *-ung*) is a case in point. It is assigned the stress pattern [1 –], which would entail a reduction of the short unstressed vowel to schwa (this is motivated elsewhere in Vennemann's thesis). This, however, does not happen, and Vennemann is forced to treat the suffix *-ung* (along with several others) as exceptional with regard to vowel reduction.

Thirdly, it seems that the basis of Vennemann's treatment of word-stress is questionable. Again, this is due to failings of the SPE-framework rather than Vennemann's individual analysis. The SPE approach to stress is notorious for several reasons. Firstly, its formalism requires extremely complex rules[22] and, secondly, it generates more degrees of word-stress than could possibly be distinguished by a normal hearer or for which there is phonological evidence[23]. It is highly unlikely that conclusive evidence for the five degrees of word-stress referred to in Vennemann's analysis of German can be found. This over-differentiation is simply an artifact of the SPE-framework.

To sum up, Vennemann's attempt to prop up his #-boundary deletion rule (8) (reproduced as (16)) by reference to stress fails (a) because his stress rules are fundamentally flawed in that they generate too many degrees of word stress and (b) because, as I have shown, they make the wrong predictions for stress assignment.

[22]E.g. the infamous English main stress rule (Chomsky & Halle 1968: 240).

[23]See Giegerich 1985 (pp. 30f.) for criticism of overly fine distinctions of stress levels and Hogg & McCully 1987 for a survey of some of the most important advances in the recent literature on stress, mainly in the metrical framework.

2.3.1.2.3 Dealing with variable items: 'unpronounceable' clusters

My third and final point of criticism of Vennemann's SPE-type analysis of FOD concerns his way of dealing with the so-called 'controversial items' (listed in (11)). According to his analysis, speakers of group B (those who have FOD in these items) find it necessary to insert a #-boundary to break up an 'unpronounceable' cluster, while speakers of group A (those who do not devoice in these cases) apparently have no difficulty in treating these 'unpronounceable' clusters as tautosyllabic. The question arises why this difference between the two groups should exist. Vennemann's choice of the term 'unpronounceable' in this context suggests that we may be dealing with some kind of physical or physiological factor which makes it impossible for B-speakers to articulate these clusters tautosyllabically. On closer inspection, however, this view becomes untenable. If it really were the case that A-speakers are in some way better vocal gymnasts, the fact that entire speech communities must suffer from some kind of lingual affliction would have to be explained. This is clearly not what Vennemann intended. I believe that he is referring to some kind of phonotactic, i.e. phonologically motivated, constraint.

Let us consider the implications of the claim that A-speakers treat these 'unpronounceable' clusters as tautosyllabic in greater detail. If A-speakers do indeed syllabify, say, *radle* as *ra.dle*, the most obvious conclusion to be drawn from this would be that *dl* as well as *gn bn dn zl* are licit syllable onsets in their dialect. Although Vennemann posits underlying representations where the clusters are broken up by a vowel (e.g. $[[\text{ordVn}]_V\text{uNg}]_N$ for *Ordnung* and $[[[\text{rad}]_N\text{Vl}]_V]\text{V}]_V$ for *radle*), the fact remains that the plosive and the sonorant become adjacent through the application of the syncopation rule deleting the vowel which separates them in their underlying representations. This, effectively, makes them syllable onsets, although this notion obviously does not exist in SPE. Vennemann himself interprets them in this way by calling them syllable-initial clusters in Vennemann 1972a, where he *is* in a position to refer to syllable-boundaries.

There is one problem with this analysis. If these clusters were indeed acceptable syllable-onsets for A-speakers, one would expect them to behave like other onsets, that is, to occur word-initially as well as word-internally. In Vennemann's variable items in (11) (and others like them) they only occur word-internally and, in fact, it appears that they are never found word-initially[24]. Possible counterexamples to this statement, however, can be found in Bavarian-Austrian dialects, which have forms such as [dlaɪt] (*die Leute*, 'the people') and [dnɔ:xt] (*die Nacht*, 'the night'). Do *dl* and *dn* occur word-initially after all? The answer to this question could only be yes if it were impossible for a vowel to surface, say, in careful pronunciation, between the stop and the following lateral or nasal. This, however, is not the case. It seems that there is a vowel underlyingly present, since, in a more formal style, the pronunciations [dɪ'laɪt] (*die Leute*, 'the people') and [dɪ'nɔ:xt] (*die Nacht*, 'the night') are also attested.

By contrast, no vowel can ever be heard breaking up the offending clusters in words such as *Adler* or *Ordnung* (or others like them). Quite irrespective of any theoretical interpretation one could apply to the Bavarian-Austrian forms and Vennemann's variable items, it is clear that the two are not comparable and that in the former case there is a vowel (underlyingly) present, while in the latter there is not, at least not one which can ever be made to surface in the same

[24]There are some words, though, which begin with [gn]. These will be discussed in detail in Chapter 4.

word, even when a different speaking style[25] is adopted. In other words, it appears that Vennemann's 'unpronounceable' clusters do not occur word-initially in German. Wiese (1988: 93f.), in fact, has syllable structure conditions which exclude these clusters from *any* syllable onsets, both word-initially and medially.

The defective distribution of these clusters is not recognised as being particularly important in Vennemann 1968 (in fact, it is only noted in passing), but a different view is taken by Vennemann in his 1972 paper on the theory of Syllabic Phonology (1972a). He considers that this defective distribution is in conflict with a universal principle, which he calls the Law of Initials and phrases as follows.

(18) Law of Initials (Vennemann 1972a: 11)

> Medial syllable-initial clusters should be possible word-initial clusters.

In Vennemann 1988, the Law of Initials is further refined to allow for apparent exceptions.

(19) Law of Initials, revised version (Vennemann 1988: 32)

> Word-medial syllable heads[26] are the more preferred, the less they differ from possible word-initial syllable heads of the language system.

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[25] In Chapter 4 I will argue that there is an empty nuclear position present, which has to remain inaudible because of the effects of proper government, which are quite independent of speaker rate and style.

[26] Vennemann uses the term 'head' to refer to what is more widely known as a syllable onset.

Both versions are clearly designed to express a universally valid insight[27] and both are in conflict with A-speakers' pronunciations of the variable items. Such a conflict leaves two options. Firstly, one could, as Vennemann does, simply state that the variable items (and others like them) are exceptions to this law. Secondly, one could try to find an alternative explanation for the existence of these apparent clusters which does not involve treating them as onsets. Let me discuss the two options in turn.

The first, interpreting the unpronounceable clusters as syllable onsets and hence as exceptions to the Law of Initials, has some undesirable implications. One of these is that a general (even universal) constraint on onsets has to be replaced by one or more very specific ones for A-speakers, stipulating that certain clusters are permitted word-internally (under certain circumstances only, as we shall see below), while they are ruled out word-initially. One aspect of this is that (as Rubach 1990 (p. 83) points out) devoicing in foreign borrowings or proper names can only be handled with a great deal of individual marking and other machinery, such as #-boundary introduction rules for A-speakers as well as B-speakers (but in different environments). The sort of problems which are likely to arise from this have already been discussed in 2.3.1.2.1.

If, however, the second option were adopted and the Law of Initials applied without exception, the devoicing facts relevant to *Fremdwörter* (as discussed in Vennemann 1978) would fall out as a result of this law. This approach would, of course, make it necessary for the 'unpronounceable' clusters which

[27]To quote just one piece of evidence in support of the Law of Initials from a non-Germanic language, Mascaró (1986: 173) observes that *dl* cannot be an onset in Catalan for two reasons. Firstly, just as in German, the cluster cannot occur word-initially and, secondly, the *d* can assimilate to the *l* (i.e. *dl* → *ll*). The assimilation process involved here, however, normally only permits syllable-*final* segments to assimilate to syllable-initial ones. In other words, if *dl* were indeed a tautosyllabic cluster, as implied by the analysis of *dl* as an onset, assimilation should be blocked.

are allegedly onsets for A-speakers to be analysed as something other than onsets. This is not possible in the orthodox SPE-framework (but it is in others, as we shall see in 2.3.4 and in Chapters 3 and 4), which is why Vennemann is prevented from choosing this, otherwise preferable, option. The case of the 'unpronounceable' clusters is a good example of how a useful insight (the Law of Initials) can be derailed by an inadequate theoretical framework.

2.3.1.2.4 Summary

To sum up, Vennemann's 1968 analysis of FOD, which involves the claim that obstruents devoice before a #-boundary, is problematic for three reasons. Firstly, the use of a #-boundary instead of a syllable-boundary, which is forced on him by the syllable-denying framework of SPE, leads to an infelicitous intermixing of morphological and phonological categories. This flaw, however, does not actually become apparent until one examines the variable items in (11) in more detail. The insertion of an additional #-boundary by rule (12) for B-speakers, which is specially introduced to deal with these items, has the disadvantage of being an ad hoc device which renders convention (6), which inserts these boundaries to mark lexical categories, completely meaningless.

Secondly, the use of a #-boundary instead of a syllable-boundary causes problems with making the correct predictions for the application of FOD itself, since the two types of boundary do not always appear in identical places, even in indigenous German words. Vowel-initial suffixes (which would be completely straightforward for a truly syllable-based analysis) necessitate a phonetically implausible rule which deletes internal #-boundaries in order to block the application of FOD before a vowel. Vennemann's attempt to provide independent motivation for this #-boundary deletion rule is unsuccessful because the stress-rules adduced for this purpose are dubious themselves.

Finally, Vennemann's treatment of the variable items exposes further weaknesses in his analysis. It crucially hinges on the claim that certain groups of speakers (A-speakers) have syllable-initial clusters of the type *dl, dn, bn* etc. This claim is very difficult to support, as these clusters do not occur word-initially (as do other syllable onsets). In fact, they appear to be restricted (in apparently syllable-initial position) to the very type of words for which they were posited.

2.3.2 Vennemann 1978

2.3.2.1 Vennemann's analysis: obstruents are voiceless in syllable codas

Vennemann's idea that the syllable 'should occupy a central position in phonology' (Vennemann 1978 (p. 175); prompted to some extent by final devoicing in German) is more fully developed in his 1978 paper on the theory of Universal Syllabic Phonology.

In this paper he proposes the syllable-based rewrite rule (20)[28] to handle alternations such as *liebe* (['li:bə], 'dear', fem. sg.) ~ *lieblich* (['li:plɪç], 'lovely').

(20) $[\text{Obstruent}] \rightarrow [-\ \text{Voice}]\ /\ \_\_\ \$$

This rule accounts both for this alternation and for *Fremdwörter*, which were deliberately excluded from his 1968 thesis. In the verb and the adjective just mentioned (and in other words like them), the affected obstruent is syllabified

[28]This type of analysis was first presented in Vennemann 1972a. My discussion is based on the later article, as the treatment of FOD is more detailed there. The idea that FOD is a syllable-final process was put forward by other researchers prior to Vennemann. See, for example, Moulton 1962, where the observation that voiced obstruents 'never occur in syllable-final position' is made (p. 48).

into the onset of the syllable before a vowel (as in *lie.be*) and into the coda before a consonant (as in *lieb.lich*). So, FOD applies only in the latter case.

However, words ending in a cluster of voiceless consonants are not dealt with by this rule. Words such as *liebt* ([li:pt], '(he/she/it) loves') or *Rads* ([ra:ts], 'wheel', gen. sg.) cannot be accommodated by the rule, as the first member of the final cluster is not immediately adjacent to the syllable boundary ($). To account for the voicelessness of these segments one would have to posit an iterative voicing assimilation rule (which is more or less what Vennemann did in 1968). This rule, according to Vennemann's 1978 view of the matter, would have the disadvantage of making the prediction that there are two separate devoicing processes in German, one which applies syllable-finally and one which involves 'voicelessness assimilation' (p. 180). He considers this as an unnecessary complication[29], which can be resolved by turning rule (20) into a more general 'constraint on the occurrence of segments in syllables' such as (21), which states that

(21) Obstruents are voiceless in syllable codas.

When combined with several other mathematically expressed theorems, (21) makes the correct predictions for all the data cited in the article, indigenous words and *Fremdwörter* alike.

2.3.2.2 Problems with Vennemann's 1978 analysis

The first problem with Vennemann's 1978 account of FOD is that it leaves too many questions unanswered. This makes it rather hard to discover whether the analysis is capable of accommodating other data as well. It is, for example, not

[29]This very complication, however, is not seen as a problem in his 1968 analysis (see 2.3.1.1).

clear how the difference in pronunciation between, say, *neblig* (['ne:blɪç], 'foggy') and *lieblich* (['li:plɪç], 'lovely') is to be dealt with. Similarly, Vennemann 1978 says nothing about the difference between words such as *handlich* (['hantlɪç], 'handy') and *Handlung* (['handlʊŋ], 'action').

The latter, of course, leads on to a whole set of variable items, first discussed in Vennemann 1968 (see (11) above). Recall that these items are pronounced differently by two groups of speakers who otherwise use FOD in an identical fashion. One group (A-speakers) fails to devoice, while the other (B-speakers) applies FOD. As already pointed out in the discussion of Vennemann 1968, it is only the latter group which devoices in accordance with the most likely syllabification available, i.e. *eig.nen, Lüg.ner, reg.net, Seg.nung, eb.nen, Eb.nung, ord.nen,* etc. The absence of devoicing from A-speakers' pronunciations poses a serious problem. This problem remains the same as that already identified for the 1968 analysis.

For devoicing in syllable-final position not to apply (as is the case in A-speakers' pronunciations of the variable items), it is necessary to syllabify in such a way that apparent syllable onsets are created which do not occur word-initially, e.g. *bn* and *dn*. It is only then that constraint (21) can make the right predictions.

This could be achieved either by syllabifying the relevant obstruents into branching onsets or by treating them as interludes (see Vennemann 1978: 212). The former option is in conflict with the Law of Initials, which makes it problematic. Interpreting the recalcitrant obstruents as interludes, on the other hand, would mean that they were doubly linked, both to the syllable they close and the one they open. One could then stipulate that doubly linked segments do not undergo FOD. However, this 'both syllables' assignment would still make the obstruents part of a branching onset, thus falling foul of the Law of Initials.

As discussed in 2.3.1.2, the Law of Initials appears to express a universally valid constraint on possible onsets and anything which clashes with it should be viewed with great suspicion.

A further problem with invoking interludes in the framework of Universal Syllabic Phonology is pointed out by Vennemann himself (*ibid.*, pp. 212f.). The theory has nothing to say about how interludes are assigned to syllables, which basically means that the theory falls short of its goal to constitute 'an adequate theory of its sound system [i.e. of a natural language/WGB]'. This would include a full theory of syllabification, which, of course, also comprises an exhaustive algorithm for the syllabification of interludes - something which Vennemann's theory of Universal Syllabic Phonology lacks.

To sum up, Vennemann's 1978 syllabic analysis of FOD works well for the words it is designed to cover, which also include *Fremdwörter*. This can be seen as an improvement on the 1968 solution, from which *Fremdwörter* were deliberately excluded. However, the variable items, which were at least tackled in Vennemann's thesis, are absent. It is these very items which reveal that the syllabic approach is unable to handle part of the pronunciation of German *Hochlautung* (spoken by A-speakers).

2.3.3 Kloeke 1982 (and Wurzel 1970)

2.3.3.1 The analysis: obstruents devoice at the end of a morpheme

It is these problems with treating FOD as a syllable-final process which led Kloeke (1982a: 128ff., 1982b) to analyse the process as strictly morpheme-final instead. The relevant rule, which was first reproduced as (2) in 2.2 (Kloeke 1982a: 132, 1982b: 172) is repeated here as (22) for convenience.

(22) *Final Devoicing*

$$[-\text{son}] \rightarrow [+\text{tns}] \,/\, \_\_ \; [-\text{segm}] \quad \left\{ \begin{array}{c} [-\text{segm}] \\ [+\text{cons}] \\ [-\text{son}] \end{array} \right\} \quad \begin{array}{l} \text{a.} \\ \text{b.} \\ \text{c.} \end{array}$$

Rule (22) says that obstruents devoice[30] before a boundary (of whatever sort), provided the boundary is followed by another boundary, a consonant or a laryngeal glide. Thus Kloeke's 1982 analysis is virtually identical with Wurzel's 1970 account, except for the fact that the relevant part of Wurzel's rule[31] reads as shown in (23).

(23)

$$[+\text{obstr}] \rightarrow [-\text{sth}] \,/\, \_\_ \; \# \left\{ \begin{array}{c} \# \\ [-\text{silb}] \end{array} \right\}$$

It says that obstruents devoice before a #-boundary if that boundary precedes another #-boundary or a non-syllabic segment. The difference between the two rules is that the third part of Kloeke's rule makes specific reference to devoicing before *h* and glottal stop (both of which he interprets as [– cons, – son]) in (22c). However, as he himself observes (1982b: 172), this part may be redundant, as suffixes with an initial *h* (e.g. *-heit* and *-haft*) or glottal stop (e.g. *-artig*[32], which is probably not a suffix at all, but part of an adjectival compound) seem to be more 'independent' than other suffixes. This fact could

[30]Strictly speaking, it says that obstruents become tense (rather than voiceless), but, as already mentioned in 2.2.2, this interpretation cannot be justified. An additional argument against it will be provided in 2.3.3.2.

[31]The rule is written with German feature labels, so [sth] corresponds to [voice] and [silb] to [syll].

[32]The semi-word *-artig*, as Kloeke (1982b: 172) describes it, may appear to be vowel-initial, but it is in fact pronounced with an initial glottal stop. The role and behaviour of glottal stop will be discussed in Chapter 4.

be expressed by having two boundaries separating them from the root. In this case, (22a) would apply.

To sum up, both Wurzel and Kloeke argue that obstruents are devoiced before a morpheme boundary, except where that boundary is followed by a vowel.

2.3.3.2 Problems with the 'morpheme-final process' analysis

Essentially, the problems with this approach are very similar to those discussed in 2.3.1.2, with reference to Vennemann's 1968 analysis, which, although intended to capture the syllable-final nature of FOD, nevertheless expressed the process in terms of #-boundaries.

Kloeke is well aware of these problems[33]. He discusses two types of possible counterexamples to his analysis, *Fremdwörter* and words which would fit into Vennemann's list of variable items.

As far as the *Fremdwörter* are concerned, Kloeke (1982a: 133) argues that most of them simply follow the generalisation that obstruent clusters in German are voiceless. According to him, it is this morpheme structure constraint which is responsible for the voicelessness of the plosives in *Simba[pv̥]e* ('Zimbabwe'), *Ru[kb̥]y* ('Rugby') or *Wi[kv̥]am* ('wigwam'). If both [v] and [v̥] (or [b] and [b̥] in the above examples) were specified as [+ voice], which is the most commonly adopted interpretation, the morpheme structure constraint could, however, not be invoked. It is for this reason that Vennemann (1978) chose to account for the voicelessness of the velar plosives in *Smara[kd]e* ('emeralds') and *Ja[kd]en* ('hunts') by means of final devoicing instead. Although the option of applying morpheme-final FOD may be open to Kloeke for words such as

[33]Wurzel (1970) has nothing to say about any problems with his analysis.

Jagden and *Smaragde*, it is not available in a considerable number of other cases, since it would entail positing morpheme boundaries where German can provide no morphological evidence for them (e.g. *Simbab+we*). Consequently, he has to claim that [v̥] and [b̥] are voiceless (in his terms, [– tns, + stVC]). According to his morpheme structure constraint (24) (Kloeke 1982a: 31), obstruent clusters have to be [+ stVC], i.e. voiceless.

(24)	wenn:	[– son]	[– son]
	dann:	[+ stVC]	[+ stVC]

In other words, his analysis of the *Fremdwörter* he cites crucially depends on a distinction between [v] and [v̥] or [b] and [b̥], which is made by means of the features [± tns] and [± stVC]. As pointed out in section 2.2, this distinction was insufficiently motivated by Kloeke when he first introduced it into his account. Now his interpretation of FOD hinges on it. I do not think that this alone can be considered as independent evidence for it. On the contrary, it appears that the distinction is made for the sole purpose of eliminating a considerable body of counterexamples to the 'morpheme-final' solution.

Furthermore, morpheme structure constraint (24) fails to account for obstruent devoicing in German pronunciations of *Fremdwörter* where the affected obstruent is followed by a nasal, e.g. *Badminton* (['bɛtmɪntən]) or *Charisma* ([ça'rɪsma]). The nasal is specified as [– stVC], and yet, devoicing occurs, in the absence of both a [+ stVC] segment *and* a morpheme boundary.

A further challenge to his analysis of FOD comes from words which are structurally similar to Vennemann's variable items (see (11) above). He (1982b: 172f.) proposes to deal with all of those which involve an obstruent preceding *l* or *n* as follows. In words such as *Handlung* (['handluŋ], 'action') or *Bildner* (['bɪldnɐ], 'sculptor'), both of which fail to undergo FOD for A-speakers[34], the morphological structure is *Hand-l-ung* and *Bild-n-er* respectively, that is, it involves a morpheme *-l-* or *-n-*. The presence of such a morpheme is what distinguishes these particular forms from others which are based on the same root, but where FOD applies in *all* dialects (in Vennemann's terms, for both A- and B-speakers). The adjective *hand-lich* (['hantlɪç], 'handy') and the noun *Bild-nis* (['bɪltnɪs], 'portrait') are examples of such words. The fact that FOD does not apply to words with the morphemes *-l-* and *-n-* (such as *Handlung* and *Bildner*) is expressed by the readjustment rule reproduced in (25).

(25)

$$[\text{u R. (22)}] \rightarrow [-\text{ R. (22)}] \,/\, \_\_\, [-\text{ segm}] \begin{bmatrix} +\text{ cons} \\ +\text{ son} \end{bmatrix} [-\text{ segm}]$$

The unmarked value for FOD is [+ R. (22)], but where the SD of rule (25) is met (i.e. where a word contains the morphemes *-l-* or *-n-*), rule (22) will be blocked. This generates the correct output for A-speakers. For this solution to make the right predictions for B-speakers, all that has to be said is that B-speakers do not have readjustment rule (25).

This readjustment rule undeniably captures the facts, but it is hard to see how any independent motivation for its existence could be found. In any case, it seems that Kloeke has overestimated the number of words this rule would apply to. It is, for example, not obvious why a word like *Handlung* should be treated as *Hand-l-ung* rather than *Handl-ung* (which is what Rubach proposes in (28) below). Conclusive evidence in favour of *Handl-ung* was presented in 2.3.1.2.1. This is actually good news for Kloeke because it means that the readjustment

[34]In the case of *Bildner* (and other similar words involving *-n-*), I have found considerable variation in my own work with A-speakers. The same speaker pronounced this word ['bɪldnɐ] and ['bɪltnɐ] in a single session. See Chapter 4 for further discussion.

rule (25) has to do a lot less work. If the root is *handl-*, then the SD of the devoicing rule (22) is not met anyway and A-speakers' pronunciations are what we would expect. Words like *Bildner*, of course, would still have to be accounted for by the readjustment rule.

B-speakers' pronunciations, on the other hand, could prove problematic. Simply removing the readjustment rule from their rule inventories would no longer do the trick. Kloeke would have to show that for these speakers there is indeed a second morpheme-boundary in words like *Handlung* and *Ordnung*, which, given the evidence in 2.3.1.2.1, will probably turn out to be impossible.

To sum up, any analysis which treats FOD as a morpheme-final process necessarily shares most of the disadvantages of Vennemann's 1968 approach, as already discussed in 2.3.1.2. Kloeke's attempt to overcome the particular problem concerning incorrect predictions being made for *Fremdwörter* fails because it crucially depends on voicing being expressed by the two features [$\pm$ tns] and [$\pm$ stVC], which, as I have shown, cannot be motivated independently. Vennemann's variable items pose another problem for this type of analysis, as some of the stems predicted by Kloeke do not appear to exist. Also, the proposed readjustment rule (25), which handles these words, cannot be motivated independently and one would have to show that the variable items differ in their morphological structures for A-speakers and B-speakers.

2.3.4 The Lexical Phonology analysis: Rubach 1990

2.3.4.1 Introduction: Wiese 1988, Hall 1989a

Before dealing with Rubach's 1990 analysis of FOD, I would first like to explain why I have chosen not to discuss the other two recent Lexical Phonology accounts currently available (Wiese 1988 and Hall 1989a) in the same amount of detail.

The most important reason is that both of them are partly beset by the same sort of problems that have already been investigated at length in the preceding sections. Wiese's (1988: 80ff.) analysis, for example, assumes syllable-final devoicing, but is unable to handle the *Hochlautung* pronunciations of Vennemann's variable items (and others like them, of course). The necessary syllabifications (involving syllable onsets such as *dn, bn, dl* and so on) are excluded by Wiese's own rigorous syllable structure conditions (p. 93f.).

It is the same apparent onsets which make Hall's (1989a) approach equally uninteresting for my purposes. In spite of explicitly referring to Wiese's syllable structure conditions, Hall tacitly permits the sort of onsets which are actually excluded by these conditions, e.g. *dn*. The problems arising from this strategy were discussed in 2.3.1.2.3.

Rubach's solution differs from the above in that it succeeds both in rejecting the sort of onsets which are in conflict with Vennemann's Law of Initials *and* in capturing *Hochlautung* pronunciations of Vennemann's variable items. I will explain how this is achieved in the next section.

2.3.4.2 Rubach's analysis: FOD is syllable-conditioned and requires cyclic syllable structure assignment

Rubach's 1990 analysis takes into account the range of problems by which both the syllabic and the morpheme-based accounts of FOD are plagued. To a certain extent, his analysis combines aspects of the two earlier ones, something which becomes possible only because Rubach's approach is couched in the framework of Lexical Phonology and employs a sophisticated Syllable Structure Algorithm (see below).

His Final Devoicing rule (26) operates in a syllable coda.

(26)

```
                              N'
                              |
                              X
                              |
[- son] → [- voiced] /       ___
```

This rule makes the right predictions in the vast majority of cases, provided that it applies postcyclically[35], when all word formation has been completed. The reason for this is obvious. Syllabification needs to refer to all segments which eventually form part of the complete word, and the application of FOD in turn depends on the final syllabification of the word in question. The plural of *Tag* ([ta:k], 'day'), for example, can be syllabified as *Ta.ge* (['ta:gə]) only once the final *-e* has become available, and it is this syllabification with the plosive in the onset of the second syllable which correctly blocks FOD.

To formalise the fact that syllabification takes affixes into account at all levels of derivation, Rubach introduces the Syllable Structure Algorithm (SSA for short) reproduced in (27) below.

(27)

```
                                        N
                                        |
                           X            X
                           |            |
N-Placement:           [- cons] → [- cons]

                                   N" (= σ)
                                  /|
                        N        / N
                        |       /  |
CV Rule:            (X) X → (X)    X

Onset Rule:         Attach the prenuclear Xs to N".
```

[35]See Booij & Rubach 1987 for a detailed discussion of the differences between postcyclic and postlexical rules in Lexical Phonology.

Coda Rule: Erect N' between N and N" to include all the postnuclear Xs.

N-placement and the CV rule are universal, while the onset rule and the coda rule are subject to language-specific constraints, e.g. constraints on permissible onsets. The CV rule is able to resyllabify codas (except, of course, on the first application of the SSA, where codas are not yet available to the CV rule), but it can only fill a single pre-nuclear slot. The purpose of the CV rule is, then, to ensure that the universally preferred syllable type CV emerges, rather than, $(VC)_\sigma(V)_\sigma$, which initially results from vowel suffixation. The language-specific onset rule, on the other hand, is responsible for generating branching onsets such as *gl, bl* and *pr* in German. It can only syllabify free segments, that is, resyllabification by the German Onset rule is blocked. The SSA applies and reapplies throughout the derivation (both lexically and postlexically) after the application of a rule, whenever its SD is met.

To tackle Vennemann's variable items, Rubach first of all makes the morphological structures involved precise. He does this by contrasting some of the relevant variable words with others where FOD is obligatory both for A-speakers and B-speakers. The relevant list is reproduced in (28).

(28)

Voiced obstruent	*Voiceless obstruent*
Handl+ung 'act' (handel+n 'to act')	hand+lich 'handy'
Ordn+ung 'order' (ordn+en 'regulate')	Bild+nis 'portrait'
ebn+en 'flatten' (eben 'flat')	Ergeb+nis 'result'
Begegn+ung 'meeting' (begegn+en 'meet')	Wag+nis 'boldness'
eign+en 'own' (eign+en 'to own')	Zeug+nis 'testimony'
nebl+ig 'foggy' (Nebel 'fog')	glaub+lich 'believable'

Like all his predecessors Rubach has doubts about clusters such as *dl* or *gn* forming permissible onsets. In fact, he decides that they cannot constitute onsets at all. Instead, - and this is the ingenious move which sets his solution apart from all others - he argues that the sonorants involved become syllabic by application of the Sonorant Syllabification rule shown in (29), which turns all extrasyllabic sonorants (marked with an asterisk) into syllable heads. Extrasyllabic sonorants are defined as those sonorants which cannot be syllabified because of a clash with the Sonority Sequencing Generalisation, which states that the sonority of segments decreases towards the edge of a syllable (see Rubach 1990: 80).

(29)

$$\begin{array}{ccc} & & \sigma\ (= N'') \\ & & | \\ {}^{*}C & \rightarrow & C \\ [+\ son] & & [+\ son] \end{array}$$

The derivation of a word such as *Handlung* would then go like this.

(30) h a n d l

Cycle 1

```
  σ
 //\\
 h a n d *l                  Syllable Structure Algorithm (27)

   σ        σ
 //\\       |
 h a n d    l                Sonorant Syllabification (29)

   σ   σ
 / | \ /\
 h a n d l                   Syllable Structure Algorithm (27)
```

Cycle 2

```
   σ   σ
 / | \ /\
 h a n d l + u n g

   σ   σ     σ
 / | \ /\   / | \
 h a n d l + u n g           Syllable Structure Algorithm (27)
```

Postcyclic

```
 ---                         Final Devoicing (26)
```

[handluŋ]

The postcyclic application of FOD is blocked because the SD of the devoicing rule (26) is not met, as there is no suitable obstruent occupying a coda position. In *handlich*, by contrast, FOD applies to the coronal plosive, as this is syllabified in the coda of the initial syllable *hand* throughout the derivation, with the *l* forming the onset of the suffix *-lich*. Rubach observes that the *l* in *Handlung*, on the other hand, is not resyllabified into the onset of the suffix *-ung* (which would incorrectly predict devoicing) because it does not occupy a coda, but a nucleus instead. He assumes that only codas can be resyllabified by the SSA (more precisely, by the CV rule).

The final step in Rubach's account of FOD has to do with the status of those sonorants which were made syllabic by the Sonorant Syllabification rule (29). Some of them remain syllabic until the final output of the derivation (e.g. in *Handel*, 'trade'), while others, such as those in *Handlung* and *Ordnung* undergo a Sonorant Desyllabification rule (never explicitly formulated in Rubach's paper) which is ordered after FOD. It appears that this rule deletes the σ-node dominating the affected sonorant. This means that it (and all other segments dominated by the same node) are completely unsyllabified. Because of this the SSA is able to syllabify them freely (i.e. even the former syllable nuclei can become onsets, although *re*syllabification of a nucleus into an onset is blocked). In the case of *Handlung*, for example, the *d* would become part of the coda of the first syllable, while the *l* would go into the onset of the suffix.

Rubach claims that he is able to do justice to the fact that FOD is syllable-conditioned (a view which I can only partially support, see Chapters 3 and 4) and that syllabification depends on morphological structure. Cyclic assignment of syllable structure makes it possible for him to eliminate the apparent conflict between the syllable-based and morpheme-based analyses of FOD and to generate correct outputs both in terms of FOD (i.e. *Han[d]lung*) and in terms of intuitional 'surface syllabification'[36] (i.e. *Hand.lung*) for the hitherto problematic pronunciations of A-speakers.

[36]See Rubach 1990 (p. 83, footnote 2, p. 92).

2.3.4.3 Problems with Rubach's analysis

2.3.4.3.1 His framework - Lexical Phonology

The most striking property of Rubach's analysis which could be considered problematic is its reliance on (level-)ordered rules and, more importantly, resyllabification. Both of these devices make the theory of Lexical Phonology even more powerful (or unconstrained) than the orthodox SPE framework, which, as already pointed out in 2.2, overgenerates systematically itself. I believe that it would take more than a thesis on final devoicing to mount a comprehensive and thoroughly argued attack on the theory of Lexical Phonology *per se*, which is why I will not attempt this here. In any case, several of the central tenets of Lexical Phonology have already been shown to be seriously flawed in Sproat's 1985 MIT thesis[37]. There would be little point in duplicating his arguments here. Instead of tackling the theoretical basis of Rubach's analysis, then, I will focus on some of the disadvantages and discrepancies that are apparent even in a treatment of FOD which has such a wealth of theoretical devices at its disposal.

2.3.4.3.2 Rubach's optional rules: German Onset (part of the SSA) and Sonorant Desyllabification

In his analysis, Rubach proposes to treat two of his rules as optional, the German Onset rule, which is part of the SSA and responsible for generating well-formed branching onsets, and the Sonorant Desyllabification rule, which applies postlexically and removes the syllable node from syllabic sonorants,

[37]See especially chapter 4 of Sproat 1985 for a thorough discussion of issues such as the motivation for lexical strata, the ordering of these strata and the viability of a strict division between lexical and postlexical rules with regard to cyclic rule application and structure preservation.

thus freeing both the sonorant and all other segments originally dominated by that syllable node.

I believe that optional rules have certain basic properties which are uncontroversial. One of these properties is that both their application *and* their failure to apply will result in well-formed outputs. If, for example, one wished to express the loss of schwa in a word such as *Frauen* ([fraʊən] or [fraʊn], 'women') in terms of a rule of schwa-deletion, such a rule could be an optional rule. Both the form with schwa and the form without it are perfectly grammatical, with the former being perceived as slightly more formal than the latter by native speakers of German.

Rubach's so-called optional rules (German Onset and Sonorant Desyllabification), however, deviate from this pattern. Treating them as genuinely optional has disastrous consequences in a considerable number of cases. It can result in surface forms with unsyllabified or incorrectly syllabified segments and, for B-speakers, it makes the wrong predictions with regard to FOD for certain sets of data. To see that his 'optional' rules actually *have* to apply in some cases, while they need to be blocked in others to generate the correct output, consider the derivation of the verb handeln ([handln][38], 'to act').

(31) h a n d l

Cycle 1

```
  σ
// \\
h a n d *l          Syllable Structure Algorithm (27)
```

[38]This transcription, together with several others to follow below, reflects the output generated by Rubach's derivation. Native speakers perceive these pronunciations without schwa as typical of relatively informal speech, whereas those with schwa, e.g. ['hand əln], represent careful or formal speech.

```
 σ        σ
//\\      |
hand      l        Sonorant Syllabification (29)

 σ   σ
/|\ /\
handl              Syllable Structure Algorithm (27)
```

Cycle 2

```
 σ   σ
/|\ /\
handl+n

 σ    σ
/|\ /|  \
handl+n            Syllable Structure Algorithm (27)
```

Postcyclic

```
---                Final Devoicing (26)

 σ
/|\
handl+n            Sonorant Desyllabification

 σ
/|\\
handl+n            Syllable Structure Algorithm (27)

*[hand]
```

Rubach makes no provision for the Sonorant Syllabification rule (29) to apply *post*cyclically as well as cyclically. Consequently, it is impossible to syllabify the *l* and the *n* in any way, as the SSA, in the absence of a non-consonantal syllable nucleus, is not able to incorporate them into a syllable either. This would mean that they are unlicensed (see Goldsmith 1990: 123f.) and would be deleted under Stray Erasure (e.g. Itô 1986, ch. 3; Durand 1986a, where this is referred to as 'Floating Consonant Deletion'). The predicted output is then *[hand], an unattested form.[39]

This undesirable result could have been avoided if the application of the Sonorant Desyllabification rule in (31) had been blocked. A readjustment rule similar to Kloeke's (see 2.3.3.2) might have been able to handle this. However, it would have to permit the application of Sonorant Desyllabification for *Handlung* (see (30) and discussion above) but block it for *handeln* and *Handel*, for example, which would make it necessary for it to refer to specific suffixes. Such a readjustment rule may well turn out to be quite difficult to motivate independently.

Another effect of generating unsyllabified segments is, of course, that, once one moves beyond a single word, these segments can then be combined with adjacent segments from other words, giving rise to incorrect surface syllabifications. Now, it may be that cross-word resyllabification is blocked, as no explicit statement to the effect that this is allowed is made in Rubach 1990. On the other hand, it is made clear that the SSA applies 'throughout the lexical and the postlexical components whenever its environment is met' (p. 81). So, it may be reasonable to assume that cross-word resyllabification is permitted. To the extent that this is the case, Rubach's analysis makes incorrect predictions for surface syllabifications. Consider the noun phrase *der Wandel in seiner Haltung* ([deːɐ vandl ɪn zaɪnɐ haltʊŋ], 'the change in his attitude'). The first noun and the following preposition *(Wandel in)* are of particular

[39]It might be possible to salvage derivations such as (31) by allowing Sonorant Syllabification to apply postcyclically as well cyclically (after Sonorant Desyllabification). However, for the SD of Sonorant Syllabification to be met, the *l* would have to be marked as extrasyllabic. It is not entirely clear from Rubach's paper exactly how extrasyllabicity is assigned, but it is conceivable that this could be done by the SSA on its application after Sonorant Desyllabification.

interest here, so the simplified derivation in (32) will take only these forms into account. Syntactic bracketing is only partial.

(32) v a n d l

Cycle 1

```
  σ
//\\
v a n d *l N]              Syllable Structure Algorithm (27)

  σ       σ
//\\      |
v a n d   l N]             Sonorant Syllabification (29)

 σ   σ
/ | \ /\
v a n d l N]               Syllable Structure Algorithm (27)
```

Postcyclic

```
 ---                       Final Devoicing (26)

 σ
/ | \
v a n d l N]               Sonorant Desyllabification

 σ
/ | \\
v a n d l N]               Syllable Structure Algorithm (27)
```

Postlexical

```
 σ              σ
/ | \\          | \
v a n d l N] [PP [P ɪ n

 σ              σ
/ | \\  /       | \
v a n d l N] [PP [P ɪ n    Syllable Structure Algorithm (27)
```

*['vand.lɪn]

The final output of the derivation implies that *Wandel in* ([vandl ɪn]) is syllabified as [vand.lɪn], with the lateral occupying the onset of *in*[40]. German speakers intuitively reject this syllabification[41]. As mentioned in 2.3.4.2, Rubach considers native speaker intuitions about syllable divisions important enough to feel the need for phonological representations to reflect them accurately (cf. *Hand.lung*, for example). Under this assumption, the output of derivation (32) is simply wrong.

However, it is not entirely clear whether native speaker intuitions about the precise location of syllable boundaries are necessarily as reliable[42] as Rubach believes them to be. Take, for example, word-internal *st*-sequences in German, e.g. in *fester* (['f ɛstɐ], 'harder'). Speakers are notoriously unsure about whether to treat this as *fes.ter* or *fe.ster*.

Native speakers also tend to have difficulties where a segment sequence which is perceived as a potential branching onset is involved, especially if there are no unambiguous clues as to the morphological structure of the word. *Hutrand* (['hu:trant], '(hat) brim'), for example, is no problem, as both Hut ([hu:t], 'hat') and *Rand* ([rant], 'edge') are familiar words, and it is clear to any native speaker what the meaning of the compound must be. The *tr*-cluster is therefore not treated as a branching onset. *Stegreif* (['ʃte:kraɪf], as in *aus dem Stegreif*,

[40]See also Giegerich (1987), who makes the point that, as a matter of principle, no syllabification should be allowed to take place postlexically, as incorrect syllabifications across word boundaries (such as the one in my example) would necessarily arise.

[41]In fact, I would argue that the first onset in *in* is filled by a glottal stop, which of course, would make it impossible for any other segment to occupy that position. Rubach, however, does not consider glottal stop as phonologically relevant and, hence, omits it from his derivations. It is for this reason that I have not included it in my transcription either, although I believe that it does have a place there. I will have more to say about glottal stop in Chapter 4.

[42]I am grateful to John Harris for challenging my own assumptions in this respect.

'off the cuff'), on the other hand, is interpreted both as *Ste.greif* and *Steg.reif*, as speakers usually do not know what its morphological structure is supposed to be. Those who opt for the former syllabification frequently misspell it *Stehgreif* (['ʃte:graɪf]) in the mistaken belief that it is derived from *stehen* (['ʃte: ən], 'to stand') and some form of *greifen* (['graɪf ən], 'to grasp'). The pronunciation ['ʃte:kraɪf] is the one found in the authoritative DUDEN pronouncing dictionary (Mangold *et al.* 1990) and corresponds to the syllabification *Steg.reif*, with a devoiced velar plosive. This reflects the fact that the word is actually a compound of *Steg* ([ʃte:k], 'bridge') and *Reif* ([raɪf], 'ring'), which is derived from MHG *stegereif* ('stirrup').

Similar problems with syllable divisions arise when it comes to some of Vennemann's variable items, e.g. *eignen*, which is variously interpreted as *ei.gnen* or *eig.nen*. Rubach himself cites further examples of speakers' judgments being contradictory. One, *Handlung*, has already been discussed. The adjective *neblig* (['ne:blɪç], 'foggy') is a similar case. It retains a voiced [b] in the *Hochlautung* (suggesting that the orthographic *b* is part of a branching onset, as a syllable-final *b* would have undergone FOD), but is nevertheless syllabified as *neb.lig* (or sometimes *ne.blig*) by the same speakers. In my experience, for these sort of words there is not just variation between speakers, but the same speaker will come up with different judgments on different occasions.

In any case, it is not at all clear whether the sort of competence which is responsible for unmonitored phonological behaviour is necessarily the same as that employed when metalinguistic tasks (such as syllabification and other labelling tasks) are being performed. As Schnitzer (1972: 92) observes, there may be 'a fundamental neuropsychological division between the ability to perform ordinary language tasks (production and perception) and the ability to perform all the other kinds of linguistic tasks'. It seems reasonable to conclude from this that one cannot necessarily expect the same results from both.

In short, it appears that there are good arguments against considering native speaker judgments about syllable divisions as an absolute yardstick for phonological representations. In the light of the facts just presented it seems surprising that Rubach finds it necessary to construct his derivations in such a way that they both generate the correct output for unmonitored pronunciations *and* mirror introspective judgments about syllable boundaries, although the latter are sometimes contradictory. The most obvious way to resolve apparent contradictions between the two (as in the word *Handlungen*, for example) would have been to model one's representations and derivations on 'normal' (and consistent) speech and to take no notice of intuitions elicited by explicit questioning. Rubach's determination to combine the two, however, occasionally forces him to syllabify the same segment first in one way, then resyllabify it in another and, finally, resyllabify it yet again, in exactly the same way as on the very first pass. This is illustrated for the [d] in *Handlung* in (33).

(33) h a n d l

Cycle 1

```
  σ
/ / \ \
h a n d *l            Syllable Structure Algorithm (27)

  σ       σ
/ / \ \   |
h a n d   l           Sonorant Syllabification (29)

  σ   σ
/ | \ / \
h a n d l             Syllable Structure Algorithm (27)
```

Cycle 2

```
 σ   σ
/ | \ /\
h a n d l + u n g

 σ   σ    σ
/ | \ /\   / | \
h a n d l + u n g          Syllable Structure Algorithm (27)
```

Postcyclic

```
---                        Final Devoicing (26)

 σ        σ
/ | \      / | \
h a n d l + u n g          Sonorant Desyllabification

 σ        σ
/ | \\  /  / | \
h a n d l + u n g          Syllable Structure Algorithm (27)
```

['handluŋ]

The *d* is first syllabified into the rime of the first syllable, then it becomes the onset of the second syllable and, finally, it returns to its original position in the coda of the first syllable. In other words, the relevant obstruent is side-lined during the crucial part of the derivation, where FOD applies, and after the application of FOD is put back on track. The two successive resyllabifications of the *d* which can be reduced to the basic formula A → B → A make (33) a Duke of York derivation by Pullum's (1976: 83) definition. Although Pullum himself refrains from rejecting the Duke of York gambit as a matter of principle (p. 100), the fact remains that this strategy is viewed with considerable suspicion by a large number of linguists (several of which are quoted in Pullum 1976), including myself.

By arguing that the phonology ought to concentrate on what speakers say without being very much aware of it rather than on what they think they say (or, more precisely, how what they think they say can be divided up[43]) I am actually weakening that part of my own argument against Rubach's optional rules which makes reference to incorrect surface syllabifications (as put forward on the basis of derivation (32)). This does not, however, detract in any way from the rather more important point I made about some outputs containing unsyllabified segments (see derivation (31)).

Moreover, there is a further argument against Rubach's 'optional' rules which is not connected with intuitional surface syllabifications. The point here is that treating these rules as genuinely optional can lead to incorrect outputs not just for syllabification, but for FOD itself. Before I can show how this comes about, however, I first need to extend Rubach's analysis to Northern Standard German (NSG for short), that is, the dialect spoken by Vennemann's B-speakers. Recall that B-speakers, unlike A-speakers (whose speech Rubach's analysis is intended to account for), systematically apply FOD in words such as *eignen, Lügner, regnet, ebnen, Ordnung, Adler, edler, Handlung* and so on.

Now, one could argue that extending Rubach's account to apply it to a dialect other than that for which it was designed is not a legitimate move. On the other hand, it has been demonstrated by Vennemann (1968, 1972a) that comparing the two dialects (*Hochlautung* and NSG) is particularly useful for a study of FOD. Besides, data from both dialects were available to Rubach when developing this analysis (as witness Rubach's reference to Vennemann 1972a, which contains data from NSG as well as *Hochlautung*). If it turns out that

[43]I believe that it is perfectly legitimate for a phonological analysis to conflict with what Rubach calls intuitional surface syllabifications, provided, of course, that it captures unmonitored speech. A good theory which can help us gain really useful insights, however, ought to be able to say *why* such a conflict arises in some cases, but not in others. The Government Phonology analysis, as I will show in Chapter 4, is in fact in a position to do that.

NSG is not at all amenable to Rubach's analysis, then that would be a clear drawback, especially when one considers that speakers from both speech communities exhibit identical usage of FOD, except for the set of words which Vennemann (1968) refers to as 'controversial items'. The Government Phonology analysis to be presented in Chapter 3 and 4 accounts for both dialects and, if it turns out that Rubach's analysis can only handle *Hochlautung*, the Government Phonology approach would be at a distinct advantage due to its greater generality. I believe, therefore, that an investigation of how Rubach's analysis stands up to NSG data is justified.

In order to account for the difference between *Hochlautung* and NSG in the application of FOD to the variable items, one could either argue that this is due to some difference in morphological structure (e.g. A-speakers treat the relevant words as morphologically simple, while B-speakers consider them as complex) or that there is a difference in the order in which A-speakers and B-speakers apply the relevant rules. As far as the items listed in (11) are concerned, there is no evidence to support the claim that the two groups make non-identical judgments about the morphological structure of these words (but see Ch.4 for a more detailed discussion of these, as well as others, where there may be such differences). As argued in 2.3.1.2.1, the sort of morphemes (specifically stems) which would be needed to account for differences between A- and B-speakers' pronunciations in terms of morphological structure cannot be motivated.

It seems, then, that the difference in FOD behaviour will have to be attributed to a difference in rule order, that is, the rule of Final Devoicing (26) has to be moved from its position in the derivation. On the face of it, it looks as if this can be done very easily. All that needs to be said is that Final Devoicing precedes Sonorant Desyllabification for A-speakers, while the two rules apply in the reverse order for B-speakers. To see that this simple reordering operation can make the correct predictions, consider the derivation of *Handlung* (for a B-speaker) in (34).

(34) h a n d l

Cycle 1

```
  σ
// \\
h a n d *l                  Syllable Structure Algorithm (27)

  σ       σ
// \\     |
h a n d   l                 Sonorant Syllabification (29)

 σ   σ
/ | \ /\
h a n d l                   Syllable Structure Algorithm (27)
```

Cycle 2

```
 σ   σ
/ | \ /\
h a n d l + u n g

 σ   σ    σ
/ | \ /\  / | \
h a n d l + u n g           Syllable Structure Algorithm (27)
```

Postcyclic

```
 σ         σ
/ | \     / | \
h a n d l + u n g           Sonorant Desyllabification

 σ         σ
/ | \\  / / | \
h a n d l + u n g           Syllable Structure Algorithm (27)

    [t]                     Final Devoicing (26)
```

['hantluŋ]

The reversal of Final Devoicing and Sonorant Desyllabification works well in (34), but it is not watertight. The optional status of Sonorant Desyllabification is still a problem. If I had chosen *not* to apply this rule in (34), the derivation from the second cycle onwards would have looked like this:

(35) *Cycle 2*

```
 σ   σ
/ | \ /\
h a n d l + u n g

 σ   σ     σ
/ | \ /\   / | \
h a n d l + u n g          Syllable Structure Algorithm (27)
```

Postcyclic

---	Sonorant Desyllabification
---	Final Devoicing (26)

*['handluŋ]

Final Devoicing would, counterfactually for a B-speaker, have been blocked. This is another piece of evidence against treating Sonorant Desyllabification as optional. Evidence against the optional status of the German Onset rule (part of the SSA (27)) follows *anon.*

Consider the derivation of *Rudrer* (['ru:drɐ], 'rower'), a form of the agent noun related to the verb *rudern* (['ru:dɐn], 'to row'). The derivation for a B-speaker is shown in (36).

(36) r u: d r

Cycle 1

```
  σ
 / | \
r u: d *r          Syllable Structure Algorithm (27)

  σ       σ
 / | \    |
r u: d    r        Sonorant Syllabification (29)

  σ    σ
 /\   /\
r u:  d r          Syllable Structure Algorithm (27)
```

Cycle 2

```
  σ   σ   σ
 /\  /\   |
r u: d r + r       (according to Rubach (1990: 90), by a rule
                   other than Sonorant Syllabification (29))

---                Syllable Structure Algorithm (27)
```

Postcyclic

```
  σ       σ
 /\       |
r u: d r + r       Sonorant Desyllabification

  σ      σ
 / | \  /   \
r u: d  r[44] + r  Syllable Structure Algorithm (27)
```

[44]Incidentally, there is some possibility that this *r* cannot be syllabified into the onset of the final syllable, as this would give rise to a syllable with an onset which is as sonorous as the nucleus. This could well be interpreted as a violation of the Sonority Sequencing Generalisation. If this turned out to be the case, then the *r* would remain unsyllabified in the final output of the derivation, a definite problem for Rubach, but not immediately relevant to the particular point I am making here.

[t] Final Devoicing (26)

*['ru:tr ər][45]

In this derivation, I have chosen to apply the Sonorant Desyllabification rule, but not the German Onset rule. The output, *[ru:trɐ], is incorrect, however. The word is pronounced ['ru:dr ɐ] by B-speakers and A-speakers alike.

The incorrect output in (36) raises the question of whether we are simply dealing with a lexical exception or whether Rubach's account misses a phonologically significant generalisation and, as a result of this, systematically overgenerates. Let me consider the former possibility first.

If we are simply faced with a lexical exception, then we would expect to find phonologically similar words which do undergo the process in question, specifically, which are derived correctly, even if the German Onset rule fails to apply. Some words which are similar to *Rudrer* in the sense required here (i.e. an FOD obstruent is followed by *r* in a potential onset position) are listed in (37)[46].

[45]The output of the complete derivation would, of course, have been *['ru:tr ɐ]. I have omitted the steps which convert the /ər/ sequence into [ɐ] for reasons of exposition.

[46]Readers with a good working knowledge of German may find the spellings used here somewhat surprising. I can assure these readers that, according to the DUDEN *Großes Wörterbuch der deutschen Sprache* (Drosdowski *et al.* 1976-1981), they - like *Rudrer* - are legitimate alternatives to the more common spellings with an *e* between the obstruent and the *r*. I have chosen the *e*-less forms to provide an environment where at least the potential for the application of FOD exists. Obviously, where the *e* is pronounced (as schwa), FOD cannot apply. Words such as *faserig* have no *e*-less alternative spellings, whereas *unsrige* does. Quite often, though, this orthographic *e* is not realised.

(37) a.

Zaubrer	['tsaubrɐ]	'wizard'
Plaudrer	['plaudrɐ]	'so. who chats'
Wandrer	['vandrɐ]	'rambler'
Zögrer	['tsø:grɐ]	'so. who hesitates'

b.

unsrige	['ʔunzrɪgə]	'ours'
faserig	['fa:zrɪç]	'stringy'

The (comparatively small number of) words which are similar to *Rudrer* all behave identically to *Rudrer*, that is, even B-speakers cannot devoice here. Clearly, then, a phonological generalisation is being missed. Looking at (37a) only, one may get the impression that the problem can be solved by making the German Onset rule obligatory. After all, the clusters involved in (37a) are all well-formed onsets in German. This solution, however, is disqualified as soon as (37b) is taken into account as well. The cluster [zr] is not a possible onset, so that the German Onset rule would necessarily be blocked in the derivation of *unsrige*, for example. What this suggests is that the special properties of words such as those in (37) (i.e. the absence of FOD) have nothing to do with the opposition of well-formed vs. ill-formed German onsets, but with the special characteristics of *r*, as opposed to *l* and *n* (or *m*). I will return to this point in 4.5. What matters at this stage is the insight that a generalisation concerning *r* is being missed.

Incidentally, a closer look at the derivation of *unsrige* (for a B-speaker) sharpens a point I made earlier about the occasional incompatibility of unmonitored phonological behaviour and native speaker judgments about syllabification. Consider the derivation in (38).

(38) u n z *r

Cycle 1

```
 σ
/ | \
u n z  *r                    Syllable Structure Algorithm (27)

 σ          σ
/ | \       |
u n z       r                Sonorant Syllabification (29)

 σ    σ
/\   /\
u n  z r                     Syllable Structure Algorithm (27)
```

Cycle 2

```
 σ    σ
/\   /\
u n  z r + i g

 σ    σ      σ
/\   /\     /\
u n  z r + i g               Syllable Structure Algorithm (27)
```

Cycle 3

```
 σ    σ      σ
/\   /\     /\
u n  z r + i g + ə

 σ    σ    σ  σ
/\   /\    | /  \
u n  z r + i g + ə           Syllable Structure Algorithm (27)
```

Postcyclic

```
 σ         σ  σ
/\         | /  \
u n  z r + i g + ə           Sonorant Desyllabification
```

```
  σ    σ    σ
 / | \  /   \/   \
u n z  r + i g + ə        Syllable Structure Algorithm (27)

   [s]                    Final Devoicing (26)

*['ʊnsrɪgə]
```

The application of the optional rule of Sonorant Desyllabification in this derivation proves that even the Duke of York gambit identified in 2.3.4.3.2 is not always able to allow Rubach to capture both the unmonitored phonological behaviour of speakers *and* their judgments on surface syllabifications. After all, it is the application of this rule which allows [z] to become part of the coda of the first syllable, thus triggering FOD and an incorrect output. At the same time, the application of the rule is vital for producing the correct surface syllabification. In other words, the application of the rule both makes and breaks the derivation.

The point is that, without Sonorant Desyllabification, the output would have been a word with four syllables. Native speakers of German, however, with a surprisingly high degree of consistency, feel that *unsrige* consists of three syllables (unlike its variant form *unserige*, which is considered to have four syllables). So, for Rubach's requirement that the output of a phonological derivation has to match intuitional surface syllabifications to be met, Sonorant Desyllabification has to apply.

In 2.3.4.3.2 I said that unwanted applications of Sonorant Desyllabification could perhaps be blocked by a readjustment rule. Now it is clear that constraining the application of Sonorant Desyllabification in order to ensure the correct output for FOD would not only require a rule which might be hard to motivate but the jettisoning of one of Rubach's avowed aims, to capture surface syllabifications. Blocking Sonorant Desyllabification here would mean generating the wrong number of syllables (four instead of three). Clearly, then, it is impossible to do both the things Rubach sets out to achieve, at least as far as speakers of NSG are concerned.

Let me return to my earlier claim that cases such as *Rudrer* illustrate the point that Rubach's analysis fails to capture certain special characteristics of *r*. This problem arises for B-speakers only. Considering that Rubach's analysis was developed for A-speakers rather than B-speakers, it may, then, not be all that serious. What still remains and is probably more serious, however, is the fact that Rubach's solution lacks generality. It is not possible to extend it to a dialect which is very similar to the one for which it was developed, at least not without creating further problems.

2.3.4.3.3 Schwa epenthesis and underlying syllabic sonorants

Another question mark over Rubach's analysis is related to, as Rubach puts it, 'what happens later to the sonorants that receive syllabicity by sonorant syllabification' (p. 86). He informally lists a few possibilities (e.g. 'a syllabic consonant may develop into [əC]' (*ibid.*)), involving surface syllabic consonants, desyllabification and resyllabification of former syllabic sonorants, and schwa epenthesis. However, he never makes it clear how exactly these various surface forms are to be generated or at what stage this is to happen.

Let me take a closer look at the problem of schwa-epenthesis to see whether his informal remarks can be taken as a basis for a principled account of this particular event. Considering that his paper is about final obstruent devoicing, it may not be immediately obvious why the presence or absence of schwa should be in any way relevant. In my view it matters a great deal, because his analysis hinges on schwa-less lexical representations which contain (as a result of the absence of schwa) what he calls extrasyllabic sonorants. Extrasyllabic sonorants are those segments which, according to the Sonority Sequencing Generalisation, cannot be included in codas or onsets. In the underlying representation /handl/ (as in *Handlung*, for example), the [l], being more sonorous than the adjacent [d] could not be part of the same syllable. It is, therefore, treated as extrasyllabic.

Extrasyllabicity is apparently assigned on the first application of the SSA (although this is not formalised) and is expressed by marking the relevant segment with an asterisk. This would yield /hand*l/ in our example. In careful speech, however, this word is pronounced ['handəl], with a schwa separating the two segments. Similarly, when speakers are asked to divide this word into syllables, they will say [han.dəl] or even [han.dɛl], but never [han.dl]. The latter is impossible. Obviously, Rubach would have to invoke a rule of schwa epenthesis to account for these pronunciations.

Let me take a closer look at three words which, in Rubach's analysis, all share the underlying form /handl/, viz. *Handel, handeln* and *Handlung*. The first cycle is identical for all three. It is shown in (39).

(39) h a n d l

Cycle 1

```
  σ
/ / \ \
h a n d *l          Syllable Structure Algorithm (27)
```

```
  σ        σ
/ / \ \    |
h a n d    l        Sonorant Syllabification (29)
```

```
  σ   σ
/ | \ / \
h a n d l           Syllable Structure Algorithm (27)
```

At the end of this cycle, *Handel* proceeds without change to the postcyclic component, while for the two other words the stem undergoes suffixation in the cyclic component. It is clear that the schwa-epenthesis rule could not apply on the first cycle, otherwise it would be impossible to prevent it from applying to *Handlung* (*['handəluŋ] is ungrammatical). The only alternative (short of marking individual suffixes for the presence or absence of schwa in a preceding syllable) is for the schwa-epenthesis rule to be treated as postcyclic or postlexical. This solution contrasts markedly with work focusing specifically on schwa/zero alternations. Detailed studies of this phenomenon, such as Giegerich 1987 and Wiese 1988[47], argue, in my view convincingly (given the framework), that schwa epenthesis has to take place in the lexicon in order to account for the large number of schwa/zero alternations which are morphologically conditioned. Although part of the lexical rule component, postcyclic rules do not interact with morphological rules (see Rubach & Booij 1987), so, with regard to schwa epenthesis, they have the same status as postlexical rules.

Rubach's proposals concerning the treatment of schwa are too vague for me to be able to compare them with Giegerich's and Wiese's in any detail. However, it is clear that Rubach is forced to deal with this highly complex phenomenon postcyclically or even in the postlexical component only. Given the need for the interleaving of schwa-epenthesis with morphological processes demonstrated by Giegerich and Wiese, it is hard to see how this might be possible.

The question of schwa/zero alternations is inextricably linked with the occurrence of syllabic sonorants, as 'ein silbischer Sonorant genau dann

[47]See also Strauss 1982 (ch. 3) for a detailed discussion of schwa/zero alternations in an earlier framework. Rennison 1981 deals with the same topic, but in a different dialect from those discussed here (Austrian).

möglich ist, wenn auch die Aussprache mit Schwa existiert [a syllabic sonorant is permissible precisely if the pronunciation with schwa exists as well]' (Wiese 1988: 168). Wiese derives syllabic sonorants from potential schwa+sonorant sequences, and he does this postlexically. Rubach, by contrast, generates syllabic sonorants in the lexical component. There is a certain amount of disagreement about whether German permits lexical syllabic sonorants[48]. If it turns out that there are no underlying syllabic sonorants in this language, then Rubach's Sonorant Syllabification rule (29) is non-structure-preserving. Cyclic lexical rules, however, are meant to be structure-preserving (see Booij & Rubach 1987; also e.g. Kiparsky 1985, Pulleyblank 1986 (p. 7) and Kaisse & Shaw 1985 for more general discussions of Structure Preservation). In other words, as a cyclic lexical rule, (29) may well be in conflict with the Lexical Phonology regulative principle which states that (cyclic) lexical rules are structure-preserving.

Let me consider this point in a little more detail. If we take the SSA as the basic and only syllabification device for German, then syllabic sonorant consonants do not exist underlyingly, since the SSA can only use [– cons] segments as the input to its N-placement rule. This would mean that the Sonorant Syllabification rule is non-structure-preserving, in spite of the fact that it is a cyclic lexical rule. One could object that, since it applies relatively early, the Sonorant Syllabification rule may be part of the basic syllabification machinery after all. If that were so, then Sonorant Syllabification (together with the SSA) would be defining syllable structure, so that, by definition, it could not be in conflict with Structure Preservation. However, Sonorant

[48]Giegerich (1987) argues in favour of lexical syllabic sonorants, while Wiese (1988), Wurzel (1985) and Höhle & Vater (1978) make more or less clear noises against this view.

Syllabification is relatively unlikely to be part of the basic syllabification machinery, since, unlike the SSA, it is not an algorithm but a phonological rule.

2.3.4.3.4 Summary

In this section I have shown that Rubach's analysis suffers from a number of more or less serious shortcomings. The optional rules of German Onset and Sonorant Desyllabification have turned out to be anything but optional. For A-speakers, they can generate unsyllabified (and hence prosodically unlicensed) segments in the final output of a derivation, and, if Rubach's approach is extended to B-speakers, even incorrect predictions for FOD itself can arise.

It has become apparent that part of the problem lies in Rubach's attempt to combine a phonologically correct output with one that matches native speaker judgments about surface syllabification, despite the fact that the latter are frequently inconsistent. If he had allowed his derivations to reflect only the former, then at least some measures could have been taken to restrict the application of his 'optional' rules.

I have also discussed the issues of schwa-epenthesis and syllabic sonorants and pointed out that Rubach's approach differs markedly from that of other researchers who have focused on these particular phenomena. On the basis of the limited information Rubach provides about how he proposes to deal with them, I have observed that his schwa-epenthesis rule(s) can only apply postcyclically or postlexically, which prevents any interleaving with morphological rules, the need for which has been demonstrated in past work. Apart from this, Rubach's Sonorant Syllabification rule generates syllabic sonorants in the lexicon. This may well be in conflict with the principle that cyclic lexical rules must be structure-preserving, if it turns out that there are no underlying syllabic sonorants in German, as some authors have argued.

2.4 Conclusion

In this chapter I have examined a range of earlier treatments of FOD from 1968 to 1990. I have shown that all of them suffer from more or less serious flaws, most of which originate from the theoretical framework the analysis in question is couched in. Most importantly, in my view, the analyses presented are essentially arbitrary in their accounts of *what* final devoicing actually consists in and they are unable to provide unified and well-motivated accounts of *where* it occurs.

In the next chapter I will put forward my analysis of FOD, in the framework of Government Phonology. This analysis, I believe, overcomes many of the problems which beset the earlier analyses discussed here and, in doing so, makes explicit the reasons for the inability of previous approaches to really get to grips with the phenomenon.

CHAPTER THREE

WHAT IS FINAL OBSTRUENT DEVOICING?
A GOVERNMENT PHONOLOGY APPROACH

3.1 Introduction

In this and the following chapter I will develop an analysis of FOD in the framework of Government Phonology (henceforth GP). The purpose of these chapters is twofold. Firstly, an analysis couched in a relatively highly constrained framework can reveal a number of facts about the phonological event of FOD which appear to have remained unnoticed in other frameworks. By the same token, some problems for earlier analyses can be resolved in the framework to be presented here. Secondly, confronting a complex phenomenon with a comparatively new theory is bound to raise some issues which indicate that areas of the theory need to be further developed, refined or even modified.

In other words, although - or rather, because - my present approach to FOD is within the theory of GP, I would like to take this opportunity to both extol the virtues of GP and to provide constructive criticism of some of its shortcomings. I will try to suggest remedies for these problems, in the hope that, if some of my solutions turn out to be inadequate, they will at least provide a useful point of departure for others.

The most important statements of GP policy are made in Kaye *et al.* 1985 and Kaye *et al.* 1990 (henceforth KLV 1985 and KLV 1990 respectively). Further important work in this framework is contained in Charette 1988, 1989, 1990, Harris 1990, Harris & Kaye 1990, Kaye 1987, 1988, 1990a, 1990b and in Lindsey & Harris 1990.

What crucially distinguishes Government Phonology from most other phonological theories is the fact that it uses neither rewrite rules of the type

A $\rightarrow$ B / C __ D nor binary features. The absence of SPE-type rewrite rules is, of course, a property which GP shares with any full-blown autosegmental theory (see e.g. Hayes 1990, and Goldsmith 1990 for an overview). Like recent work in syntax, GP is based on principles and parameters instead, and the atoms that can be manipulated within the theory are elements rather than binary features. Binary features are also rejected by sister segmental theories such as Dependency Phonology (e.g. Durand 1986b, Anderson & Durand 1987, Anderson & Ewen 1987) and Particle Phonology (Schane 1984). I will introduce the details of these and several other aspects of GP as and when they become relevant to my discussion of FOD, but before moving on to this, I would like to present the central theoretical concept from which GP derives its name, government, as well as some basic principles of GP.

3.2 Phonological government, 'ground rules' and some principles of grammar

3.2.1 Phonological government

Government Phonology makes the claim that segments are not simply arranged next to one another, but are bound together through government. Governing relations are asymmetric relations that skeletal positions enter into. A governing position is known as the governor (or head), while the governed position is referred to as the governee.

The 'area' over which a governing relation extends defines a governing domain. In other words, two skeletal positions in a governing relation constitute a governing domain. The term 'domain' is used in GP to refer to two different entities, viz. governing domains as just defined and phonological domains, which typically correspond to analytic morphological domains. In what follows

I will not always distinguish the two types from one another explicitly. This is because it is either abundantly clear from the context what is meant or because the distinction is unimportant.

According to KLV (1990: 221), governing relations are established at the level of lexical representation, where the level of lexical representation is defined as 'the level at which the stem is attached to accompanying affixes, if any' (KLV 1990, endnote 34). I find this definition somewhat vague. I propose to interpret it so that governing relations are always present. There is no lexical entry without governing relations. Just as there is no underspecification in GP at the melodic level (i.e. segmental representations are fully specified even in underlying representation), so, I would claim, there is no lack of governing superstructure either. The phonology, then, interprets a representation which already has governing relations.

The governing relations which can be built on a given structure of skeletal positions and associated segments are predictable. In other words, the version of the lexicon proposed here contains a substantial amount of basically redundant information. Ever since the early 1960's, the period when the first statements on the evaluation metric were made (see Hyman 1975: 103ff.), redundancy has been abhorred by phonologists. The development of Underspecification Theory (see e.g. Archangeli 1988; also Anderson & Durand 1988a, b, no date) is in a sense a consequence of treating a simpler grammar (in terms of countable features) as being more highly valued than a relatively more complex one. In other words, from the point of view of the evaluation metric, a lexicon which contains redundancies is not highly valued.

It is, however, legitimate to ask whether the evaluation (or simplicity) metric can be taken as an absolute yardstick for different types of phonological theories. Given the powerfulness of the SPE-system, it is clear that certain metatheoretical principles had to be invoked in order to curb some of the potential excesses. Not just in the context of SPE, though, it is probably uncontroversial to assume that of two, otherwise equivalent, analyses the simpler account is to be preferred. The question is then whether an account which excludes governing relations, that is, information on syllable structure, from the lexical representation is equivalent to one which does not.

Consider external evidence from tip-of-the-tongue (TOT) phenomena (see e.g. Aitchison 1987, ch. 11) and speech errors (e.g. Fay & Cutler 1977). Experiments which induced a TOT state in a subject by giving a definition of a (relatively rare) word which was then to be recalled by the subject found that syllable structure tended to be accessible to the subject at a time when much of the segmental structure could not be recalled. Subjects who were asked to make explicit guesses about the number of syllables in unrecalled words had a success rate of around 57%. This is significantly better than chance, with the chance result having been estimated to be around 25%.

In a study of malapropisms[1], Fay & Cutler (1977) report that in 87% of the cases the number of syllables of the intended word and the word actually uttered were identical. In principle, though, the correct number of syllables could still be identified by the speaker if nuclei only were marked in the lexicon, with no governing relations (and hence constituents[2]) being present, that is, if a lexical representation took the form in (1).

[1]Malapropisms, in their sense, are probably best defined as word substitution errors which are neither semantic errors nor spoonerisms, anticipations, perservations, omissions or blends.

[2]The establishment of governing relations is inextricably linked with the formation of constituents and vice versa.

(1)
```
    N
    |
x   x   x
|   |   |
p   ɪ   t
```

If, however, the correct stress pattern can also be recalled in TOT cases or malapropisms, then this is clear evidence in favour of the view that relatively detailed information on governing relations and constituent structure must be available in the lexical representation, since stress assignment is frequently quantity sensitive (see e.g. Hogg & McCully 1987, van der Hulst 1984, Giegerich 1985). This is precisely what the relevant studies have found. According to Aitchison (1987: 123), 'TOT studies all ... agree that if someone gets the syllables right they almost always get the stress pattern right'. Fay & Cutler also report that in 98% of the cases the stress patterns of the intended word and the word uttered in error were the same.

It seems, then, that the two possible accounts of lexical representations (one including governing relations and one without) are not equally suitable for capturing the facts. Although, from a simplicity metric point of view, the information on syllable structure is actually redundant, performance studies suggest that the speaker can access this information under circumstances where she could not have derived it from segmental or skeletal structure. Therefore, I would like to propose that the phonology interprets fully syllabified representations.

This proposal, in fact, is not at all novel. It is probably no more than a notational variant of the syllable template approach put forward by, for example, Selkirk (1982) and Itô (1986). Selkirk (1982: 356f.) explicitly makes the point that syllable structure is present in underlying representation:

> We will not assume that the principles of BSC [basic syllable composition/WGB] 'apply', in the sense that they participate in a phonological derivation, converting a phonological representation. Rather, we think of them as well-formedness conditions on underlying phonological representation, which thus is to be thought of as having syllabic structure.

To return to the discussion of government in GP, the theory recognises government at three levels, viz. constituent government (holding between skeletal positions within a constituent), inter-constituent government (holding between skeletal positions in two contiguous constituents) and government at the level of nuclear projection, which holds between heads of nuclear constituents. Government at the first two levels is strictly local and strictly directional. In other words, positions which are in a governing relation must be adjacent (strict locality). Government is universally defined as being left-headed for constituent government and right-headed for inter-constituent government (strict directionality).

A direct result of these two principles (strict locality and strict directionality) is that constituents are maximally binary, as it is logically impossible for *both* strict directionality *and* strict locality to be respected in a branching constituent which is anything other than binary (see Kaye 1987: 132 or Kaye 1990b: 306f. for the proof). At first sight, restricting constituents to maximally two positions may appear to be an approach which is faced with numerous counterexamples, e.g. initial *s*+consonant sequences such as, say, *str* in Italian. As shown in KLV 1990, however, the members of this sequence are not syllabified into a single constituent, but two adjacent constituents. To the extent that this analysis can be applied to other languages (and there is no particular reason why this should be impossible), such *s*+consonant sequences do not constitute counterexamples to the GP claim that constituents are maximally binary.

There are three syllabic constituents, viz. onset (O), nucleus (N) and rhyme (R). The nucleus is the head of the rhyme (left branch). The syllable, however, is not a constituent, for two reasons. Theory-internally, it would be anomalous in being the only right-headed constituent, given that each N governs the immediately preceding O (see below). Theory-externally, there is no conclusive evidence for the existence of such a constituent. All arguments in favour of the syllable (such as those advanced by Selkirk (1982), for example) can ultimately be reduced to arguments in favour of the kind of rhyme we find in GP, together with the concept of nuclear projection.

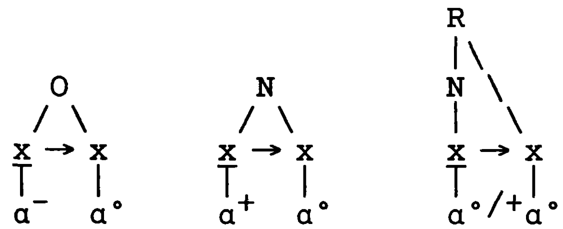
Licensing is the motor which drives phonology, and every skeletal position within a domain, except for the head, has to be licensed, as stated in the Licensing Principle (2) (Kaye 1990b: 306).

(2) *Licensing Principle*
All phonological positions save one must be licensed within a domain. The unlicensed position is the head of this domain.

A position can be licensed either by government or by parameter setting. The latter option is available only for empty domain-final nuclear positions (to be discussed in detail in Chapter 4), while the former accounts for the remainder of the licensing work within a domain.

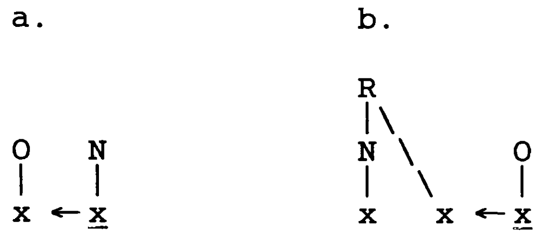
Licensing within a branching constituent is effected by constituent government, as shown in (3) below. The variable α represents any suitable segment, and the superscripts will be explained shortly. The arrows indicate the direction of government. Heads are underlined.

(3)



Constituents themselves are licensed as follows. Each onset is licensed by an immediately following nucleus through interconstituent government, as illustrated in (4a).

(4)



Each nucleus (bar the head of the domain), in turn, is licensed either through being governed by another nucleus at the level of nuclear projection (see (5), which illustrates left- and right-headed government at the level of nuclear projection) or, as already mentioned, by parameter setting.

(5)

A post-nuclear rhymal position (i.e. the right-hand position in a branching rhyme; informally referred to as 'coda'), which itself is not a constituent, appears to have a special status in the context of licensing in that, on the one hand, it is licensed (through constituent government) by the nucleus which c-commands it and, on the other hand, it has to be further licensed by a following onset. This is captured in the Coda Licensing Principle (Charette 1988: 232, Kaye 1990b: 311), which restricts the occurrence of post-nuclear rhymal positions to those environments where they are licensed by a following onset. I will give a more detailed account of this principle in Chapter 4.

What I would like to note at this point is that the 'coda' appears to be the only skeletal position which requires this kind of 'double licensing'. This may be a function of the fact that, although the governing relation between a nuclear head and the post-nuclear rhymal position is a constituent governing relation inasmuch as both positions are sisters within the rime, it differs from the two remaining constituent government configurations. This difference lies in the fact that the two positions are not immediately dominated by the same node. The nuclear head position is immediately dominated by N, whereas the 'coda' is immediately dominated by R. This suggests that the governing relation is less 'close' (for want of a better word) than it is in the cases of branching onsets and branching nuclei. The prediction derivable from this interpretation is that greater variation in terms of charm and complexity should be tolerated in both governor and governee. This prediction appears to be borne out by the facts, as charmless vowels are tolerated in the nuclear head position (whereas positive charm typically seems to be required for branching nuclei), and comparatively complex segments, such as nasals, frequently occupy the 'coda', whereas segments of such a high degree of complexity are excluded from the governed position in a branching onset or nucleus.

To return to my overview of government and 'syllable' structure in GP, each nucleus is preceded by an onset (although this need not necessarily have a skeletal point), so that a well-formed phonological representation consists of a set of O R sequences, which are, informally, referred to as 'syllables'. As a result, the right-most position in a domain is always a nucleus[3] (recall that a phonological domain boundary typically corresponds to an analytic morpheme boundary).

For governing relations to hold, the segments associated with the skeletal positions which enter into a governing relation have to fulfil certain charm or complexity requirements. The details of this will be discussed in the section on segmental representations (3.3), so suffice it to say at this stage that (positively or negatively) charmed as well as charmless segments can govern, while only charmless segments are potential governees. Positively charmed segments are only found in nuclear head positions, while negatively charmed segments are restricted to non-nuclear (head) positions. Charmed segments are 'strong' governors in the sense that they can govern simply by virtue of their charm, while charmless segments are 'weak' governors which can govern only if they are no less complex than their governees[4].

The most typical charm values associated with constituent government are shown in (3) above, where constituent government relations are also illustrated.

Like constituent government and inter-constituent government (see (4) above for those cases of inter-constituent government which are relevant to my discussion of FOD), government at the level of nuclear projection is also local

[3]This nucleus was omitted from the hypothetical lexical representation in (1), since its presence is predictable.

[4]Harris (1990: 273f.) argues that 'any segment, be it charmless or charmed, must satisfy certain complexity requirements before it can occupy a governing position'. It seems that this claim is too strong in the context of branching rhymes, where it is quite possible for a simplex segment such as [a] (consisting only of the element A^{+}) to govern a segment which is more complex, e.g. a lateral (composed of two elements; see 3.3.4) or a nasal (composed of two or three elements; see 3.3.4 and 3.4.3.2.3). Examples such as *Wald* ([valt], 'forest') or *Hand* ([hant], 'hand') are easy to come by, not just in German.

(but not strictly local), in the sense that, at the relevant level of projection, the two nuclear constituents concerned are adjacent, although other material may intervene at lower levels. Unlike constituent and inter-constituent government, government by nuclear projection is language-specific in its directionality. Directionality at this level of government is parametrically variable and is reflected in such prosodic phenomena as tone, stress, harmony and syncope. Both right-headed and left-headed government at this level are shown in (5) above.

3.2.2 'Ground rules' and some principles of grammar

Before concluding this general introduction to GP, I would like to introduce and discuss a few 'ground rules' to which work within the theory is meant to adhere, as well as some principles of grammar. Let me begin with the 'ground rules'.

The term 'ground rules' is used by KLV (1990: 194) to refer to what may equally well be described as 'metatheoretical principles', at least, that is how I interpret them. For sake of brevity, I will simply refer to them as principles. They are privativeness, (phonetic) universality and non-arbitrariness (see KLV 1990: 194).

Privativeness is used in the traditional (Trubetzkoyan) sense, meaning that all oppositions contrast the absence of a particular property (or element) with its presence. Negative values, such as those familiar from binary features, do not exist. The absence of a particular property means precisely that, i.e. that the property is not present. As a result, what would be a negative value in a binary feature framework cannot spread in GP, since spreading of something that isn't there is impossible.

Universality has two manifestations, one mainly phonetic and the other phonological. Firstly, it requires that the same phonological object be manifested uniformly regardless of the phonological system it occurs in. In other words, a phonological object is recognisable and interpretable without reference to other members of a given system. This also means that an object which is defined by the phonology as, say, [u] will be a high back rounded vowel in any language in which this object occurs. In principle, I agree that universality is a useful 'ground rule' to have, but, in practice, adherence to a strict version of it seems somewhat problematic. The object which in Japanese, for example, functions precisely like [u] from a phonological point of view (by spreading onto [h] to create a voiceless labial-velar fricative) is in fact an *un*rounded high back vowel. The corresponding segment in German, i.e. the segment which behaves like [u] (by fusing with [ɪ] and producing [ʏ]) *is* in fact [u]. Perhaps the principle of phonetic universality has not been properly fleshed out yet, specifically, it is not clear exactly how much phonetic variation is to be permitted for one object to be treated as phonologically the same as another. The sort of issues to be addressed here would be, for example, the question of the 'identity' of English [iː] with [ɪi], which are essentially regional variants of one another. My view is that the phonology should not distinguish between these two, but what *exactly* are the sort of distinctions that the phonology should reflect?

The second aspect of the principle of universality is that markedness conventions are universal.

The third metatheoretical principle in GP is that of non-arbitrariness. It stipulates that there must be 'a direct relation between a phonological process and the context in which it occurs' (KLV 1990: 194). As pointed out by KLV (*ibid.*), this is a principle to which essentially any full-blown autosegmental framework can adhere by virtue of the sort of representations that are used. This also holds for GP, with one possible exception. This exception is what is known as 'ambient elements' (see KLV 1990, endnote 16; Charette 1988: 157f.). Ambient elements are elements which manifest themselves by fusing with an element or elements present in a given lexical representation, but which have no identifiable local source. Charette (*ibid.*), for example, argues that it is impossible for a nuclear position containing only the cold vowel (see 3.3.1) to be realised in French. In order for such a position to be able to receive phonetic interpretation, the cold vowel has to fuse with the element A^+. In the majority of cases, however, there is no local source for A^+ available, so that an ambient A^+ has to be posited for French.

In spite of the fact that ambient elements, which can essentially be posited at will, are in conflict with the principle of non-arbitrariness, it seems that we have to live with them for the time being, until we gain a better understanding of what is really going on. It should, however, be noted that the arbitrariness inherent in positing ambient elements is not unique to GP. On the contrary, it can also be found in other theories. Any vowel epenthesis rule, for example, is essentially arbitrary. The point is that in other frameworks this is not seen as quite so much of a problem.

After these three 'ground rules' I will now introduce two principles of grammar, viz. the Projection Principle and the Obligatory Contour Principle.

The Projection Principle ensures that there is no change in governing relations (and thus syllable structure) from underlying representation to the final output of a derivation. According to the Projection Principle (6), the phonology cannot manipulate governing relations.

(6) *Projection Principle*
Governing relations are defined at the level of lexical representation and remain constant throughout a phonological derivation.

The fact that the Projection Principle precludes any changes in governing relations during the course of the derivation means that resyllabification is impossible. This is desirable, because it makes the framework much more constrained than any theory which countenances resyllabification, provided, of course, that the same empirical ground can be covered by both. Note that the Projection Principle allows for governing relations to be *added* in the course of the derivation, while *changing* existing governing relations is prohibited. This interpretation of (6) is required for handling analytic morphology, i.e. analytic affixation and compounding, and stress assignment. As far as analytic morphology is concerned, on the first cycle, governing relations hold within a domain only. On the second cycle, however, additional skeletal points become available, and there is evidence to suggest that new governing relations are established which involve skeletal positions formerly separated by a domain boundary. One such piece of evidence, which concerns a proper governor in an analytic suffix governing a position inside the stem, will be presented in Chapter 4. Other evidence to support this reading of (6) comes from stress assignment, which entails building governing relations at various levels of nuclear projection. It stands to reason that this can only occur once word formation has been completed.

The second principle of grammar I want to discuss here is the Obligatory Contour Principle (OCP; see e.g. McCarthy 1986 and Yip 1988 for discussion and Goldsmith 1990 (pp. 307ff.) for an overview of its history). In GP, it has a kind of dual function. On the one hand, it ensures that no identical segments appear adjacently on the melody tier and, on the other, it performs a function which differs rather from the original idea of what the OCP should do. This function, which appears to be unique to GP, is to eliminate a licensed empty nuclear position which occurs next to a filled nucleus. A typical configuration for this is where an analytic vowel-initial suffix is attached to a consonant-final stem in a language which parametrically licenses domain-final empty nuclear positions (see 4.2.1 for details). Suffice it so say here that such final empty nuclei are licensed by the language to remain without phonetic content. This configuration is illustrated in (7), where α stands for any suitable segment. On the first cycle, the two nuclei cannot see each other because of the intervening domain boundary. On the second cycle, however, the brackets have been erased and the two nuclei are adjacent. The empty onset position cannot separate them, since it dominates no skeletal point. Under the OCP, operating in the way just described, the empty nucleus is then completely eliminated.

```
(7)   a.  O1   N1    O2   N2
          |    |          |
          x    x ]        x ]
          |               |
          α               α

      b.  O1   N2
          |    |
          x    x
          |    |
          α    α
```

After this general introduction to some of the central ideas and principles of GP, let me now return to the main concern of this chapter, i.e. the question of *what* exactly happens to an obstruent when it undergoes FOD. Obviously, the answer can no longer be [+ voice] → [– voice], as it was in the SPE-derivative analyses presented in Chapter 2, since binary features are not part of GP. Before making any proposals about what I think FOD means in GP terms, I will first take a look at what exactly is available in GP, that is, what the phonological atoms are, what particular properties they exhibit and how they can be combined to form segmental representations.

3.3 Phonological elements and segmental representations in GP

3.3.1 Phonological elements in Government Phonology

All segments are either elements themselves or consist of a combination of elements[5]. Each element is fully specified, which means that elements are pronounceable at all levels of derivation, by themselves or in combination with others[6]. There is no underspecification in GP.

Elements, by definition, are either charmed (positively or negatively) or charmless. Charm values, which are part of the inalienable properties of each element, are indicated by superscript $^+$ (for positive charm), $^-$ (for negative charm) and ° (for charmlessness or neutral charm). When elements fuse with one another to form complex segments, charm values impose certain restrictions on which elements can fuse with which. Elements with like charm typically repel one another, whereas elements with opposite charm values (+ and –)

[5]See especially KLV 1985, KLV 1990, Harris 1990 and Kaye 1990a for further details.

[6]Readers familiar with KLV 1985 will find that my account of charm values and fusion differs from that put forward in the 1985 paper. This reflects developments of the GP theory which became necessary once consonants were tackled by the authors of KLV 1985 (as pointed out in Kaye 1990a). See also KLV 1990 and Harris 1990 for details of the amended version of charm theory.

attract one another. Charmless elements, however, can freely fuse with one another, as well as with charmed elements[7].

The combination of elements is carried out through fusion operations, each of which involves a pair of elements, with one being defined as the head and the other as the operator. Each element has a single salient or marked property. It is this property which is contributed by the operator in the process of fusion, while everything else (including the charm value) is normally taken from the head.

The only element which does not have a salient property is the so-called 'cold vowel' v°. The implication of this is that fusion with the cold vowel in the operator role results in no change to the head at all. The presence of the cold vowel only manifests itself when it itself is the head.

Those elements which are relevant to the present discussion of FOD, together with their charm values and their phonetic realisations, as well as their salient and unmarked properties, are listed in (8) below.

[7]Coleman (1990: 184f.) makes the point that it is impossible for charmless elements to be properly accommodated in GP. Either they are treated as ***having neutral charm*** and hence should not be expected to combine with one another or they are interpreted as lacking any charm value whatsoever, which, according to him, would violate the principle that all elements are fully specified. I find it hard to see why the absence of charm should entail underspecification, as there is no need for the charm value to be filled in at any stage. It could be seen in the same way as the absence of labiality from a non-labial segment, for example. If that seems unacceptable, one could treat neutral charm as a kind of 'weak' charm value which has no power to either attract or repel. Either way, neutral charm or charmlessness do not constitute a problem for the theory.

(8)

		Salient property	Unmarked properties
U°	[ʊ]	labial	back, high, lax ...
R°	[ɾ]	coronal	tap, ...
I°	[ɪ]	palatal	non-labial, high, lax ...
v°	[ɨ]	*none*	non-labial, back, high, lax ...
h°	[h]	narrowed	glottal, ...
ʔ°	[ʔ]	occluded	glottal, ...
N^+	[ŋ]	nasal	nonlabial, back ...
L^-	L	slack vocal folds	
H^-	H	stiff vocal folds	

The defining properties of the elements shown in (8) are couched in articulatory terms. This is a reflection of the historical development of GP. At the time of the inception of the first GP elements (see KLV 1985), phonological debate was dominated by articulatory features and communicating new ideas was easiest and most effective when carried out with reference to these features. More recently, however, it has been suggested that it would be more appropriate for the primitives of phonological theories to be defined acoustically rather than in primarily articulatory terms (see Lindsey & Harris 1990 and Harris & Lindsey 1991), a development which, to a certain extent, is also manifested in DP (see e.g. Durand 1987). This would capture the fact that perception is prior to production in language acquisition and that it is with reference to cognitive categories based on *sound* patterns that the child makes sense of what she hears.

This means that acoustic correlates of GP elements have to be identified. In other words, invariant properties of the signal have to be found which correspond to phonological elements. This ties in with the approach of Stevens & Blumstein (1981, see also Blumstein & Stevens 1979), who argue that, in spite of the massive variation due to coarticulation effects, there is enough invariance to be found in short-time spectra to enable researchers to identify at least the place of articulation of certain segment types, particularly of stops and, to a lesser extent, nasals. Obviously, this is a major research task which, at the time of writing, is still in its early stages. Some initial encouraging results are reported in Lindsey & Harris 1990. What emerges from their work is the fact that there is no single cue to a particular element, but that integrated cues exist which combine to form acoustic superpatterns. According to Lindsey & Harris (1990: 364),

> each element is a 'superpattern' (to which we may give an arbitrary label such as 'coronality') subsuming one or more 'subpatterns' (such as high or low band of noise, high or low F_2 locus), each of which in turn must be mappable onto a range of physical values. Only the superpatterns are manipulable by the phonology.

On the basis of the results reported by Lindsey & Harris it is now possible to redefine h° and ʔ° in acoustic terms. The 'noise' element h° manifests itself as aperiodic energy (noise) in the signal. This is the acoustic correlate of the turbulent airflow caused by the narrowing in the vocal tract. The GP element h° appears to match what is expressed by the categorial gesture representation |C:V| in DP. The occlusion element ʔ°, on the other hand, manifests itself as a sudden drop in amplitude, a definition which corresponds very closely to that given by Durand (1987: 81) for what, in DP, is captured by |C|. The only way of achieving this acoustic effect without adding marked resonance characteristics (associated with a specific supralaryngeal gesture) to the signal (Harris 1990: 263) is by means of a glottal stop. Hence, the occlusion element ʔ°, when forming a simplex segment, corresponds to a glottal stop [ʔ]. By the same token, the noise element h° corresponds to a voiceless glottal fricative [h] when articulated in isolation. Harris (1990) argues that it forms part of the segmental representations of obstruents, viz. fricatives, affricates and released plosives. The occlusion element $ʔ^{\circ}$ is associated with non-continuants, that is, nasal and oral stops, and laterals.

Work is currently being carried out at SOAS (University of London) to establish invariant acoustic correlates for some of the remaining elements listed in (8), but until the preliminary findings reported in Williams 1991 have been further substantiated, it seems safer to rely on articulatory definitions, such as the following.

When associated with consonants (i.e. segments which occupy non-nuclear positions), the first four elements in (8) specify the place of articulation of the relevant segment. U° is associated with labials, e.g. bilabial and labio-dental stops and fricatives, R° with coronals and I° with palatals. The cold vowel, when playing the role of the head in the fusion operation, specifies velarity in consonants.

The nasal element N^{+} refers to a lowering of the velum and is found both in nasal stops and nasalised vowels.

The two elements relating to laryngeal activity, L^{-} and H^{-}, can form part of segments occupying nuclear and non-nuclear positions. The former are traditionally interpreted as low toned (L^{-}) or high-toned (H^{-}) vowels/resonants. That is, L^{-} denotes slack vocal folds and H^{-} stiff vocal folds[8]. For non-nuclear positions, the presence of L^{-} is often treated as full voicing, while H^{-} indicates voicelessness. The absence of either L^{-} or H^{-} is to be interpreted as the absence

[8]See Halle & Stevens 1971 for a discussion of these terms.

of an active laryngeal gesture (as in a neutral segment, e.g. a lax stop in Korean[9]).

3.3.2 Segmental representations of some obstruents

Elements are arranged on autosegmental lines in such a way that each element occupies its own line (labelled according to the salient property of the element)[10]. Phonological representations consist of a two-dimensional grid where autosegmental lines and segmental positions intersect.

The five obstruents which undergo FOD in German would be represented as shown in (9). For reasons of exposition I have chosen the voiceless series. This, of course, is not meant to prejudge the issue of what FOD is. Heads are underlined. In the light of my earlier claim that an operator contributes only its salient property to an expression, while all other properties of a segment are those of the head, it will seem surprising that the segments in (9) are all negatively charmed. I will discuss this anomaly shortly.

[9]See, for example, Hirose *et al.* 1974 and Kagaya 1974 for experimental studies which show the absence of an active laryngeal gesture in lax Korean stops.

[10]Lines can be fused (parametrically variable) to prevent the elements occupying these lines from combining with one another and thus to account for the absence of certain segment types, e.g. of front rounded vowels in English (fusion of U°- and I°-lines). It is physically and logically impossible for the vocal folds to be stiff and lax at the same time, which is why the L^{-}- and H^{-}-lines must be fused universally. Contour tones may involve either a sequence of separate nuclei, each with its own laryngeal element, or a contour segment, where two laryngeal elements are attached to a single skeletal point by separate association lines. In neither case would fusion of the L^{-}- and H^{-}-lines be a problem.

(9)	x	x	x	x	x
	$\underline{U}^{\circ}$			U°	
		$\underline{R}^{\circ}$			R°
			$\underline{v}^{\circ}$		
	ʔ°	ʔ°	ʔ°		
	h°	h°	h°	$\underline{h}^{\circ}$	$\underline{h}^{\circ}$
	H^{-}	H^{-}	H^{-}	H^{-}	H^{-}
	p^{-}	t^{-}	k^{-}	f^{-}	s^{-}

Purely for greater ease of reading, I use informal notation, involving phonetic symbols with superscript charm values, as shorthand for full segmental representations. In this notation b^-, d^- etc. refer to a voiced (lenis) segment containing L^-, p^-, t^- etc. to a voiceless (fortis) segment containing H^- and p°, t° etc. to a neutral segment with no laryngeal element. So, the representations in (9) show the voiceless series (characterised by stiff vocal folds). For the voiced series (b^- d^- g^- v^- z^-), L^- would occupy the bottom line instead of H^-, while the neutral series (p° t° k° f° s°), with no active laryngeal gesture, would have empty intersections at this point.

As already mentioned, my claim that the voiced and the voiceless series both have negative charm appears to contradict my earlier assertion (see p. 127) that the charm of an expression is taken from the head. Given that all the heads in (9) are neutral, all three series (voiced, voiceless and neutral) should be charmless. However, it has been suggested (Jonathan Kaye, p.c.) that L^- and H^-, exceptionally, contribute their negative charm to an expression (i.e. a combination of elements), even when they are operators. I will discuss this suggestion in the next section.

3.3.3 Do H^- and L^- contribute their charm even when operators?

Allowing the laryngeal elements to contribute their charm even when they are operators has the effect that segments containing a laryngeal element automatically become charmed and so acquire the status of 'strong' governors, which can govern simply by virtue of being charmed, and, conversely, which cannot occupy governed positions themselves. Establishing this kind of link between the laryngeal elements and their potential for 'providing' charm on the one hand and government on the other may appear to be no more than a matter of fulfilling theory-internal formal requirements. Without independent phonetic evidence it comes dangerously close to circularity, since a charmed segment can only occupy a governing position, while, at the same time, it is the fact that a segment occupies a governing position which means that it has to be charmed. If it can be shown that charm (as produced by laryngeal elements, for example) imposes certain restrictions on what sort of segments can occur where, and that those restrictions manifest themselves in terms of genuine distributional asymmetries, then the circularity no longer exists. Coda positions, which can only be occupied by charmless segments, exhibit such asymmetries with regard to voicing. No lexical voice contrasts exist in coda positions. In some languages, such as English, for example, it is possible for the voicing property of the governing onset (i.e. the laryngeal element of that onset) to spread onto the preceding coda position (see Harris 1990: 280), but the coda itself has no lexical laryngeal element[11]. Alternative pronunciations of the noun *exit* as [ɛgzɪt] and [ɛksɪt], but not *[ɛkzɪt] or *[ɛgsɪt] illustrate this point.

[11]I understand this kind of spreading in the sense of 'identification with a governor'. The target segment does not actually *acquire* an extra element. See also the discussion of this point in 3.4.3.2.3.

Let me now return to the question of whether H^- and L^- contribute their charm even when operators. Another aspect of what I said in the preceding paragraph is that differences in charm can be exploited in order to account for certain asymmetries in governing relations involving segments of equal complexity. Consider English words such as *doctor, opt* and *act* vs. **dotcor*, **otp* and **atc*. The absence of *[tp] and *[tk] clusters in English (where the two segments are not separated by an analytic boundary) is not simply due to an accidental gap. Native speaker judgments of **dotcor*, **otp* and **atc* as impossible words of English provide conclusive evidence for this. Therefore, the absence of these clusters has to be accounted for in the phonology. What is crucial here is inter-constituent governing relations, such as the one illustrated in (10).

(10)
```
R
|\
N \      O
|  \     |
x   x <- x
    |    |
    |    R°
    v°   |
    |    |
    ʔ°   ʔ°
         |
         h°
         |
         H⁻

    k°   t⁻
```

The absence of the 'noise' element h° from k° is due to the fact that this segment is not released when occupying a coda position (see Harris 1990: 280), as it does in (10). This, however, is not an intrinsic property of all English *k*'s. On the contrary, a released fully voiceless k^- (containing H^-) can be motivated as well. This segment occupies the governing position of branching onsets, e.g. [kl], as shown in (11).

(11)

```
        O
       / \
      x   x
      |   |
      |   R°
      v°  |
      |   |
      ʔ°  ʔ°
      |
      h°
      |
      H⁻

      k⁻  l°
```

To capture the absence of *[tp] and *[tk] clusters in a number of Germanic languages (and probably even universally), it would be useful to be able to prevent [t] from occupying a governed position. Precisely this effect can be achieved by claiming that all *t*'s in such languages have H^- in their segmental make-up, the crucial point being that this H^- is one of the defining properties of voiceless coronal plosives, i.e. it always has to be present. By contrast, velar and labial plosives without this element are also grammatical.

In other words, there is no *t°, whereas k° and p° do exist. For a segment to be able to occupy a governed position, it has to be charmless. In a language where no charmless *t* exists, it is impossible for voiceless coronal plosives to occupy governed positions and, hence, to be governed. So, allowing H^- to contribute its charm to an expression even when it is an operator enables us to capture a generalisation about governing asymmetries. If the constraint which stipulates that H^- has to be present in a voiceless coronal plosive is parameterised, then it would also be possible to extend this treatment to other language families, if it turns out that different 'ungovernable' segments are found there. Of course, the question remains why it should be *t° that is non-existent in English. This question, or the non-theory-specific question why *[tp] and *[tk] clusters are ungrammatical in English, however, has, to my knowledge, remained unanswered quite generally in phonological theory.

It seems, then, that there are arguments in favour of allowing H^- to contribute its charm to an expression even when an operator. Why L^- should be expected to do the same is less clear. The only argument in favour of treating H^- and L^- alike in this respect that I am aware of is that of simplicity. A more general statement can be made by referring to laryngeal/negatively charmed elements only, rather than by specifying an individual element.

Endowing the laryngeal elements with this special property, however, is not without its problems. Take the case of any tone language, say, Vata (see Kaye 1982, 1989: 82f.), for example. Consider the partial segmental representations of the phrases shown in (12).

(12) a. (à) lā 'we carry' b. (à) là 'we carried'[12]

```
        O   N                  O   N
        |   |                  |   |
        x   x                  x   x
        |   |                  |   |
        |   A+                 |   A+
        R°                     R°  |
        |                      |   L-
        ʔ°                     ʔ°

        l°  a+                 l°  a-
```

The element A^+ represents an unrounded low vowel when realised in isolation. I have deliberately left open the question of which element is the head of the expression associated with the nucleus in (12b). Whatever the choice, the segment occupying this nuclear position will have negative charm. Under the

[12]The following IPA symbols are used: ā = Mid Tone (which is interpreted as the absence of tone here), à = Low Tone.

assumption that the laryngeal elements can contribute their charm even when operators, any other charm value is excluded. However, as already observed earlier, one of the principles of GP precludes negatively charmed segments from occupying nuclear positions (see KLV 1990: 202). In other words, the structure in (12b) is ill-formed. The same would be true of a representation involving a high tone (H^-), of course.

The only conclusion to be drawn from this is that the assumption that laryngeal elements can always contribute their charm even when non-heads is in some way incorrect. To solve the problems it causes, one could either argue that no operators can ever contribute their charm to an expression or that this is only possible where the correct charm values for the relevant skeletal positions result. In other words, the manifestation of this exceptional property of laryngeal elements can be overridden by a general principle of grammar. As I have shown above, allowing these elements to contribute their charm regardless of the role they play in the fusion operation can help express certain generalisations connected with government asymmetries. In the light of this fact, it seems preferable to maintain this option, with the proviso that it is blocked whenever a conflict with a more general principle would arise. Instead of the ill-formed structure in (12b), this blocking effect would allow us to derive the well-formed structure in (13) for *(à) là* 'we carried'.

(13)

```
O    N
|    |
x    x
|    |
|    A+
R°   T
|    L-
ʔ°

l°   a+
```

3.3.4 Segmental representations of coronal sonorants in German

On the basis of what has been said so far, a first attempt can now be made at representing the three coronal sonorants which can precede FOD consonants in FOD environments[13]. My initial suggestions are set out in (14).

(14)			
	x	x	x
	|	|	|
	R°	$\underline{R}^{\circ}$	$\underline{R}^{\circ}$
	|		|
	$\underline{ʔ}^{\circ}$		$ʔ^{\circ}$
			|
			N^{+}
	l°	r°	n°

The reason why (14) is no more than a first attempt is that, as they stand, the representations of n° and r° are not entirely uncontroversial (whereas l° does not appear to be problematic). Let me begin with r°.

As discussed in 1.2.2.1, orthographic *r* is realised as a vowel ([ɐ]) in my dialect, unless it immediately precedes a filled nuclear position. No other consonant can be vocalised in my dialect (or in the form of German *Hochlautung* described in the DUDEN pronouncing dictionary (Mangold *et al.* 1990) or in NSG). *R*-vocalisation involves, among other things, alternations between [r] and [ɐ] in all dialects. This is illustrated by the data set in (15). In (15a), *r*-final stems with no suffixes exemplify the vocalisation of *r*. The same stems,

[13]Recall that FOD can apply either after a long vowel or diphthong or after one of *l, r* or *n*. See Chapter 1 for details.

with vowel-initial suffixes, in (15b) show that the vowel [ɐ] does indeed alternate with [r][14].

(15)	a.	schwer	[ʃve:ɐ]	'heavy'
		bohr'	[bo:ɐ]	'(I) drill'
		ihr	[ʔi:ɐ]	'you' (pl., familiar form)
		hör'	[hø:ɐ]	'(I) hear'
		stur	[ʃtu:ɐ]	'stubborn'
		führ'	[fy:ɐ]	'(I) guide'
	b.	schwere	['ʃve:rə]	'heavy' (nom. pl.)
		Bohrer	['bo:rɐ]	'drill'
		ihre	['ʔi:rə]	'their'
		hörig	['hø:rɪç]	'enslaved (to someone)'
		sture	['ʃtu:rə]	'stubborn' (nom. pl.)
		Führer	['fy:rɐ]	'guide'

In the course of the discussion of Rubach's (1990) analysis of FOD it became clear that [r] seems to block the application of FOD to a preceding obstruent in some way (see 2.3.4.3.2). Now we have seen that [r] is unique among German (*Hochlautung* or NSG) consonants in alternating with a vowel. It may well be that the two facts are connected. If that is indeed the case, then the phonology should enable us to express this connection. This, however, is not a trivial matter and requires additional machinery which will not be introduced until Chapter 4. So, for the time being, I would simply like to note that [r] exhibits some special properties, which are likely to mean that the representation in (14) is incorrect or, at least, incomplete. In particular, [r] is more vowel-like than other consonants, as witness the fact that it can alternate

[14]Recall that a word-final apostrophe in the orthography indicates an apocopated final schwa. Loss of the 1st sg. ending *-e* is practically obligatory in anything other than careful or emphatic speech.

with [ɐ] under certain circumstances. I will discuss the representation of [r] in more detail in 4.5.

The representation of nasals is not entirely straightforward either. There is evidence from languages as diverse as Japanese (Shohei Yoshida, p.c.), Greek (Stamatoula Pagoni, p.c.), Kikuyu (Niger-Congo; northern, eastern and central Africa; see Clements 1985) and Zoque (Penutian; Mexico; see Goldsmith 1990: 221) which suggests that nasals can spread voicing onto adjacent obstruents, or at least onto adjacent stops. Given the representation of a nasal proposed in (14), this event remains entirely mysterious. It is unclear how this can occur. If, however, an L^- is included in the representation of the nasal, it is immediately apparent how voicing could be spread from a nasal to an oral stop[15]. It is the laryngeal element L^- that spreads.

There are two options for accounting for the absence of such spreading in languages like English and German. Either the L^- cannot spread or it is absent from the nasal in the first place. I propose the latter. Firstly, in the absence of evidence in favour of L^- in nasals (that is, in languages where no voicing spreads from nasals) the data can still be accounted for if a simpler (i.e. L^--less) representation is posited. Secondly, as we shall see later, my analysis of FOD in German is more straightforward if laryngeal elements are restricted to obstruents.

[15]This approach was first proposed by Jonathan Kaye (p.c.).

3.4 What are the changes involved in FOD?

3.4.1 What is 'voicing'?

3.4.1.1 Some general cues to the voicing contrast

Asking what the changes involved in FOD are amounts more or less to asking what FOD actually *is*. Considering its name, final obstruent *devoicing*, this may look like a completely unnecessary question to pose, but, as I shall show in this and the following subsection, it is far from obvious what exactly the term 'voice' refers to, quite irrespective of any phonological framework. As far as GP is concerned, there is obviously no binary feature [± voice], so I need to address the question of how voicing phenomena can be expressed in this framework.

Before doing so, however, I would first like to take a closer look at the physical phenomena the traditional term 'voicing' is meant to cover. My aim here is to show how complex the acoustic cues to the voicing contrast are, which, phonologically speaking (at least in the traditional terms of [+ voice] vs. [– voice]), is usually considered to be very simple. The task of identifying invariant acoustic cues to this contrast is gargantuan and, in spite of a considerable amount of work having been carried out over several decades[16], it is far from completed. It may be that it has been hampered to some extent by the overly simplistic [± voice] feature, but the distorting effects of this unsuitable label have probably been minimal, considering that the researchers have not explicitly searched for correlates of this feature, but for cues which express a meaning-differentiating contrast in a language, regardless of the label.

[16]See Watson 1983 for a comprehensive and detailed survey, on which much of the present discussion is based. Further interesting facts and observations can be gleaned from Parker 1974 and Lisker & Abramson 1964 and the references in both papers.

So, what are the cues to the voicing contrast, whatever the phonological label one may choose for it? In what follows, I will discuss a number of possible cues, not all of which are suitable for all manners of articulation of an obstruent or all positions within an utterance[17]. I will always try and make it clear which cue can be used where.

One of the first distinctions between voiced and voiceless obstruents which springs to mind is connected with vocal fold vibration. It would be conceivable to consider only those segments which exhibit glottal pulsing (i.e. vocal fold vibration) throughout their articulation (e.g. throughout the closure phase for stops) as voiced. This, however, is problematic to the extent that some phonologically voiced stops have very little or no vocal fold vibration. Initial and final *b, d, g* in English words such as *bet, debt, get, nib, hid* and *egg* are frequently articulated with no periodic energy. Furthermore, it would be impossible to explain how hearers are able to identify the voicing value of a whispered obstruent, as whisper involves no glottal pulsing whatsoever. And yet, hearers can carry out this task with perfect accuracy.

Another well-known cue is voice onset time (VOT, originally proposed in Lisker & Abramson 1964). This works best for pretonic (initial) stops, but it can also be used to some extent for intervocalic stops. What is measured is the period of time from the release of the stop to the beginning of periodic energy associated with a following vowel or sonorant. A VOT of around + 20 ms (i.e. the onset of voicing lags behind the release by 20 ms) has been considered to be indicative of a voiceless stop, while 0 or negative VOT values are most

[17]By this I mean the traditional tripartite division into utterance-initial, utterance-final and intervocalic position. However, as Watson (1983: 2) points out, this division covers only part of the environments which should be investigated (consonant clusters, word-initial but not utterance-initial position etc. are excluded), but it reflects the bias in the literature. In what follows, the terms 'initial' and 'final' refer to utterance-initial and utterance-final position respectively.

typical for voiced stops. In other words, VOT relates aspiration to the voicing contrast. VOT by itself, however, is not entirely adequate because of certain restrictions. Firstly, in initial but not immediately pre-tonic positions, VOT values are generally reduced and contrasts less clear. Secondly, final stops, whether released or unreleased, cannot be dealt with in terms of VOT, as there is no voicing following these segments. Thirdly, the concept of VOT cannot directly be extended to fricatives, since fricatives are not generally associated with aspiration. There are studies of 'VOT' in initial fricatives in existence (e.g. Massaro & Cohen 1977), but what is referred to as 'VOT' here is in fact the period from the onset of friction to the onset of voicing. In other words, the closure duration of the segment itself is included, or, perhaps, the label VOT is even synonymous with 'closure duration' in this context, which marks a clear departure from the original idea. Be that as it may, there is evidence that shorter duration of friction means that a fricative is more likely to be perceived as voiced (see Watson 1983: 13).

Not just temporal cues, such as VOT, have been investigated for initial stops. Spectral properties, such as formant transitions and loci have also attracted attention (see Watson 1983: 4f.), especially with regard to the first formant (F_1). Studies reporting links between voicing and spectral information associated with F_1 have been challenged in recent years, but conclusive results are not, as yet, available. A further spectral cue concerns the fundamental frequency (F_0) rather than F_1. Some studies suggest that a low-rising F_0 contour is perceived as a voiced stop, while others have found additional evidence indicating that it is the onset frequency of F_0 which is crucial. Moreover, it has been observed that the spectral information both from F_1 and from F_0 can interact with VOT.

Specifically for final stops, the relationship between the voicing value of the stop and the length of the preceding vowel has come under close scrutiny. This has been prompted by an apparently universal tendency for vowels preceding a voiced segment to be relatively long, while those preceding a voiceless segment tend to be relatively short (see, for example, Chen 1970; also Walsh & Parker 1981a, O'Kane 1978). In English, this tendency is particularly marked, but there are other languages, such as Spanish and Russian, for example, where it appears that the length difference is too small to be perceptible. So, although vowel length by itself is unlikely to be the sole cue for the voicing value of a segment, it does appear to have some role to play in this context.

A further approach to the problem focuses on the transition from the preceding vowel to the following stop (see Parker 1974, Walsh & Parker 1981b; cf. also O'Kane 1978). The claim being made is that the fundamental frequency of the vowel drops during the transition to a voiced segment (this is termed gradual transition), while it remains unchanged until the onset of the consonant articulation before a voiceless segment (abrupt transition). Again, this may turn out to be a factor in the recognition of the voicing value of a segment, but in itself it is not sufficient, especially as it cannot be used for initial stops, whereas there is some evidence that it does work for final fricatives (see references in Kohler 1982).

As for initial stops, certain properties of the release bursts (amplitude, duration and frequency) have been consistently linked with the voicing contrast. Voiceless obstruents tend to be associated with greater amplitude, duration and higher frequency than their voiced congeners. The problem with final stops, though, is that these are frequently not released, so any cue derived from the release will be unavailable. Moreover, this cue is unsuitable for use with fricatives, as these lack a release burst altogether.

Closure duration has been interpreted as yet another cue to the voicing contrast, one of the few cues which are largely unaffected by manner or position (provided, of course, that stops are released). Voiced segments tend to be shorter than their voiceless congeners.

What emerges from this discussion is that, as yet, it has been impossible to pinpoint a single acoustic cue or set of cues which consistently and reliably mark a voicing contrast for both stops and fricatives, irrespective of the position within the utterance where the segment in question occurs. F_0 perturbations were mentioned as one of many potential or partial cues, without much further comment. The reason for this is that I feel that F_0 deserves a somewhat more detailed investigation of its own, since it has been explicitly associated with the voicing contrast in GP (see below).

3.4.1.2 F_0 perturbations and the voicing contrast

In KLV 1990 (p. 216), the claim is made that the laryngeal elements L^- and H^- 'control (non-spontaneous) voicing properties in consonants and represent tone on vowels'.

The unifying property of these apparently disparate aspects of vowels and consonants is F_0. It is a well-attested fact that in tonogenesis it is voiced obstruents which give rise to a low tone and voiceless obstruents which can trigger the development of a high tone on the following vowel (see Hombert *et al.* 1979 and the references there). So, the odds are that voiced obstruents are F_0 depressants, that is, they involve a drop in F_0, which manifests itself as a rising contour in voiced consonant+vowel sequences. Conversely, voiceless consonants are F_0 raisers. To see the predictions made by GP analyses of English obstruents in the context of F_0 perturbations, consider the following segmental representations which have been proposed for English (see Harris

1990). I have chosen bilabial stops for the purposes of this example, but the claims made for these segments are also valid for all other English obstruents (with the exception of [t], of course; see 3.3.3 above). To keep things as simple as possible, I have reserved full segmental representations for those segments which are immediately relevant to the discussion and will continue to do so throughout this thesis. The remaining segments are in broad transcription.

(16)

```
a. bee              b. plea                 c. blue

O     N              O        N              O        N
|    / \            / \      / \            / \      / \
x   x   x          x   x    x   x          x   x    x   x
|    \ /           |   |     \ /           |   |     \ /
U°    i            U°  l      i            U°  l      u
|                  |                       |
|                  |                       |
|                  |                       |
ʔ°                 ʔ°                      ʔ°
|                  |                       |
h°                 h°                      h°
                   |                       |
                   H⁻                      L⁻

p°                 p⁻                      b⁻
```

The claim implicit in this analysis is that those consonants which have traditionally been treated as voiced can be divided into two groups, those which occupy governing positions and those which do not. The *b* in *bee* belongs to the latter category, as it has no governing responsibilities. It lacks a laryngeal element and, therefore, has no charm. The *b* in *blue*, on the other hand, occupies a governing position in a branching onset. In the unmarked case, the governing position in a branching onset is occupied by a negatively charmed segment. One way of acquiring negative charm is to acquire a laryngeal segment. One way of acquiring negative charm is to acquire a laryngeal element, L^- in the case of a voiced [b]. Hence the L^- in *blue*. Conversely, a voiceless [p] occupying the governing position in a branching onset is likely to contain H^- in its segmental representation. This is illustrated in *plea*. A fourth case (not shown in (16)) involves [p] in a non-branching onset, e.g. in the word *pea*. Here, H^- is also present, and marks the lexical distinction between p° (as in *bee*) and p^- (as in *pea*).

The prediction for F_0 perturbations made by these representations is the following. F_0 should remain relatively constant in words like *bee*, should show a rising contour in *blue* and exhibit a falling contour in words such as *plea* and *pea*. According to a study carried out by Jean-Marie Hombert, this, however, is not the case. In Hombert's experiment (see Hombert *et al.* 1979 (p. 39) for details), five adult male American English speakers' pronunciations of the sentence "Say C[i] again" were recorded, where C = [p t k b d g]. For three of the five speakers, [w] and [m] were also included. Each token was repeated ten times, and for each one F_0 was sampled at 20 ms intervals from vowel onset to 100 ms after vowel onset. The results over all five speakers and all places of articulation showed a clearly falling F_0 contour for the voiceless stops (from c.136 Hz to c. 130 Hz), while a rising F_0 was observed for the voiced stops (from 119 Hz to 127 Hz). Considering that the data used in the experiment corresponded to words such as *pea* and *bee*, no F_0 perturbation would be predicted for *bee* by the GP analysis set out above, and yet, this is where the (rising) contour was most dramatic[18]. This problem might be solved by positing L^- as part of what has so far been described as neutral p°. On the other hand, this analysis could be in conflict with the GP principle of phonetic universality (see KLV 1990: 194 and discussion in 3.2.2) to the extent that the

[18] Hombert *et al.* report similar rising contours for [m], which do not match their expectations. To the extent that F_0 perturbations depend on an oral pressure build-up, sonorants should 'perturb F_0 minimally or not at all' (p. 40). It is for this reason that the authors attribute the rising contour in both [m] and [b d g] to the 'rise-fall contour typically used on stressed syllables' (ibid.) in this case. This interpretation is not convincing, however, since it fails to explain the falling contour associated with voiceless stops. Anyway, as far as the rising contour associated with [m] is concerned, an alternative view is available in GP. If English nasals do contain L^- (contrary to my earlier suggestions), then the rising contour is precisely what is expected. However, the rising contour in [b d g] is still unaccounted for.

initial segment in the English word *bee* differs from that in the French word *bis* ([bi], 'greyish brown'). Traditionally, the former has been described as partially voiced (or even voiceless unaspirated), while the latter has been classified as fully voiced.

Another, more general, problem with treating F_0 perturbations as a cue to the voicing contrast is that prevocalic consonants appear to have a very different effect from postvocalic consonants with regard to F_0. Hombert *et al.* (1979: 49), for example, refer to studies which indicate that postvocalic consonants have similar F_0 effects on preceding vowels as do prevocalic consonants on following vowels, but with a much smaller magnitude. However, they also mention studies which report a very different result, specifically, that postvocalic consonants invariably *lower* the F_0 in the preceding vowel, regardless of whether these consonants are voiced or voiceless. Reduced magnitude of F_0 perturbations may not be a serious problem, as long as the perturbations remain perceptible. Identical effects for both voiced and voiceless consonants, on the other hand, imply that F_0 is unsuitable for indicating the voicing value of any word-final (or, at least, prepausal) consonant. That is, unless voiced postvocalic consonants consistently depress F_0 to a different degree from voiceless postvocalic consonants, F_0 contours cannot be exploited for determining the voicing value of final consonants. This conclusion is further supported by studies referred to by Löfqvist (1975: 237), which report 'no influence of a following consonant on the F_0 of a preceding vowel'.

These contradictory findings for F_0 as a voicing cue are further complicated by results reported by Parker (1974). He observes that in English words such as *pick* and *pig* F_0[19] drops before a voiced stop and remains constant before its

[19]Parker actually uses the term 'period of vocal cord vibration', but, as far as I can ascertain, this is identical with F_0.

voiceless congener. This finding matches that reported by Hombert for prevocalic plosives in English and is problematic for the GP analysis for the same reasons. After all, the GP analysis predicts a rising F_0 contour for *pick* (since the final [k] has H^-) and a relatively constant F_0 level for *pig* (recall that the [g] lacks a laryngeal element). Moreover, Parker reports the same F_0 drop before zero, i.e. prepausally, in a vowel-final word. This may indicate that the F_0 is not phonologically significant, i.e. that, as far as the phonology is concerned, no such drop occurs at all, which could go some way towards salvaging the GP analysis illustrated in (16). In that case, it raises the issue of exactly how much of an F_0 perturbation is required for it to be phonologically significant. On the other hand, Parker's findings may mean that a drop in F_0 is not a cue to the voicing contrast at all.

Yet another problem is that of the interaction between F_0 and stress. Massaro & Cohen (1977: 376) quote a 1972 study by Lea in which F_0 perturbations were examined both for stressed and unstressed syllables in English homographs, such as *permit*, where stress falls on the initial syllable for the noun and on the final syllable for the verb. It was found that the F_0 contour alone did not reliably distinguish between voiced and voiceless consonants in these words. A falling F_0 contour, for example, was associated both with voiceless *and* voiced prevocalic obstruents in an unstressed syllable. Clearly, there is substantial room for error in a study of this type. Differing manner of articulation of the consonant in question (plosive vs. nasal in *permit*, for example) may have distorted the results. Also, it is not clear from the information provided by Massaro & Cohen how Lea avoided including F_0 effects caused by the intonation in his investigation of voicing-conditioned F_0 contours. This, in fact, is the crux of the matter. Given the role F_0 plays in stress and intonation, how can it be reliably isolated as a voicing cue? This problem is tackled in Kohler 1982, where it becomes clear that very carefully controlled experimental conditions and relatively complex interpretation algorithms are necessary in order to be able to isolate segmentally conditioned F_0 perturbations from intonational macropatterns.

Finally, on the basis of an investigation of pitch as a voicing cue, Haggard *et al.* (1970) hypothesise that the falling F_0 contour associated with a prevocalic voiceless stop (which they term 'pitch skip/dip') is likely to characterise also the contrast between /f, v/ and /θ, ð/, but not /s, z/ and /ʃ, ʒ/. The fact that, according to the authors, the glottis opens partially for the latter pairs of fricatives means that cessation of glottal vibration is common and, therefore, pitch skip/dip occurs even for the voiced fricative. So, F_0 perturbations may not be a suitable voicing cue for all fricative types.

It appears that, although F_0 perturbations clearly have some role to play in expressing a voicing contrast, it is far from obvious what exactly that role is and how these perturbations are correlated with the laryngeal elements. It may turn out that it is the interaction of F_0 disturbances and VOT, for example, which is the invariant correlate of phonological elements, or perhaps the interaction of F_0 perturbations and several of the other cues mentioned in 3.4.1.1. Whatever the outcome may be, there can be little doubt that establishing the precise acoustic correlates of the laryngeal elements requires extensive research work, extensive enough to merit a PhD dissertation of its own. It is for this reason that I shall concentrate on phonological arguments and develop an analysis on the basis of these arguments alone. Given the highly constrained nature of GP, such an analysis should make strong predictions which can be tested at the phonological level, so that phonetic evidence of the kind just discussed may not be absolutely crucial.

In the light of the fact that the precise nature of 'voicing' is still so poorly understood, regardless of whether one attempts to deal with it in terms of acoustic cues or by referring to articulatory facts (such as vocal fold vibration; see the beginning of 3.4.1.1 for discussion), I will continue to use the term in its broad traditional sense. More precise terms (such as references to GP laryngeal elements) will be employed where necessary.

3.4.2 What are the options for FOD made available by GP?

There are two aspects to the question of how FOD can be interpreted in the framework of GP. Firstly, a decision has to be made about which elements are involved and, secondly, we need to know what kind of phonological process we are dealing with[20]. In what follows, I will address both these issues at a fairly superficial level. My aim is to identify the most plausible solution at that level and to subsequently put this solution to the test by pushing it to its logical conclusions and seeing whether it makes the right predictions.

I will begin with the issue of what kind of phonological process FOD may be and then turn to the question of which element(s) are involved. A certain amount of overlap will be unavoidable, as the two issues are very closely linked.

Before identifying FOD as a particular phonological process, I first need to establish what phonological processes are available in GP. Being a relatively constrained theory, it recognises only two types of phonological process, composition and decomposition. Either an element is added to a phonological representation through spreading from a neighbouring segment[21] (composition)

[20]This, of course, begs the question of whether FOD is a phonological *process* (in the sense that there is an actual *change* involved) in the first place. It does, however, seem the most obvious point of departure. I will return to this issue in Chapter 4.

[21]The notion of spreading will be further refined in 3.4.3.2.3.

or an element is delinked (decomposition, reduction). No other phonological processes are possible.

Both composition and decomposition affect the phonological strength of the segment concerned. Phonological strength is a notion which is by no means new and strength hierarchies have been set up on numerous occasions, to account for particular historical sound changes, synchronic clustering asymmetries, typical tautosyllabic segment sequences and so on[22]. I will return to other aspects of how exactly GP handles these facts later in this chapter and in the following chapters. What matters for the moment is that something approximating the traditional notion of strength is captured by means of charm and complexity. Charmed segments are stronger than charmless segments, regardless of whether this charm is positive or negative. It is for this reason that typically only charmed segments occupy head positions. The strength of charm*less* segments depends on their complexity[23]. The more elements a segment is composed of, the more complex it is deemed to be. Strength is directly proportional to complexity, so, more complex segments are stronger than less complex segments. This interpretation of strength automatically leads to decomposition processes being equated with weakening, and composition with strengthening.

To return to the special case of FOD, it is now clear that treating it as a process means that it has to involve either composition or decomposition. Let me consider the former option first. If FOD involves composition, the only

[22]See, for example, Hooper 1976 (ch. 10), Foley 1977 (ch. 3), Vennemann 1972a, Sigurd 1955 and Lass 1984 (pp. 177f.).

[23]See Harris 1990 (p. 274) for a more detailed discussion which argues for a slightly different position from the one I am adopting here. Cf. also footnote 4 for a counterargument to some of Harris' claims.

possibility is that voicelessness is added to an underlyingly voiced segment. In principle, this could be achieved by adding H^-. This would entail the lexical representation not containing a laryngeal element at all, as it would not be possible to add H^- to a representation with L^-, since the two autosegmental lines are fused universally (see footnote 10). The relevant intersection on the resulting single line would have to be empty for H^- to be able to occupy it. Delinking lexical L^- and attaching H^- in a single move, as it were, is not a realistic option either. Such a move would be in conflict with the principle of non-arbitrariness. Recall that non-arbitrariness requires 'a direct relation between a phonological process and the context in which it occurs' (KLV 1990: 194) to exist. So, if an element is delinked, the affected segment must be in an environment where weakening has to take place for some reason. It is unlikely - perhaps even impossible - for that particular environment to require strengthening (through spreading; see 3.4.3.2.3 for further discussion) of the very same segment at the same time[24]. It is for this reason that replacement is not countenanced in GP. This means that H^- would have to be added to a segment with no lexical laryngeal element. Such an event would obviously increase the complexity of the affected segment (by adding one element, H^-) and thus make FOD a strengthening process.

For this to make any sense at all, one would expect at least two conditions to be met. Firstly, there would have to be a local source for the element H^- and, secondly, the affected segment should be in an environment where it needs to be strengthened. In other words, the strengthened segment should have governing work to do, as this is what motivates strengthening processes. In fact, neither of the two conditions appears to be met. Invariably, there is no local source for the laryngeal element H^- available in FOD environments. It is also

[24]I owe this argument to Geoff Williams.

clear from the data that FOD frequently occurs in configurations where the affected obstruent is not governing at all. This, for example, is the case in words where it is preceded by a long vowel or a diphthong, as illustrated by the words *Rad* ('wheel; bicycle') and *Haus* ('house') in (17). There is no governing relation between the FOD obstruent and the preceding nuclear position. The same would, of course, be true if the FOD obstruent were preceded by a short vowel (i.e. a non-branching nucleus), but recall that, due to the historical lengthening process discussed in 1.2.2.2, voiced obstruents in German are, on the whole, only preceded by long vowels or diphthongs.

(17) a. [ra:t] b. [haʊs]

```
a.                              b.
O     N     O   N               O     N     O   N
|    / \    |   |               |    / \    |   |
x   x   x   x   x               x   x   x   x   x
|    \ /    |                   |   |   |   |
r     a     t                   h   a   ʊ   s
```

It is clear that the FOD segments ([d/t], [z/s] in (17)) do not occupy governing positions in words of this type. On the other hand, there are configurations where they do, as in words where the FOD obstruent is preceded by a sonorant in a post-nuclear rhymal position, e.g. in *halb* ('half') or *Kind* ('child').

(18) a. [halp] b. [kɪnt]

```
a.                              b.
    R                               R
    |\                              |\
O   N \     O   N               O   N \     O   N
|   |  \    |   |               |   |  \    |   |
x   x   x ←x    x               x   x   x ←x    x
|   |   |   |                   |   |   |   |
h   a   l   p                   k   ɪ   n   t
```

Here, the FOD obstruent does indeed occupy a governing position. So, perhaps one could argue that strengthening is required after all. However, I think that it is important to remember that only sonorants, i.e. relatively weak segments are permitted to fill the governed coda position. Stronger segments, such as other obstruents, can never immediately precede an alternating obstruent. Consider the words in (19), which have an obstruent rather than a sonorant in the coda. None of the obstruents governing that coda can undergo a voicing alternation[25].

(19)	korrupt	[ko'rʊpt]	'corrupt'
	Konzept	[kɔn'tsɛpt]	'draft'
	Rezept	[re'tsɛpt]	'recipe'
	Akt	[ʔakt]	'act'
	Pakt	[pakt]	'pact'
	Trakt	[trakt]	'tract'
	Effekt	[ʔe'fɛkt]	'effect'
	Haft	[haft]	'custody'
	Gift	[gɪft]	'poison'
	oft	[ʔɔft]	'often'
	Luft	[lʊft]	'air'
	Hast	[hast]	'hurry'
	Frist	[frɪst]	'period of time'
	Lust	[lʊst]	'pleasure'
	Fest	[fɛst]	'festivity'
	acht	[ʔaxt]	'eight'
	Bucht	[bʊxt]	'bay'
	Recht	[rɛçt]	'right'

In all these words (and the list could easily be extended), the governing onset position is occupied by a [t], the critical part of the configuration being that shown in (20).

[25]It could be argued that this list is incomplete and hence creates a false picture, as words where a potentially governing obstruent *does* exhibit a voicing alternation, such as, say, *Smaragd*, should have been included. Similarly, voiced obstruents potentially governing a rhymal obstruent also appear to exist, e.g. in *Gelübde*. However, as already pointed out in Chapter 1, there is a good chance that in these (very rare) words the two obstruents are not actually next to one another, but are separated by an empty nuclear position (the details of which will be discussed in Chapter 4). The final *-de* in *Gelübde* is likely to be an analytic suffix, for example. It is for this reason that they do not feature here.

(20)
```
R
|\
N \      O
|  \     |
x   x ←- x
|   |    T
V  {p}   t
   {k}
   {f}
   {s}
   {x/ç}
```

One could argue that, in order to be able to govern here, the *t* has to have negative charm. This would suggest that we are dealing with a segment with lexical H^-. The question is now whether the alternating obstruents acquire H^- in the course of the derivation to give them extra governing power. If that were indeed so, then one would have to explain how it can be that there are voiced alternants in governing positions at all, e.g. in *halbe* (['halbə], 'half', nom. pl.) or *Kinder* (['kɪndɐ], 'children'). After all, they, too, have governing work to do, yet, they are less complex and lack charm. Also, it would be unclear why H^- is added where there are no governing relations to make strengthening necessary. Thirdly, the question of where this H^- comes from would still be a problem. The only possible solution would be to posit an ambient H^-, a solution which has to remain very much a last resort, as it is essentially arbitrary and thus conflicts with the GP principle of non-arbitrariness (see KLV 1990: 194f. and discussion in 3.2.2). In short, the composition analysis is beset by serious problems, and it is worth taking a closer look at the decomposition approach.

Treating FOD as a case of decomposition would mean that a lexically present element which is responsible for making the affected segment voiced is lost through the application of FOD. In other words, one could say that voiced alternants lexically contain L^-, and that this element is delinked by FOD. This approach can overcome several of the difficulties created by the composition analysis. Since it defines FOD as a weakening process, there is no longer any need to look for strengthening environments. On the contrary, one would expect to find FOD at typical lenition sites. Furthermore, treating FOD as the loss of lexical L⁻ has the advantage that no floating element needs to be posited. At first blush, it seems that the decomposition analysis may be less problematic than the strengthening approach.

Incidentally, GP is not the only framework where a reduction analysis of FOD is available. In DP, the loss of voicing can be expressed by the loss of one occurrence of the component |V| from the representation of the categorial gesture. Voiced fricatives are characterised as |V:C;V| and voiced stops as |C;V|, while their devoiced congeners appear as |V:C| and |C| respectively (see, for example, Anderson & Durand 1987a (p. 4) or Anderson & Durand 1986 (p. 34). Mascaró (1987a) also makes a case for interpreting devoicing as reduction, specifically, reduction of feature-geometric content.

Let me now deal with the question of which elements are involved in FOD in more detail. I have already suggested that H⁻ and L⁻ may have a role to play. This comes as no surprise in the light of the fact that they 'control (non-spontaneous) voicing properties in consonants' (KLV 1990: 216), as already observed earlier. None of the other elements available in GP are serious candidates for involvement in FOD.

I will assume, then, as a working hypothesis, that FOD consists in the loss of L⁻. In the remainder of this chapter, I will explore the implications of this hypothesis in detail and see how well the predictions that can be made on the basis of it are supported.

Before moving on to this, however, let me make a general point which arises from treating FOD as the loss of L⁻. As already observed (in 3.3.1), the laryngeal elements H⁻ and L⁻ are associated with resonants only in tone languages, where they represent high tone and low tone respectively. In languages such as English and German, however, they are reserved for obstruents only, where they represent voicing. What flows from these facts in the light of the proposed analysis of FOD is that sonorant devoicing should not be attested at all. Either we are dealing with a non-tone language such as English or German, where laryngeal elements are not present in resonants, or we are looking at a tone language, where delinking of a laryngeal element would mean loss of tone, not of voicing.

This conclusion appears to be incorrect, since sonorant devoicing has been reported in the literature, at least for Angas (Clements & Halle 1983: 45), Russian (e.g. Barry 1989), Icelandic and French (both Escure 1975: 165f.). It is worth noting, however, that sonorant devoicing frequently occurs where the affected segment is adjacent to a voiceless obstruent. In other words, the process may involve spreading of the noise element h° and thus be quite different from FOD. Where there is no adjacent obstruent present, the 'devoicing' effect does not appear to be phonologically significant, as, at least in French, no phonological contrasts are affected. In other words, what has been described as 'sonorant devoicing' in the literature is distinct from FOD in that it either consists in a very different phonological process or has no place in the phonology of the language at all, since it is not linguistically significant.

Having made this general point, I will now examine some more specific predictions which my analysis of FOD makes for German.

3.4.3 Final obstruent devoicing as loss of lexical L^{-}

3.4.3.1 A typical weakening process?

Many phonologists would probably answer the question of whether FOD is a typical weakening process with a definite no. This can be concluded from various strength hierarchies (see footnote 22) and explicit statements[26] made in the past. However, as Harris (1990: 257) observes, there is no general consensus on which processes are to be interpreted as weakening and which as strengthening. The same process may be weakening for one investigator and strengthening for another. These inconsistencies are due to the fact that, when examined according to traditional methods, different aspects of phonological strength allow different, even contradictory, conclusions to be drawn. Traditional ways of looking at phonological strength provide a less than coherent picture. In the remainder of this subsection I will discuss a study of phonological weakening which illustrates this point very well.

In a 1977 paper (based on her 1975 PhD thesis) Escure presents a survey of widely accepted weakening processes in a variety of languages, e.g. spirantisation, gliding and deletion, on the basis of which she identifies several apparently typical properties of weakening processes. These properties are then expressed in terms of three hierarchies, viz. an environmental hierarchy, which ranks possible environments by their likelihood to be associated with weakening, a hierarchy of major class and manner features, which captures typical weakening trajectories and thus amounts to a strength hierarchy, and a hierarchy of cavity features, which correlates place of articulation and propensity to undergo weakening processes. The hierarchy which is particularly important here is Escure's environmental hierarchy, reproduced as (21). Environments where weakening is most common/most likely appear at the top and environments where weakening is least likely/unattested at the bottom of the hierarchy.

[26]E.g. Foley, quoted by Smith (1981: 589) and Lass (1971: 27).

(21)	(1) Final	(a)	V __ C_1^n ## or VC_1^n __ ##
		(b)	V __ C_1^n #
		(c)	V __ # C
		(d)	V __ ##
	(2) Intervocalic	(e)	V __ V
		(f)	V __ # V
		(g)	V # __ V
	(3) Initial	?	## __ V

It is clear from this hierarchy that weakening is most likely utterance-finally and least likely utterance-initially. An implicational hierarchy that can be derived from (21) makes the prediction that, among other things, there will be no weakening processes which apply intervocalically but not finally[27]. By contrast, there should be weakening processes which apply both finally and intervocalically, and one can also expect to find some which apply finally but not intervocalically. FOD (in German, at least) is such a process. It applies in all the environments listed under the heading 'final' in Escure's environmental hierarchy. The utterance-final environments in (21a) are exemplified by words such as *gibt* ([gi:pt][28], '(he/she/it) gives'; from *geben*, 'to give') and *Wald* ([valt], 'forest'), that in (21b) by utterance-internal *gibt*, that in (21c) by something like *Rad von* ([ra:t fɔn], 'wheel of') and that in (21d) by utterance-final *Rad*, for example. To sum up, as far as the environment where FOD applies is concerned, FOD behaves just like a typical weakening process.

[27]It appears that Escure's environmental hierarchy is not universally valid. If tapping in, say, New York City English is considered as weakening, then it contradicts the claims made by her hierarchy, since it applies intervocalically but not, on the whole, word-finally. This, however, does not detract from the point that all the environments in (21a) through (21d) are typical weakening environments in a vast number of languages.

[28]*Gibt*, of course, is morphologically complex, but for Escure's purposes this is not relevant.

What about FOD's place in strength hierarchies, which have usually prompted the interpretation of FOD as strengthening? Consider Escure's own strength hierarchy, reproduced in (22).

(22)

weaker	1	2	3	4	5	6	stronger
∅	glides	liquids	nasals	voiced fricatives	voiced stops	voiceless stops	
					voiceless fricatives		

This strength hierarchy is typical in that it ranks voiceless obstruents as stronger than their voiced congeners. Obviously, however, there is a conflict to be resolved here. On the one hand, Escure puts forward an environmental hierarchy which identifies FOD as a typical weakening process and, on the other hand, she claims in her hierarchy of major-class and manner features (22) that FOD must be a strengthening process. She resolves the conflict by revising her major-class and manner hierarchy for FOD only. She states that, in final position, 'it is the feature [- voice] and not [+ voice] which represents the first stage of the weakening process' (p. 61). It seems that the weight of the evidence must be on the side of the environmental hierarchy. One argument, for example, is that FOD is frequently followed by further decomposition (e.g. spirantisation, which will be discussed very briefly in 3.4.3.2.1 and, in more detail, in Ch. 6). Provided FOD is seen as weakening, the affected segment would only be moving in one direction along the strength scale, whereas the strengthening view would require an about-turn. Therefore, it is quite likely that many of the researchers who have set up strength scales which, by implication, classify FOD as strengthening would agree with Escure when pressed on the specific issue of FOD and concede that it does appear to break the general pattern by *weakening* a segment to [- voice].

If the weakening analysis available in the GP framework, however, is adopted, this conflict does not arise in the first place and no *ad hoc* modification to any hierarchy becomes necessary. In fact, of course, GP does away with the need for separate strength scales altogether. The relative strength of a segment can be read off its segmental representation without reference to a metatheoretical taxonomic statement, such as a traditional strength scale like (22). This must be a step in the right direction, as it is not at all clear how such scales could ever be successfully integrated into any phonological theory[29].

We have seen that FOD bears some of the hallmarks of a weakening process. This is a rather unexpected result for frameworks employing strength hierarchies, but it is precisely what is predicted by more recent approaches which deal with final obstruent devoicing in terms of reduction (e.g. Mascaró 1987a). Let me now explore the implications of my analysis of FOD as the loss of L^-.

3.4.3.2 What are the implications of losing L^-?

3.4.3.2.1 FOD is not a neutralisation process in the sense of Kiparsky 1976

To see exactly what the implications of this analysis for segmental structure are, it is necessary to consider the full segmental representations both of alternating and of non-alternating (i.e. exclusively voiceless) obstruents in German. The former are shown in (23), with the left-hand member of each pair representing the lexical representation of the segment in question and the right-hand member the same segment as it appears in an FOD environment.

[29]See Harris 1985 (ch. 2) for a detailed discussion of some of the fundamental problems with strength hierarchies.

(23)

x	x	x	x	x	x	x	x	x	x
$\underline{U}^\circ$	$\underline{U}^\circ$					U°	U°		
		$\underline{R}^\circ$	$\underline{R}^\circ$					R°	R°
				$\underline{v}^\circ$	$\underline{v}^\circ$				
ʔ°	ʔ°	ʔ°	ʔ°	ʔ°	ʔ°				
h°	h°	h°	h°	h°	h°	$\underline{h}^\circ$	$\underline{h}^\circ$	$\underline{h}^\circ$	$\underline{h}^\circ$
|	‡	|	‡	|	‡	|	‡	|	‡
L^-	L^-	L^-	L^-	L^-	L^-	L^-	L^-	L^-	L^-
[b]	[p]	[d]	[t]	[g]	[k]	[v]	[f]	[z]	[s]

I have already suggested in the context of (19) above that non-alternating obstruents (i.e. those which can govern other obstruents) have negative charm. This is not absolutely necessary, as, according to the Complexity Condition (24), a neutral segment can also govern, provided that it is no less complex than its governee (Harris 1990: 274).

(24) *Complexity Condition*
Let α and β be segments occupying the positions A and B respectively. Then, if A governs B, β must be no more complex than α.

In fact, all the governing relations in (19) could, in principle, have been established with a neutral *ʔ*° occupying the governing onset, as inter-constituent government appears to fully exploit this relatively weak version of the Complexity Condition[30] by tolerating equal complexity for governor and governee. However, I will argue in 3.4.3.2.2 that the governing onsets in (19) are not occupied by *ʔ*° but by *ʔ*⁻ (with lexical H⁻).

[30]KLV (1990: 218) advance a stronger version of this condition. They stipulate that the governor must be *more* complex than the governee.

Setting this point aside for the time being, it seems that for constituent government (as opposed to inter-constituent government), greater governing power is required. In a branching constituent, the governor is either charmed or *more* complex than the governee (not just *as* complex). In branching onsets, the governor is typically negatively charmed. German, like a number of other Indo-European languages, such as English, French and Italian, but unlike, say, Bantu languages, licenses branching onsets. Some examples of words beginning with straightforward branching onsets[31] are given in (25).

(25)	bl	blau	[blaʊ]	'blue'
		Blei	[blaɪ]	'lead'
	br	braun	[braʊn]	'brown'
		Brett	[brɛt]	'board'
	dr	drei	[draɪ]	'three'
		Drama	['dra:ma]	'drama'
	gl	Glas	[gla:s]	'glass'
		glauben	['glaʊbən]	'to believe'
	gr	grau	[graʊ]	'grey'
		Gras	[gra:s]	'grass'
	pl	Platz	[plats]	'space'
		Plan	[pla:n]	'plan'
	pr	Preis	[praɪs]	'price'
		prall	[pral]	'bursting'
	tr	Traum	[traʊm]	'dream'
		Treffer	['trɛfɐ]	'hit'
	kl	Klasse	['klasə]	'class'
		klug	[klu:k]	'clever'

[31]There are some word-initial consonant clusters such as [tsv] and [kv], which may, or may not, be branching onsets. Their status is controversial because of the fact that the governed position would be occupied by a fricative, something which does not appear to be possible in other languages. It may be an aspect of the special properties of [v], which, as observed in Ch. 1, appears to behave like both a fricative (for the purposes of FOD) and a glide (in, perhaps, occupying a governed position in a branching onset, if [tsv] and [kv] are treated as branching onsets). This point, however, is not relevant to the present discussion, which is why I shall not pursue it further.

kr	krass	[kras]	'crass'
	Krieg	[kri:k]	'war'
fl	Flug	[flu:k	'flight'
	flach	[flax]	'flat'
fr	frei	[fraɪ]	'free'
	Frau	[fraʊ]	'woman'

The governor in each of these branching onsets is negatively charmed, that is, the segments occupying these governing positions are b^-, d^-, g^- (with lexical L^-) and p^-, t^-, k^-, f^- (with lexical H^-) respectively. I propose to treat the latter set as in English (see 3.4.1.2), where lexical H^- is usually present in voiceless obstruents even when they occupy *non*-branching onset positions. There is no evidence to suggest that English non-alternating obstruents are different from their German counterparts in this respect. So, non-alternating obstruents which occupy onset positions (but not codas, as we shall see later) have lexical H^-. Their lexical representations would then be those shown in (26).

(26)					
	x	x	x	x	x
	$\underline{U}^{\circ}$			U°	
		$\underline{R}^{\circ}$			R°
			$\underline{v}^{\circ}$		
	ʔ°	ʔ°	ʔ°		
	h°	h°	h°	$\underline{h}^{\circ}$	$\underline{h}^{\circ}$
	H^-	H^-	H^-	H^-	H^-
	[p]	[t]	[k]	[f]	[s]

Before moving on to a detailed discussion of the implications of these particular segmental representations, I will briefly make explicit the reasons for restricting charmed segments to *onset* positions, to the exclusion of codas. As already mentioned, one of the basic principles of GP is that potential governors are restricted to head positions and potential governees to governed positions. In other words, the governing position in branching onsets or nuclei has to be occupied by either a charmed segment or a segment of sufficient complexity. Conversely, a governed position, such as a coda or the right-hand position in a branching nucleus can never be associated with a potential strong governing segment, i.e. a charmed segment[32]. It is for this reason that my proposal concerning non-alternating voiceless obstruents restricts segments with lexical H^- to onsets. This universal principle of grammar actually accounts for a number of distributional restrictions which have in the past been treated as syllable-final devoicing and distributional restrictions on voicing in German (see Chapter 2). How exactly this works will be discussed in 3.4.3.2.2. Let me now return to the implications of the segmental representations shown in (23) and (26).

The most obvious implication is that so-called devoiced obstruents are distinct from their lexically voiceless congeners at all levels of representation. Lexically, voiced segments have L^-, while their voiceless congeners have H^-. When occurring in an FOD environment, segments with lexical L^- have no laryngeal element at all. In other words, my analysis of FOD entails the claim that it is not a neutralisation process (in the sense of Kiparsky 1976), insofar as devoiced obstruents are distinguishable from their underlyingly voiceless congeners. This sharply contrasts with the majority of phonological analyses of FOD available to date, certainly of those which are SPE-derivative[33]. If my claim is correct,

[32]This statement can actually be further refined. Not only are charmed segments excluded from governed positions, but the governed position in a branching nucleus apparently does not tolerate segments which contain more than a single element (see Harris 1990: 276). The coda, on the other hand, can handle relatively complex segments, such as nasals, for the reasons discussed in 3.2.

[33]See Chapter 6 for a more detailed discussion of this point.

however, then the absence of neutralisation in the sense just defined ought to manifest itself both phonologically and phonetically.

The relevant evidence and associated issues will be discussed in detail in Chapter 6, so I will only summarise the most important points here. On the whole, it appears that my claim is borne out by the facts. Speakers of Northern Standard German (NSG for short) systematically spirantise underlyingly voiced velar plosives in FOD environments, whereas the spirantisation of non-alternating velar plosives is blocked, as illustrated in (27). This suggests that these speakers maintain a phonological distinction between the two segment types. *Hochlautung*, unlike NSG, does not exhibit general spirantisation of velars, except for words ending in *-ig* (see Chapter 1 for discussion). Spirantisation of underlyingly voiced velar stops in FOD environments, as we encounter it in NSG, is illustrated in (27a). (27b) shows that spirantisation of underlyingly voiceless velar stops is blocked in the same dialect.

(27) a. *Lexically voiced (with L⁻)*

Berg	[bɛɐç]	'mountain'
Tag	[tax]	'day'
trug	[tru:x]	'(he/she/it) carried'
Sog	[zo:x]	'suction'
lag	[la:x]	'(he/she/it) lay'
Sieg	[zi:ç]	'victory'
Weg	[ve:ç]	'way'
Zeug	[tsɔɪç]	'stuff'

b. *Lexically voiceless (with H⁻)*

Werk	[vɛɐk]	'factory'
schrak	[ʃra:k]	'(he/she/it) shrank (back)'
buk	[bu:k]	'(he/she/it) baked'
Pik	[pi:k]	'spades' (cards)

As far as the phonetic evidence is concerned, there are a number of experimental production studies addressing the very point at issue here[34]. They report statistically significant (albeit small) differences in the duration of the preceding nucleus, the duration of voicing into the closure/friction phase of the affected obstruent and the duration of that closure/friction phase between lexically voiced and lexically voiceless obstruents in FOD environments. These findings are summarised in (28).

(28) *Phonetic variables* — *Most common findings*

Phonetic variables	Lexical L^-	Lexical H^-
Duration of preceding vocalic nucleus	longer	shorter
Duration of voicing into closure/friction (from the left)	longer	shorter
Duration of closure/friction	shorter	longer

This evidence is further strengthened by perception experiments which examined native hearers' ability to distinguish between lexically voiced and lexically voiceless obstruents in FOD environments without access to context for disambiguation. The findings of these experiments are summarised in (29).

(29)

Study	*Percentage of correctly identified tokens*
Port *et al.* 1981	70%
O'Dell & Port 1983	63%
Port & O'Dell 1985	59%
Port & Crawford 1989	69%

[34]See Port & O'Dell 1985, Fourakis & Iverson 1984 (as reanalysed in Port & O'Dell 1985) and Port & Crawford 1989; similar findings were also reported for Polish in Slowiaczek & Dinnsen 1987 and Jassem & Richter 1989, for Russian in Pye 1986 and for Catalan in Dinnsen & Charles-Luce 1984 and Charles-Luce & Dinnsen 1987.

As already mentioned, a more detailed discussion of these facts and their implications follows in Chapter 6.

3.4.3.2.2 Syllable-final devoicing and voicing assimilation in German can be reduced to a universal principle of grammar

As discussed in Chapter 2, a number of distributional restrictions involving voice (or rather its absence) have been dealt with in the context of final devoicing.

Rubach (1990), for example, would attribute the voicelessness of the emboldened obstruent in *Fremdwörter* such as *Charybdis* and *Charisma* to the application of a syllable-final devoicing rule. My account, however, makes the application of any phonological process for this purpose unnecessary, as a glance at the representations of these words will confirm. Recall that, under my analysis, devoiced segments are charmless due to the lack of a laryngeal element and that, due to a universal principle of grammar in GP, only neutral segments may occupy a coda position. In other words, my account makes the prediction that devoiced obstruents and obstruents which occupy a coda position are identical.

(30) a. *Charybdis* [ça'rʏpdɪs]

```
            R
            |\
O   N   O   N \     O   N   O   N
|   |   |   |  \    |   |   |   |
x   x   x   x   x   x   x   x   x
|   |   |   |   |   |   |   |
ç   a   r   ʏ   p   d   ɪ   s
```

b. ***Charisma*** [ça'rɪsma]

```
                  R
                  |\
O    N    O    N  \       O    N
|    |    |    |   \      |    |
x    x    x    x    x     x    x
|    |    |    |    |     |    |
ç    a    r    ɪ    s     m    a
```

The crucial obstruent occupies the coda position and, therefore, has to be neutral. This requirement (to be neutral) has to be met at the point when governing relations are established, that is, at the level of lexical representation, as defined in 3.2.1. So, the segment is lexically neutral and *no* devoicing process applies to it. This means that lexically there are three obstruent types, viz. those containing L^-, those containing H^- and those which lack a laryngeal element altogether. It may look as though there were a three-way voicing contrast in the lexicon, in spite of the fact that only a two-way contrast can be motivated phonologically (see e.g. Keating 1984). The lexical three-way contrast, however, is just an illusion. Charmless obstruents occur precisely where either no contrast can ever be established at all (in the coda position, for example) or where only one of the other two options is available, e.g. in an FOD environment, where L^- is absent. Elsewhere, only segments with L^- or H^- can occur, and contrast. So, no three-way contrast in the traditional sense exists.

As already observed, treating FOD as the loss of lexical L^- (yielding a neutral obstruent) means that obstruents which are subject to FOD and neutral coda obstruents are identical. The voicelessness of [p] in *Charybdis* and [s] in *Charisma* can then be accounted for very simply, as both segments occupy a coda position. Most other examples of so-called syllable-final devoicing conform to the same pattern. The so-called syllable-final obstruent is in a coda position and, therefore, has to be neutral. Given that its phonological representation is identical to that of a devoiced final obstruent, this means that it, too, has to be interpreted as 'voiceless' by the hearer. To extend the data set illustrating distributional constraints regarding voice, the relevant list from Chapter 1 is reproduced here (in a slightly modified form which will be motivated shortly) as (31) for convenience.

(31) a. Indigenous words

Ab.laß	['ʔaplas]	'indulgence'
aus.laufen	['ʔaʊslaʊfən]	'to leak'
los.gehen	['lo:sge:ən]	'to walk off, to go off'
und	[ʔʊnt]	'and'
als	[ʔals]	'as'

b. *Fremdwörter*

Ab.domen	[ʔap'do:mən]	'abdomen'
Charyb.dis	[ça'rʏpdɪs]	'Charybdis'
Charis.ma	[ça'rɪsma]	'charisma'
Rug.by	['rakbi]	'Rugby'
Bad.minton	['bɛtmɪntən]	'badminton'
Marxis.mus	[mar'ksɪsmʊs]	'Marxism'
Wig.wam	['vɪkvam]	'wigwam'
Simbab.we	[zɪm'bapve]	'Zimbabwe'
Wod.ka	['vɔtka]	'vodka'
Us.beke	[ʔʊs'be:kə]	'Uzbek'
Ad.jektiv	['ʔatjɛkti:f]	'adjective'

The pair of particles (*und, als*) in (31a) is of no interest at this point, as FOD applies word-finally[35] anyway. What matters is the set of words with internal devoicing, i.e. all the remaining items on the list. All the *Fremdwörter* (in

[35]This will be discussed in detail in Chapter 4.

(31b)) can be analysed in exactly the same way as *Charybdis* and *Charisma*[36]. Note that not a single one of the crucial obstruents here is preceded by a long vowel or diphthong. Such nuclei would prevent the following obstruent from occupying the coda position, as the rhyme would have to accommodate three skeletal positions. As noted in 3.2.1, however, GP countenances only binary constituents, so such a rhyme would be ill-formed. This point is illustrated in (32), where the ill-formed rhyme dominating a long vowel (or heavy diphthong) followed by a consonant in (32a) is contrasted with two well-formed rhymes (in (32b)), the first representing a short vowel followed by a coda consonant and the second a long vowel or a heavy diphthong (obviously, for the heavy diphthong the two skeletal positions would be attached to one vowel each).

(32)
```
a.                b.

*   R             R             R
    |\            |\            |
    N \           N \           N
   / \ \          |  \         / \
  x   x x         x   x       x   x
   \ /  |         |   |        \ /
    V   C         V   C         V
```

The first group of indigenous words in (31a), by contrast, is less uniformly amenable to the treatment described for the *Fremdwörter*. The very first word (*Ablaß*) poses no difficulties in this respect, but *auslaufen* and *losgehen* could well be problematic, as the 'devoiced' obstruent could not occupy a coda due to the fact that it is preceded by a heavy diphthong in *auslaufen* and by a long vowel in *losgehen*. Interestingly, however, there is every indication that *aus* and *los* are analytic prefixes which occupy their own domain. In other words, we are really dealing with verbal compounds rather than merely prefixed forms.

[36]There is a problem with the noun *Adjektiv* concerning the governing power of the segment associated with the governing onset position. This will be dealt with at the end of this subsection.

What we are looking at is a form of the type [[A][B]], rather than [A[B]]. There are analytic prefixes of the latter variety in German[37], e.g. *be-*, *ge-* and *ver-*, but these often have a reduced vowel and cannot bear stress, whereas *aus* and *los*, in fact, carry the main stress in *auslaufen* and *losgehen*. As far as stress assignment is concerned, they behave precisely like the first term in more 'obvious' compounds, such as *Milchmann* (['mɪlçman], 'milkman') or *Radweg* (['ra:tve:k], 'cycle path')[38].

Furthermore, both *aus* and *los* can occur independently, *aus* as a preposition and as a subject complement (a role normally performed by an adjective), and *los* as a subject complement only. Examples of this are given in (33).

(33)	aus dem Haus	'out of the house'
	aus Langeweile	'because of boredom'
	Der Film ist aus.	'The film is over.'
	Der Hund ist los.	'The dog is loose.'
	Was ist los?	'What's the matter?' (literally: what is loose?)

The two verbs, *auslaufen* and *losgehen*, are what traditional grammars of German (e.g. Hammond 1981) call 'separable' verbs. This term captures the fact that in the infinitive they appear as a single word, but that the prefix (or rather, the first term of the compound) has to be separated out under certain circumstances, e.g. in the present tense. How this works is shown in (34).

[37]The fact that they are not taken into account when stress is assigned proves their analyticity.

[38]See Chapter 1 for further examples.

(34) *auslaufen*

Das Bier läuft aus.	'The beer is leaking out.'
Mein Paß läuft morgen aus.	'My passport expires tomorrow.'

losgehen

Ich gehe jetzt los.	'I'll start walking now.'
Das Gewehr geht gleich los.	'The gun is about to go off.'

In compounds like this, FOD does actually apply, although obviously not word-finally. The mechanism involved will be discussed in Chapter 4, so, at this point, all that needs to be said is that FOD applies *domain*-finally (which would account for *losgehen* and *auslaufen*) as well as *word*-finally.

Incidentally, although, in principle, *Ablaß* could be treated as a case of a coda being occupied by a neutral plosive, the fact of the matter seems to be that we are dealing with another compound, as witness the fact that *ab* bears primary stress in *Ablaß* and, in other respects as well, can behave in precisely the same way as *aus*. The presence of an analytic domain-boundary also explains why the formation of a branching onset [bl] is blocked in this word. The morphological structure of *Ablaß* is shown in (35), which illustrates the state of affairs on the first cycle.

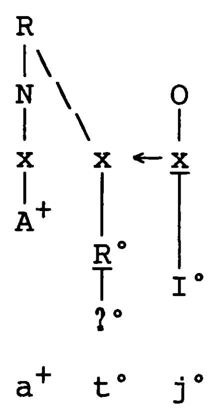
(35)

```
     O   N   O   N     O   N   O   N
     |   |   |   |     |   |   |   |
 [ [ x   x   x   x ] [ x   x   x   x ] ]
     |   |   |         |   |   |
     ʔ   a   p         l   a   s
```

The formation of a branching onset across a domain-boundary is blocked universally, as governing relations (which include the formation of constituents) are originally established within a domain. When the second domain, which contains the skeletal point for the potential branching onset, becomes accessible on a later cycle, these governing relations cannot be undone again and, therefore, it is not possible to syllabify two positions from separate domains into a single constituent[39]. This would be in conflict with the Projection Principle (see 3.2.2 for discussion).

To sum up so far, I have shown that many cases which have been treated as syllable-final devoicing in the past actually involve no devoicing at all, but can be seen as instantiations of that principle of grammar in GP which allows only governable segments to occupy governed positions. Before dealing with obstruent clusters, I would like to discuss a problem involving a very small subset of the *Fremdwörter* listed in (31), which I hinted at in footnote 36 and which is the reason for *Adjektiv* having been separated from the remainder of the list. If there is no internal analytic morphology in the noun *Adjektiv* (similarly, *Adjutant* 'adjutant', *adjustieren* 'to calibrate', etc.), then the following governing configuration would hold between the coda of the first syllable and the onset of the second syllable.

(36) *



Under the assumption that the [t] in the coda position is not released, it contains two elements, while the governing glide is simplex. In other words, the configuration in (36) is in conflict with the Complexity Condition (24) and,

[39]Quite apart from this, there is an empty nuclear position separating the two potential members of the branching onset. This would have to be deleted in some way for the formation of a branching onset to become possible. GP, however, makes no provisions for the deletion of such positions, except under the OCP, which cannot apply here (see discussion in 3.2.2).

therefore, ill-formed. If, however, it could be shown that the [t] (in the governed position in (36)) was in fact domain-final, then there would be no problem, since the following [j] would not be in a governing relation with it at all. So, is there any evidence which suggests that *Adjektiv* has internal analytic morphology? As far as I can see, there is.

The Latin preposition ***ad*** occurs as a separate preposition in several phrases which (like *Adjektiv* itself) are used in educated speech, e.g. ***ad acta, ad absurdum, ad calendas graecas, ad infinitum, ad libitum,*** etc. It can also be combined with German words, e.g. in ***ad eins*** ('re one'). So, I propose that *Adjektiv* be treated in the same way as the separable verbs discussed in the preceding paragraphs. Its morphological structure is then as shown in (37).

(37)

```
                           R
                           |\
     O    N    O    N    O  N \     O     N     O    N
     |    |    |    |    |  |  \    |    / \    |    |
 [ [x     x    x    x] [x   x   x   x   x   x   x    x] ]
     |    |    |         |  |   |   |    \ /    |
     ʔ    a    t         j  ɛ   k   t     i     f
```

Let me now turn to clusters which, while not involving any voicing alternations at all, have been analysed in terms of obstruent cluster devoicing rules (e.g. Vennemann 1968: 73) or morpheme structure conditions (e.g. Kloeke 1982a: 31), both expressing the same fact, namely that all members of tautosyllabic German obstruent clusters have to be voiceless. In the GP analysis, the general principle barring ungovernable segments from governed positions can be invoked again. Some relevant words have already been mentioned in a different context (in (19) above) but are repeated here as (38) for convenience.

(38)	Haft	[haft]	'custody'
	Gift	[gɪft]	'poison'
	oft	[ɔft]	'often'
	Luft	[lʊft]	'air'
	Hast	[hast]	'hurry'
	Frist	[frɪst]	'period of time'
	Lust	[lʊst]	'pleasure'
	Fest	[fɛst]	'festivity'

Again, one member of the cluster is in a coda position and, therefore, has to be charmless. The governor, as already mentioned, could, in principle, be charmless as well (recall that inter-constituent governing relations tolerate a zero complexity slope). Alternatively, it could contain a lexical H^-. I would argue that H^- has to be present, for the following reason. If it is possible for a neutral obstruent to govern another obstruent, then one would expect clusters involving such neutral governors to occur freely. To the extent that my analysis of FOD as loss of L^- is correct, we know that a devoiced obstruent is a neutral segment and could constitute a neutral governor. We have already seen that such a neutral governor can govern sonorants, specifically *l* and *n*[40], e.g. in *halb* ([halp], 'half') and *Kind* ([kɪnt], 'child'). With the possible exception of [kd/t] in *Smaragd* ([sma'rakt], 'emerald'), the structure of which is something of a mystery, no obstruent clusters involving an FOD undergoer are, however, attested in German. It appears that fricatives and oral stops are in some way 'too strong' for a neutral governor, so a charmed governor is required. The charmed governor contains H^-.

Unfortunately, GP provides no means of capturing the fact that obstruents demand greater governing power from their governors than sonorants do. Complexity cannot be invoked, since nasals are as complex or, perhaps, even

[40]I have excluded postvocalic *r* here, because the question of what exactly its segmental representation looks like is still open.

more complex than fricatives, such as [s] and [f]. If it turns out that it is not just in German that segments which govern obstruents have to have particular governing power, then this may be quite a serious problem. There is evidence from *t*-lenition in English (see e.g. Harris 1990: 289f.) which suggests that it is precisely where fricatives are being governed that decomposition of the governor is blocked, since this would lead to a reduction in governing power. So, it looks as if we are not dealing with an idiosyncratic property of German alone. This appears to be an interesting problem for the theory, which cannot be done justice to here.

Before moving on to a discussion of what the reduction in complexity caused by the loss of L^- means for the governing power of fricatives, I would like to deal with a potential problem for the analysis as presented so far. This problem arises from the apparent existence of voiced obstruents in coda positions, that is, apparent counterexamples to my claim that coda positions are reserved exclusively for neutral (i.e. voiceless) obstruents.

Consider the data set in (39), which consists of relatively recent borrowings, all typical *Fremdwörter* used almost exclusively in educated speech. With the possible exception of *prägnant* ('terse, pithy'), none of them require a gloss. Instead, I have given the corresponding form in the source language(s), as shown in Drosdowski *et al.* 1976-1981.

(39)	Lignin	[lɪ'gni:n]	L: lignum
	Magnesia	[ma'gne:zia]	ML: magnesia, Gr: magnēsíē
	Magnet	[ma'gne:t]	L: māgnēs, Gr: mágnēs
	Magnolie	[ma'gno:liə]	F name: Magnol
	Magnitude	[magni'tu:də]	L: māgnitudo
	Dignitar	[dɪgni'ta:ɐ]	F: dignitaire, ML: dignitārius
	prägnant	[prɛ'gnant]	F: prégnant, L: praegnāns
	Signal	[zɪ'gna:l]	F: signal, L: sīgnālis
	designieren	[dezɪ'gni:ɐn]	L: dēsīgnāre
	Diagnose	[dia'gno:zə]	F: diagnose, Gr: díagnōsis
	Prognose	[pro'gno:zə]	L: prognōsis, Gr: prógnōsis
	ignorant	[ʔɪgno'rant]	L: īgnōrāns
	Stagnation	[ʃtagna'tsio:n]	L: stāgnāre
	Fragment	[fra'gmɛnt]	L: frāgmentum
	Pragmatik	[pra'gma:tɪk]	Gr: pragmatikē
	Segment	[zɛ'gmɛnt]	L: segmentum
	Pigment	[pɪ'gmɛnt]	L: pigmentum
	Magma	['magma]	L: magma, Gr: mágma
	Dogma	['dɔgma]	L: dogma, Gr: dógma

(Abbreviations: L = Latin, ML = Middle Latin, Gr = Greek, F = French)

The problem we are faced with is how to represent the syllable structure of these words. One possible approach to the noun *Signal* is illustrated in (40).

(40)

```
        R
        |\
  O     N \     O     N     O    N
  |     |  \    |    / \    |    |
  x     x   x   x   x   x   x    x
  |     |   |   |    \ /    |
  z     ɪ   g   n     a     l
```

The trouble with the structure in (40) is that a voiced [g] occupies the coda position. According to my analysis, this should not be possible. Recall that only segments containing L^- are interpreted as voiced, and those, of course, are prevented from occupying this position by their charm (but cf. discussion of spreading from governor in 3.3.3).

The only conclusion to be drawn from this is that the [g] does not occupy a coda position but an onset. The sequence [gn] is not a branching onset (see Chapter 4 for arguments and a more detailed discussion), so there has to be a licensed empty nuclear position between the two onset positions occupied by the velar stop and the coronal nasal respectively. This licensed empty nuclear position could receive its licensing from being properly governed by the following branching nucleus (see Chapter 4 for a more detailed discussion of proper government). So, my proposal for the syllable structure of *Signal* and, *mutatis mutandis*, for the remaining words listed in (39) is contained in (41)[41].

(41)

```
        R       R   <-   R
        |       |        |
    O   N   O   N   O    N      O   N
    |   |   |   |   |   / \     |   |
    x   x   x   x   x  x   x    x   x
    |   |   |       |   \ /     |
    z   ɪ   g       n    a      l
```

I will return to these particular structures in Chapter 4, where I will show that they also need to be invoked for native words such as Vennemann's variable items (e.g. *eignen*). For now, let me take a closer look at the effects which the decomposition involved in FOD has on governing segments. Most of the subsection concerned with this will be devoted to fricatives, which, due to their relatively low degree of complexity *vis-à-vis* plosives, are more likely to be in some way impaired as far as their ability to govern is concerned than plosives.

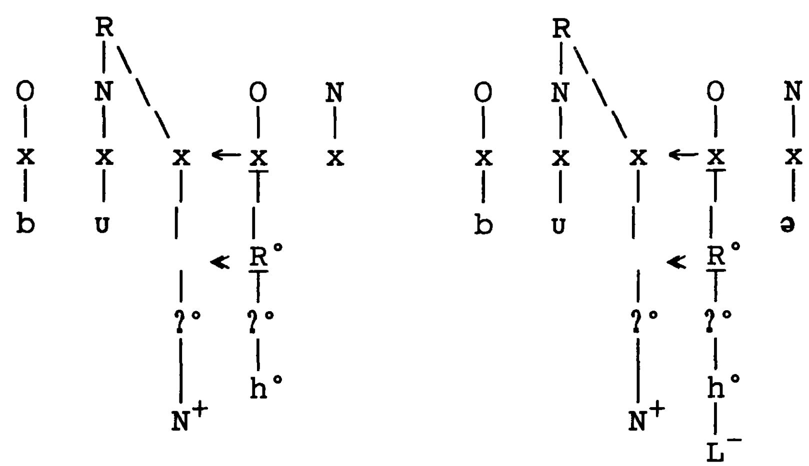
[41]The details of the representation given here (including the governing relations at the level of nuclear projection) will be further discussed in Chapter 4.

3.4.3.2.3 Devoiced fricatives can govern only homorganic nasals

To see how the strength of a segment in terms of government is affected by the loss of L⁻, it is necessary to consider configurations where a governing relation is known to hold between the FOD consonant and some other segment (strictly speaking, the skeletal positions they are attached to). It is in such configurations that charm values and segmental complexity are crucial. As we have already seen, it is impossible for an alternating obstruent to govern another obstruent. This may well be an indication of the fact that the reduction in complexity which goes with FOD reduces the governing power of such a segment.

Another obvious place to look for similar effects is in governing domains where the governee is a relatively complex sonorant, such as a nasal. Similar effects may manifest themselves there. Consider, for example, the noun *Bund* ([bʊnt], 'league'). A suffixed form involving the same stem where FOD fails to apply is shown in (42b). This is contrasted with a form where the FOD obstruent appears in word-final position, that is, where FOD is triggered, in (42a).

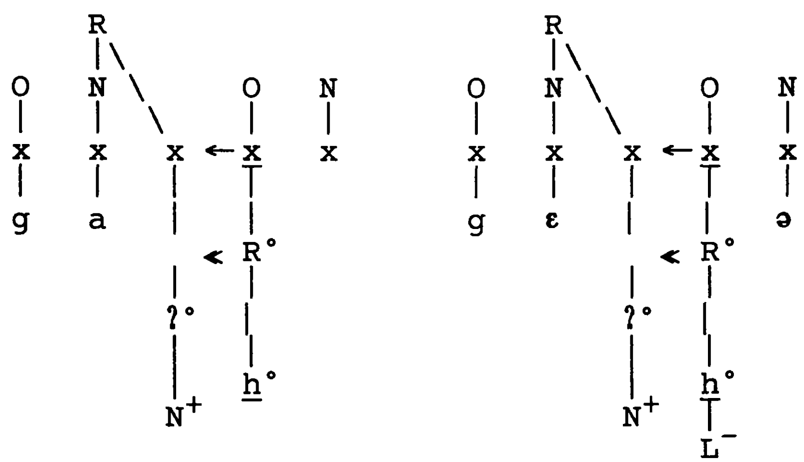
(42) a. [bʊnt] b. ['bʊndə]



In (42b) the nasal can be governed by virtue of the fact that the governing onset position is associated with a charmed segment. In (42a), on the other hand, the governing obstruent is charmless (due to the absence of L⁻), which means that it has to govern by complexity alone. Recall that, under the Complexity Condition (24), a neutral segment can govern, provided that it is no less complex than its governee. No problems appear to arise where the governing onsets are occupied by plosives, provided that these plosives are released (and hence contain h°), which appears to be the case[42].

Fricatives, however, may be problematic, since they are less complex than the corresponding stops. As argued by Harris (1990: 269), they lack the occlusion element ʔ°, which is present in stops. To see how fricatives perform under the same conditions as the stops in (42), consider the representations of *Gans* ([gans], 'goose') and *Gänse* (['gɛnzə], 'geese') shown in (43).

(43) a. [gans] b. ['gɛnzə][43]



[42]Westbury & Keating (1986: 161) even go as far as to claim that devoiced stops in German are realised with aspiration. This indicates that these stops are released, as it is physically impossible for unreleased stops to be aspirated.

[43]The details of the change in vowel quality (due to umlaut) need not concern us here. For a more comprehensive statement of the facts and an analysis in a different framework see Lodge 1989.

The governing relation between n° and s° in *Gans* (in (43a)) could be in conflict with the Complexity Condition[44]. Such a conflict would arise if the nasal were to be considered as being composed of three elements (R°, ʔ° and N^+).

Whether it should be assumed that the nasal does contain these three elements is a point worth discussing. Let me take nasal+stop clusters as an illustration, although what I have to say in this context should also hold for nasal+fricative clusters. The assumption that nasals such as the coda nasal in *Bund* or *Bunde* are composed of three elements implies that there is no difference between a homorganic nasal+stop cluster and a cluster involving a nasal followed by a stop at a different place of articulation. The special status of homorganic nasal+stop clusters, though, is well known, at least since the so-called Prince languages (e.g. Goldsmith 1989, Harris 1990: 279f.) were first brought to the attention of the phonological world. As argued by Goldsmith, Prince languages have codas which do not license a separate place feature. As a result, these languages exhibit only homorganic nasal+stop clusters and geminates, and no other heterosyllabic consonant clusters.

The idea behind Goldsmith's analysis can also be captured in GP. All that needs to be said is that the post-nuclear rhymal position is either completely empty (as in the case of geminates, where everything spreads from the governor) or that it contains only the nasal element N^+ and the occlusion element ʔ° (and the place element spreads from the governing onset). The important point is that, in Prince languages, the coda cannot actually *contain* a

[44]Incidentally, the representations in (43) appear to constitute counterexamples to Harris' (1990: 280) implicit claim that nasals occupying coda positions are specified for nasality only in the lexical representation. Only if they are followed by stops is it possible for them to acquire the occlusion element ʔ° through spreading.

place element of its own (similarly to the case of voicing assimilation as described in 3.3.3). So, the place element is not present for the purposes of the Complexity Condition. The complexity of the coda in the former case is then zero and in the latter case it is two.

In 3.4.2 I said that composition through local spreading constituted strengthening in the sense that the complexity of the affected segment is increased by adding an element. Now I appear to be contradicting this claim by arguing that spreading does not affect the complexity of a segment at all. This apparent contradiction is due to the fact that I have used the term spreading to refer to two different things. The first I would consider to be genuine spreading, that is, an element is added to a segmental representation, thus increasing its complexity. This kind of spreading has been described under the heading 'strengthening' in Harris 1990 (pp. 294f.). It appears that it applies mainly to governors, never to governed positions, and in some cases it involves the addition of an ambient element. Strengthening of a governor by means of an ambient element occurs, for example, in Pulaar (also known as Fula or Fulani; West Atlantic; West Africa), where the diminutive prefix consists solely of a skeletal point. In order to be able to govern this point, a stem-initial glide fuses with an ambient occlusion element $ʔ^{\circ}$. Whether this still counts as 'spreading' is debatable.

Be that as it may, it is the second type of 'spreading', which, perhaps, would be better referred to as 'identification with a governor'[45] which is relevant to the present discussion. It allows a governee to assume some of the properties of an adjacent governor, whereby non-contrastiveness is invariably maintained. Non-contrastiveness is what characterises heterosyllabic clusters in Prince

[45]I owe this idea to John Harris.

languages, where, say, a nasal preceding a coronal stop could never contrast with another nasal in the same position. The only nasal which can occur there is a coronal.

The following prediction can be made on the basis of the discussion so far. If, due to a possible conflict with the Complexity Condition, an FOD fricative can govern a nasal only if that nasal identifies with its governor for its place of articulation, then FOD fricatives should only occur in homorganic nasal+fricative clusters. Nasal+fricative clusters involving differing places of articulation should be reserved for one of the two following cases. Either there is an analytic boundary present, which separates the nasal from the fricative, so that no governing relation exists between the two, or the fricative has lexical H^-, which provides it with charm throughout the derivation.

To test this prediction, we need to examine non-homorganic nasal+fricative clusters, which are quite rare in German. A few, though, can be found, and these are listed in (44).

(44) a.

Wunsch	[vʊnʃ]	'wish'
Punsch	[pʊnʃ]	'punch'
Mensch	[mɛnʃ]	'human being'
Ramsch	[ramʃ]	'junk'
Hanf	[hanf]	'hemp'
fünf	[fʏnf]	'five'
Senf	[zɛnf]	'mustard'
Genf	[gɛnf]	'Geneva'
manch	[manç]	'many'
Mönch	[mœnç]	'monk'

b.

Gemse	['gɛmzə]	'chamois'
Wams	[vams]	'jacket'
Sims	[zɪms]	'(window) sill'

If the nasals and the fricatives in (44) are actually adjacent, then we would expect no alternation to take place, as the fricative must have H⁻ to be able to govern. This is what we find in (44a). None of the fricatives exhibit a voicing alternation in these words. Looking at (44b), however, we do find an alternation between [z] and [s] in suffixed forms or, in the case of *Gemse*, in the pronunciation with apocopated final schwa or the variant form *Gams* ([gams]). Given the Complexity Condition and my analysis of FOD, this can only mean that the alternating fricative is not actually governing the nasal. The two cannot be adjacent, but have to be separated in some way.

Before investigating how this separation can be achieved, I would first like to take a look at non-homorganic nasal+stop clusters. These should occur freely, since, in principle, a released stop can govern any nasal, regardless of its place of articulation. Remarkably, though, the number of such clusters is extremely limited. A search of a machine-readable dictionary with 115, 000 entries yielded only the following.

(45) a.

Amt	[ʔamt]	'office'
gesamt	[gə'zamt]	'whole'
Samt	[zamt]	'velvet'
Zimt	[tsɪmt]	'cinnamon'

b.

fremd	[frɛmt]	'strange'
Hemd	[hɛmt]	'shirt'
verleumden	[fɛɐ'lɔɪmdən]	'to slander'

All of these words can be related to earlier forms or even synchronic alternants containing a vowel between the nasal and the stop, viz. MHG *ambet*, MHG *gesament*, MHG *samit*, MHG *zimmet*, MHG *fremede*, MHG *hemede* and NHG *Leumund* ('reputation') [46]. It is conceivable that the MHG forms involved analytic vowel-initial suffixes. The vowel has since been lost, but, I would claim, the phonological manifestations of this formerly analytic structure are still in place. In other words, the nasal and the following stop are separated by an analytic boundary, even today[47]. So, the two are not in a governing relation.

This also means that there are no non-homorganic nasal+stop clusters in German where the stop is actually governing the nasal. This is surprising, given that stops should be able to govern any nasal quite easily. I would like to propose that this unexpected gap is due to the fact that a German coda cannot license N^+, ʔ° *and* a place element. As far as nasals are concerned, German behaves like a Prince language.

If that is the case, then the putative nasal+fricative clusters in (44) must have a different explanation. They can no longer be interpreted as a configuration where a nasal with its own place element occupies a coda position which is governed by a fricative at a different place of articulation. Such a new explanation suggests itself when we consider earlier or contemporary foreign forms of the words listed in (44). They either contain a vowel between the

[46]All the etymological information in this section comes from Drosdowski *et al.* 1976-1981.

[47]Similar remnants of what appears to have been an analytic structure are attested in English, viz. the verbs *hoax*, *coax* and *traipse*, where the [s] behaves like an analytic suffix, as far as the phonology is concerned (Jonathan Kaye, p.c.).

nasal and the fricative or there is evidence for an analytic structure involving a consonant-initial analytic suffix[48]. This is confirmed in (46).

(46) a.

Mensch	[mɛnʃ]	OHG *mennisco, mannisco*
Ramsch	[ramʃ]	French *ramas, ramasser*
Hanf	[hanf]	MHG *hanef*, OHG *hanaf*
Senf	[zɛnf]	MHG *senef*
Genf	[gɛnf]	French *Genève*
manch	[manç]	MHG *manec, manig*
Mönch	[mœnç]	MHG *mönnich*

b.

Gemse	['gɛmzə]	MHG *gemeʒe*
Wams	[vams]	Old French *wambais*
Sims	[zɪms]	MHG *simeʒ*

So, it appears to be the case that non-homorganic nasal+fricative clusters are rare, but this is not because the fricatives cannot govern but because of a special property of the German coda (a property which, to some extent, it shares with codas in Prince languages). The fact that non-homorganic nasal+stop clusters are at least as rare supports this interpretation. So, we can learn only very little about what the reduction in complexity associated with FOD means for the governing power of fricatives by investigating apparent nasal+fricative clusters. The absence of alternating obstruents (both stops and fricatives) after another obstruent is probably more revealing.

[48] There are a few exceptions to this generalisation it seems, viz. *Wunsch* (MHG *wunsch*, OHG *wunsc*), *fünf* (MHG *vunv, vünv*, OHG *finf, funf*) and *Punsch* (from English *punch*).

3.5 Conclusion

In this chapter I have investigated the question of what the changes are which take place when FOD applies. I have examined several hypotheses at a fairly superficial level and found that, at first blush, treating FOD as a reduction phenomenon involving the loss of lexical L^- is more promising than the other options available.

I have put this hypothesis to the test by examining its implications and verifying the predictions which can be made on the basis of it. On the whole, they have been borne out by the facts. My analysis of FOD as a reduction process, therefore, is reasonably well supported.

Having resolved the issue of *what* FOD is, I will address the hoary problem of *where* it occurs in the next chapter.

CHAPTER FOUR

WHERE DOES FINAL OBSTRUENT DEVOICING OCCUR? A GOVERNMENT PHONOLOGY APPROACH

4.1 Introduction

This chapter contains the second part of my Government Phonology analysis of FOD. It tackles the issue of where FOD occurs. As shown in Chapter 2, this problem has received considerably more attention in the literature over the past two decades than the question of what FOD is. A variety of solutions have been proposed, all of which are beset by more or less serious problems. I will argue that a successful treatment of FOD has to make reference to empty categories, specifically, to empty nuclear positions.

In what follows I will concentrate on true voicing alternations (i.e. FOD proper) only, since the question of how to handle distributional restrictions involving voicing has already been dealt with in Chapter 3. I will begin by examining the most straightforward FOD environments, from which I shall move on to a discussion of Vennemann's so-called variable items.

4.2 Straightforward FOD environments

4.2.1 Word-final and term-final in compounds

Before going into the details of where FOD occurs, let me provide a brief reminder of the sort of facts to be accounted for, by repeating part of the survey of FOD forms from Chapter 1 here, for convenience. In Chapter 1, I observed that FOD is triggered word-finally, before certain suffixes and at the end of a term within a compound. Let me begin with the simplest cases, i.e. those where FOD applies word-finally. The relevant data is contained in list (1).

(1)

Root		**√+Suffix**	**Gloss**
a. Indigenous words			
Dieb	[di:p]	['di:b+ ə]	'thief'
Rad	[ra:t]	['ra:d+ ə]	'wheel'
Tag	[ta:k]	['ta:g+ ə]	'day'
brav	[bra:f]	['bra:v+ ə]	*'good; well-behaved'*
fies	[fi:s]	['fi:z+ ə]	'nasty'
Haus	[haʊs]	['haʊz+ ə]	'house'
König	['kø:nɪç]	['kø:nɪg+ ə]	*'king'*
halb	[halp]	['halb+ ə]	'half'
Wald	[valt]	['vald+ ə]	'forest'
Balg	[balk]	['balg+ ə]	'brat'
Calw	[kalf]	['kalv+ ɐ]	*(place name)*
Hals	[hals]	['halz+ ə]	'neck'
Korb	[kɔɐp]	['kɔɐb+ə]	'basket'
Bord	[bɔɐt]	['bɔɐd+ə]	'shelf'
Berg	[bɛɐk]	['bɛɐg+ə]	'mountain'
Kurv'	[kʊɐf]	['kʊɐv+ə]	*'bend; curve'*
Vers	[fɛɐs]	['fɛɐz+ə]	'stanza'
Hemd	[hɛmt]	['hɛmd+ə]	*'shirt'*
Gems'	[gɛms]	['gɛmz+ə]	*'chamois'*
Bund	[bʊnt]	['bʊnd+ ə]	'league'
Gans	[gans]	['gɛnz+ə]	'goose'
Smaragd	[sma'rakt]	[sma'rakd+ ə]	*'emerald'*
Magd	[ma:kt]	['me:kd+ ə]	*'maid'*

b. *Fremdwörter*

Cherub	['çe:rʊp]	[çe:ru'bi:n ən]	'cherub'
Snob	[snɔp]	[sno'bɪsmʊs]	'snob'
rapid	[ra'pi:t]	[ra'pi:d ə]	'rapid'
Monolog	[mono'lo:k]	[mono'lo:g ə]	'monologue'
Verb	[vɛɐp]	['v ɛɐbən]	'verb'
Ford	[fɔɐt]	---	'Ford car'
Chirurg	[çi'rʊ ɐk]	[çi'rʊ ɐgən]	'surgeon'
kursiv	[kʊɐ'zi:f]	[kʊɐ'zi:v ə]	'italic'
konfus	[kɔn'fu:s]	[kɔn'fu:z ə]	'confused'

I will first take a look at the most common configurations, that is, the majority of the indigenous words listed in (1a). There are two predominant syllable structures involved here. They are shown in (2).

```
(2)  a. Branching rhyme          b. Branching nucleus

     R                           R
     |\                          |
     N \      O   N              N      O   N
     |  \     |   |             / \     |   |
     x   x <- x   x            x   x    x   x
     |   |    |                 \ /     |
     ɑ  {r}  {p}                 ɑ     {p}
        {l}  {t}                       {t}
        {n}  {k}                       {k}
             {f}                       {f}
             {s}                       {s}
```

As already observed in earlier chapters, in the vast majority of cases, an FOD obstruent is preceded by either a long vowel or diphthong or by one of *l*, *r* and *n*. Turning to what follows the FOD obstruent, we find greater consistency. In all cases in (1), the FOD obstruent is apparently word-final, that is, followed by a word-boundary. GP, however, makes no provision for consonants in absolute word-final position, which is why, in this framework, the existence of such segments is only apparent. As described in 3.2.1, a well-formed phonological representation consists of O R sequences, so the word-final position is actually a nucleus (as illustrated in (2)), to be precise, a parametrically licensed domain-final empty nuclear position. Although these positions have already been referred to in 3.2.1, they merit further discussion here.

Parametrically licensed domain-final empty nuclear positions, as their name suggests, are empty nuclear positions which occur at the end of an analytic domain in languages where the relevant parameter is set to YES. These positions, or rather, the parameter which controls them, have an important role to play in the typological classification of languages. This typological potential, however, can only be fully realised thanks to the fact that GP contains a principle known as the Coda Licensing Principle (see especially Kaye 1990b). To understand the function of this principle in the present context, consider the German word *Bus* ([bʊs], 'bus'). In principle, it would be possible to represent its syllable structure as shown in (3).

(3) *

```
        R
        |\
    O   N \
    |   |  \
    x   x   x
    |   |   |
    b   ʊ   s
```

The Coda Licensing Principle, quoted from Kaye 1990b (p. 311) in (4), however, rules this out.

(4) *Coda Licensing Principle*
Post-nuclear rhymal positions must be licensed by a following onset.

The coda position occupied by the *s* in (3) is not licensed, since there is no following onset. Therefore, the syllable structure in (3) is ill-formed. The well-formed alternative is shown in (5).

(5)
```
O   N   O   N
|   |   |   |
x   x   x   x
|   |   |
b   u   s
```

The Coda Licensing Principle, then, stipulates that there are no non-nuclear positions immediately preceding a domain-boundary, that is, all consonants which *appear* to be at the end of a word, are actually followed by a domain-final empty nuclear position. This is true universally. Consequently, the occurrence of word-final consonants depends on whether a language licenses domain-final empty nuclear positions. The languages of the world can be divided into two groups depending on whether they license such positions or not (further divisions are of course possible and necessary, but this is the one relevant to our discussion). The most clear-cut cases are at both ends of the spectrum. Languages exhibiting words which end in consonant clusters, such as *help* in English or *Bund* in German, license such positions. By contrast, languages which do not permit word-final consonants at all, such as Italian or Desano (Eastern Tucanoan; Colombia, Brazil), for example, do not. Languages which have only single word-final consonants (such as Korean or European Portuguese) require a more detailed analysis to decide whether the empty nuclear position is licensed by parameter setting or proper government (see (27) below).

To sum up so far, I have observed that FOD applies whenever an FOD segment immediately precedes a domain-final empty nuclear position. However, I have restricted the discussion up to this point to those words where the affected obstruent is preceded either by a long vowel or diphthong or by a coronal sonorant. It appears that this, unlike the presence of a domain-final empty nuclear position, is not a *sine qua non* for the application of FOD, though. FOD can apply equally well to forms with a preceding short vowel (e.g. *König,* *Cherub, Snob* etc.) or a preceding obstruent. Two things are, however, worth noting.

The fact that in the vast majority of cases it is a long vowel which precedes the FOD obstruent is due to what one can probably only describe as a historical accident (see 1.2.2.2 for a more detailed discussion), that is, a diachronic lengthening process which affected stressed vowels preceding voiced consonants[1]. With the exception of words ending in *-ig*, all cases of short vowels preceding an FOD obstruent are recent borrowings, which entered German after the lengthening process had run its course (e.g. *Cherub, Snob*).

The second point is that, in the rare cases where the FOD obstruent is preceded by another stop or a non-homorganic nasal, e.g. in *Magd, Jagd* or *Smaragd* and *Hemd* or *fremd* (see 1.2.2.2 for details), there is evidence for the presence of a licensed empty nuclear position preceding the FOD obstruent or, perhaps, an analytic boundary. It is, for example, likely that *Jagd* began life as an analytic form, with a suffix containing a coronal stop. The fact that this stop is not part of the verb stem *jag-* (cf. *jag-en*, ['ja:gən], 'to hunt') supports this view to some extent. Although the noun may no longer be analytic in terms of synchronic morphology, the phonological consequences of the original analytic structure may still be in place. So, from a phonological point of view, we may still be dealing with a configuration such as that set out in (6)[2]. The [k] reflects the surface pronunciation, not the underlying segment (which, of course, is

[1]Interestingly, this lengthening process did not take place in Dutch (another language with FOD), so that voicing alternations after short stressed vowels can occur. This fact further supports my view that the length of the preceding vowel is essentially independent of FOD itself. What matters is what comes *after* the FOD obstruent. I am grateful to Jan Kooij for drawing my attention to this property of Dutch.

[2]The MHG forms *jaget* or *jagat* suggest that the original form may have been [[jag]et] or [[jag]at], with a vowel-initial suffix. This vowel has since been lost, and the NHG form is that shown in (6).

voiced). Throughout this thesis, I will continue to show the predicted surface pronunciation in derivations, rather than the underlying segment(s).

(6)

```
        O     N     O   N     O   N
        |    / \    |   |     |   |
    [ [ x   x   x   x   x ]   x   x ]
        |    \ /    |         |
        j     a     k         t
```

Although it may not be possible to resolve *all* the questions posed by these structurally unusual and rare words in detail by means of the present analysis, the vast majority can be accounted for. However, they, together with the more straightforward items in (1), suggest the hypothesis in (7).

(7) FOD applies preceding a licensed domain-final empty nuclear position.

The remainder of this chapter will be devoted to refining and justifying (7). It certainly appears to hold for compounds, where each term consists of an analytic domain of its own. In other words, a two-term compound (such as those shown in (8)) has the structure [[A][B]], with FOD potentially applying before each domain-final empty nucleus.

(8) a. Nouns

Leib-wächter	['laɪpv ɛçtɐ]	'body guard'
Leib-eigener	['laɪp ʔaɪgənɐ]	'serf'
Lob-gesang	['lo:pg əzaŋ]	'song of praise'
Farb-stoff	['fa ɐpʃtɔf]	'colouring'
Schreib-tisch	['ʃraɪptɪʃ]	'desk'
Wald-brand	['valtbrant]	'forest fire'
Wald-ameise	['valt ʔa:maɪzə]	'red ant'
Rad-nabe	['ra:tna:b ə]	'hub'
Geld-beutel	['g ɛltbɔɪtəl]	'purse'
Bild-hauer	['bɪlthau ɐ]	'sculptor'
Weg-weiser	['ve:kvaɪz ɐ]	'signpost'
Aug-apfel	[' ʔaukʔapfəl]	'eye-ball'
Berg-steiger	['b ɛɐkʃtaɪgɐ]	'mountaineer'

Berg-amt	['bɛɐkʔamt]	'Mining Office'
Zweig-stelle	['tsvaɪkʃtɛlə]	'branch'
Haus-tier	['hausti:ɐ]	'pet'
Haus-arzt	['haus ʔaɐtst]	'family doctor'
Hals-band	['halsbant]	'dog collar'

b. Adjectives

lob-abhängig	['lo:p ʔaphɛŋɪç]	'dependent on praise'
farb-echt	['faɐpʔɛçt]	'colour-fast'
schlag-empfindlich	['ʃla:k ʔɛmpfɪntlɪç]	'shock-sensitive'
flug-fertig	['flu:kfɛɐtɪç]	'ready for flying'
haus-eigen	['haus ʔaɪgən]	'very own'
geld-orientiert	['gɛltʔoriənti:ɐt]	'money-oriented'
trag-fähig	['tra:kfe:ɪç]	'strong'
leid-voll	['laɪtfɔl]	'sorrowful'
schlag-artig	['ʃla:k ʔaɐtɪç]	'sudden'
sieb-förmig	['zi:pfœɐmɪç]	'sieve-shaped'
staub-frei	['ʃtaupfraɪ]	'dust-free'
wald-arm	['valt ʔaɐm]	'sparsely wooded'
halb-leer	['halple:ɐ]	'half-empty'
farb-echt	['faɐpʔɛçt]	'colour-fast'
...		

c. Verbs

blind-schreiben	['blɪntʃraɪbən]	'to write without looking'
lob-preisen	['lo:ppraɪzən]	'to praise highly'
gesund-pflegen	[gə'zuntpfle:gən]	'to nurse (someone) back to health'
übrig-bleiben	['y:brɪçblaɪbən]	'to be left over'
wund-liegen	['vuntli:gən]	'to develop a bedsore'
wund-arbeiten	['vunt ʔaɐbaɪtən]	'to work (one's fingers) to the bone'
stand-halten	['ʃtanthaltən]	'to stand firm'

4.2.2 Before certain suffixes

So far, so good. What about suffixes which trigger FOD in a stem-final obstruent? One could argue that these suffixes involve two domains, that is, a structure such as [[A]B]. Given that the relevant suffixes do not affect stress-assignment within domain A and cannot bear primary stress (that is, they are stress-neutral), that they are usually productive and do not tend to exhibit lexical selectivity, this assumption is reasonable. So, I propose to treat the suffixes in (9) as analytic. Then it is possible to extend the analysis as presented so far to these suffixed forms as well. FOD applies before a licensed domain-final empty nuclear position in all cases.

(9) a. Nominal

(i) Derivational

Suffix	**Example word**		
-ler	Häusler	['hɔɪslɐ]	'cottager'
-heit	Kindheit	['kɪnthaɪt]	'childhood'
-keit	Farbigkeit	['faɐbɪçkaɪt]	'colourfulness'
-ling	Liebling	['li:plɪŋ]	'darling'
-nis	Ergebnis	[ʔɛɐ'ge:pnɪs]	'result'
-sal	Labsal	['la:pza:l]	'refreshment'
-sel	Geschreibsel	[gə'ʃraɪpsəl]	'scribbling'
-schaft	Liebschaft	['li:pʃaft]	'love affair'
-tum	Herzogtum	['hɛɐtso:ktu:m]	'dukedom'
-chen	Hündchen	['hʏntçən]	'little dog'
-lein	Äuglein	['ʔɔɪklaɪn]	'little eye'
-de	Gelübde	[gə'lʏpdə]	'vow'
-bold	Tugendbold	['tu:gəntbɔlt]	'paragon of virtue'
-werk	Laubwerk	['laʊpvɛɐk]	'foliage'
-gut	Treibgut	['traɪpgu:t]	'flotsam'

(ii) Inflectional

Suffix	**Example word**		
-s	Urlaubs	['ʔu:ɐlaʊps]	'holiday', gen. sg.

b. Adjectival/Adverbial (derivational suffixes only)

Suffix	**Example word**		
-bar	lösbar	['lø:sbaɐ]	'soluble'
-los	farblos	['faɐplo:s]	'colourless'
-haft	glaubhaft	['glaʊphaft]	'believable'
-lich	kindlich	['kɪntlɪç]	'child-like'
-sam	kleidsam	['klaɪtza:m]	'becoming'
-kundig	schreibkundig	['ʃraɪpkʊndɪç]	'literate'
-mäßig	bildmäβig	['bɪltme:sɪç]	'by means of a picture'
-wert	preiswert	['praɪsve:ɐt]	'good value for money'
-lustig	schreiblustig	['ʃraɪplʊstɪç]	'keen to write'
-fest	schlagfest	['ʃla:kfɛst]	'shock resistant'
-wärts	abwärts	['ʔapvɛɐts]	'down'
-lings	blindlings	['blɪntlɪŋs]	'blindly'

c. Verbal (inflectional suffixes only)

Suffix	**Example word**		
-t	schreibt	['ʃraɪpt]	'(he/she/it) writes'
-st	schreibst	['ʃraɪpst]	'(you, sg.) write'
-te	liebte	['li:ptə]	'(he/she/it) loved'

Now, what exactly is it that distinguishes the analytic suffixes in (9), which trigger FOD, from the suffixes in (10), which don't?

(10) a. Nominal

(i) Derivational

Suffix	**Example word**		
-erei	Dieberei	[di:bə'raɪ]	'thieving'
-el	Hebel	['he:b əl]	'lever'
-er	Schreiber	['ʃraɪb ɐ]	'scribe'
-icht	Weidicht	['vaɪdɪçt]	'place where willows grow'
-ung	Färbung	['f ɛɐbuŋ]	'colouring'
-e	Binde	['bɪnd ə]	'band'
-in	Hündin	['hʏndɪn]	'bitch'
-ur	Glasur	[gla'zu: ɐ]	'glaze'
-ation	Delegation	[delega'tsio:n]	'delegation'
-ik	Motivik	[mo'ti:vɪk]	'motif'
-ität	Naivität	[naʔi:vi'te:t]	'naivety'

(ii) Inflectional

Suffix	**Example word**		
-es	Grabes	['gra:b əs]	'grave', gen. sg.
-en	Lieben	['li:b ən]	'loved ones'
-e	Herzoge	['h ɛɐtso:gə]	'dukes'
-er	Häuser	['h ɔɪzɐ]	'houses'
-ern	Häusern	['h ɔɪzɐn]	'houses', dat. pl.

b. Adjectival (derivational suffixes listed below, inflectional suffixes mostly identical with those of nouns)

Suffix	**Example word**		
-ig	leidig	['laɪdɪç]	'tiresome'
-isch	kindisch	['kɪndɪʃ]	'childish'
-en	seiden	['zaɪd ən]	'silken'
-ern	gläsern	['gle:z ɐn]	'(made of) glass'
-iv	impulsiv	[ʔɪmpʊl'zi:f]	'impulsive'
-ös	nervös	[nɛɐ'vø:s]	'nervous'

c. Verbal (inflectional suffixes only)

Suffix	**Example word**		
-en	schreiben	['ʃraɪb ən]	'to write'
-e	schreibe	['ʃraɪb ə]	'(I) write'
-ieren	rasieren	[ra'zi: ɐn]	'to shave'

It is obvious that the suffixes in (10) are all vowel-initial, whereas all of those in (9) are consonant-initial. Before dealing with this point, let me first see how the hypothesis that FOD applies before a licensed domain-final empty nuclear position stands up to the words in (10). Consider the representation of the verb *schreiben* ('to write') shown in (11). The infinitive suffix *-en* is stress-neutral, exhibits no lexical selectivity and is even used productively, so there can be little doubt that it is analytic - hence the bracketing in (11).

(11)

```
        O         N       O   N   O   N   O   N
       / \       / \      |   |       |   |   |
  [ [ x   x    x   x    x   x ]     x   x   x ]
      |   |    |   |    |           |   |
      ʃ   r    a   ɪ    p           ə   n
```

The FOD obstruent immediately precedes a domain-final empty nuclear position in (11). So, on the first cycle, when only the domain containing the stem is available, FOD will apply. On the second cycle, however, the final empty nucleus which triggered FOD on the first cycle is deleted under the OCP (see 3.2.2). Recall that the empty onset has no effect on the application of the OCP, as it dominates no skeletal position. So, the configuration on the second cycle is as shown in (12).

(12)
```
        O         N       O    N    O    N
       / \       / \      |    |    |    |
    [ x   x     x   x     x    x    x    x ]
      |   |     |   |     |    |    |
      ʃ   r     a   ɪ    b/p   ə    n
```

The nuclear position following the FOD obstruent is now filled, so, at this stage, FOD should not apply, which is precisely what the actual pronunciation ['ʃraɪb ən] suggests. However, FOD has already applied, on the first cycle. The laryngeal element L^- has already been delinked. Reattaching it again on the next cycle would, in my view, amount to a Duke of York gambit. As already mentioned in 2.3.4.3.2, I consider an analysis which can do without this strategy as preferable to one which needs to employ Duke of York derivations. So, if the Duke of York gambit which involves reattaching the delinked L^- is to be rejected, then two options are open to us. Either the analysis of FOD presented in Chapter 3 has to be changed in some way or the suffix *-en* is to be interpreted as non-analytic. A non-analytic suffix *-en* would yield the following structure. The formative boundary + is invisible to the phonology, that is, it is treated as if it did not exist.

(13)
```
        O         N       O    N    O    N
       / \       / \      |    |    |    |
    [ x   x     x   x     x  + x    x    x ]
      |   |     |   |     |    |    |
      ʃ   r     a   ɪ     b    ə    n
```

FOD would be blocked because the FOD obstruent is followed by a filled, as opposed to a licensed empty, nuclear position, so that the correct output is generated. The trouble is that not just *-en* would have to be treated as non-analytic, but all the other vowel-initial suffixes in (10) as well. Under this analysis, the bottom line would be that we have to interpret all consonant-initial suffixes as analytic and all vowel-initial suffixes as non-analytic. In other words, we have to assume that we are dealing with a grammar where morphological structure depends on the phonology, that is, where phonological facts determine morphological structure. In GP, however, the morphology-phonology interface is assumed to be the exact opposite of this. The morphology feeds the phonology, where only analytic morphology is visible to the phonology. There is no way in which the phonology can condition the morphology. In other words, it is impossible for this kind of phonologically conditioned analytic morphological structure to arise.

Moreover, there are strong arguments *against* many of the vowel-initial suffixes being interpreted as non-analytic, since these are stress-neutral, exhibit no lexical selectivity and are used productively, like *-en*. These facts contradict the assumption that vowel-initial suffixes can *all* be treated as non-analytic. This view is further supported by the fact that some suffixes such as *-ist* and *-erei*, are not stress-neutral (see Giegerich 1985, 1987 and Hall 1989a for further discussion). Their behaviour suggests that there are two different types of vowel-initial suffixes, those which are analytic and those which are not, with the stress-neutral ones belonging to the former group.

These arguments appear to force the conclusion that it is the analysis of FOD proposed in Chapter 3 which is incorrect. I argued that L^- is involved in some kind of *reduction* event, and this claim appears to be well enough supported. What is completely unsupported, however, is the assumption that FOD is necessarily a *process*, in the sense that it involves a change in the segmental representation. An alternative to treating FOD as a process is considering it as a matter of phonological interpretation, specifically of autosegmental licensing (see Goldsmith 1989, 1990: 123ff.).

4.3 FOD as an instance of autosegmental licensing

Consider the possibility that L^- is an element which, perhaps like the coda position (see 3.2.1 for discussion), has to be licensed in more than one way. Being part of an expression may not be sufficient for licensing L^-. What is also required is a nucleus which has enough licensing power to enable the onset which contains L^- to license this L^- in its turn. There would be a certain degree of similarity between this kind of autosegmental licensing (i.e. licensing of segmental content) and government-licensing (see Charette 1988: 195ff., 1990), where a nucleus is required to license its onset to govern a preceding rhymal position. Given that government is a form of licensing, the onset is involved in some kind of licensing in both cases, licensing a skeletal position in one and licensing an element in the other.

There is evidence from several languages, including English (see Harris 1990), Greek (Stamatoula Pagoni, p.c.), and (Middle) Korean (see Heo 1990), which suggests that domain-final empty nuclear positions have only limited licensing power. This limited licensing power manifests itself in the fact that the segmental content they can license a preceding onset position to have is restricted. The fact that onsets which precede these nuclear positions are often subject to reduction processes (e.g. in English, Korean) is a result of this. By the same token, a blocking effect on spreading from a neighbouring segment into such an onset (in Greek) is a manifestation of the limited licensing power of licensed empty nuclei. So, phenomena which can be interpreted as manifestations of the limited licensing power of licensed empty nuclei on the melody tier have been described. Before these, however, came to the attention of GP phonologists, a different effect due to the limited licensing power of licensed empty nuclei had been pointed out by Charette (1988: 195ff.), who observed that the governing ability of an onset was also affected by the status of the following nucleus. Licensed empty nuclei in several cases could not government-license. Given this evidence, it comes as no surprise that it is these very positions which should be unable to provide the necessary licensing authority for L^{-}[3].

The parallels between the behaviour of government-licensing and of autosegmental licensing of L^{-} extend further than the mere fact that the relevant onset position is involved in some kind of licensing in both cases. As argued by Charette (1988: 259ff.), languages which parametrically license domain-final empty nuclear positions do not necessarily endow these positions with government-licensing power. In languages such as Pulaar (West Atlantic; West Africa) or Wolof (West Atlantic; Gambia, Senegal), for example, parametrically licensed final empty nuclei are not government-licensers, whereas in languages such as French and English they are. Similar language-specific settings concerning the *autosegmental* licensing power of licensed empty nuclear positions are apparently also needed. They may, or may not, be independent of a licensed empty nuclear position's ability to government-license its onset. Whether the two are interdependent is a matter for future research.

As far as autosegmental licensing is concerned, for any language with parametrically licensed final empty nuclei, two options are available. Firstly, this position may have unrestricted autosegmental licensing power. This appears

[3]A similar idea, i.e. that governed nuclei should me more limited in their ability to license segmental material in a preceding onset than governing nuclei, is expressed in Harris 1990 (p. 284).

to be a relatively rare case, which possibly applies in French, where there do not appear to be any domain-final reduction phenomena[4]. Secondly, a language may exhibit licensing restrictions concerning final empty nuclei. If this is the case, then it becomes necessary to investigate which elements cannot be licensed. In Korean, it is conceivable that neither of the laryngeal elements can be licensed (see Heo 1990 for some relevant facts from Middle Korean). In German, on the other hand, of the laryngeal elements it is only L^- which is subject to this kind of restriction, a property which it may share with the coronal element $R°$ (see below).

If FOD is indeed a matter of autosegmental licensing, it can be treated as purely interpretive, since 'autosegmental licensing is distinct from association' (Goldsmith 1989: 149). L^- remains present in the representation, although its presence does not manifest itself, neither phonetically nor in terms of segmental complexity or charm. Interpretive phenomena do not involve an actual change to a representation (which would have to be undone again in a Duke of York derivation), so analytic vowel-initial suffixes are no longer a problem. Also, all the arguments put forward in Chapter 3 still hold. In most respects this licensing analysis is like the delinking account, except for the fact that it is purely interpretive, which means that no Duke of York moves are required.

My proposal in a sense adds to the phonological events which are countenanced in GP. Reduction effects can now be accounted for both in terms of autosegmental licensing and delinking. This raises the question of whether both of them are actually needed. As far as I can see, what has been treated as delinking in the past (e.g. *t*-lenition in English; see Harris 1990, Harris & Kaye

[4]Liaison, a possible counterexample to the claim that French has no domain-final reduction phenomena, can be dealt with by reference to floating segments (see, for example, Prunet 1986, Charette 1988 and Durand 1986a), so that no reduction need be involved.

1990) can be reanalysed in terms of autosegmental licensing as proposed here. Whether there is evidence in favour of having a separate reduction process involving actual delinking is an issue which cannot be resolved on the basis of a study of German. This is a point which I will have to leave open for future research.

What I would like to propose here is that, in German, L^- is not the only element which requires this kind of special licensing. As I will show in 4.5, *r*-vocalisation appears to happen in a way which is very similar to FOD, except that a different element is involved, probably the element R° (see 4.5). It looks as if R°, like L^-, needs to be doubly licensed in order to be able to manifest itself.

So, let me illustrate what happens to an FOD obstruent in a word with a vowel-initial analytic suffix, using the same example as before, but with a full segmental representation of the FOD obstruent. An element which is present, but not licensed, is shown in brackets.

(14) a.

```
          O         N         O    N    O    N    O    N
         / \       / \        |    |         |    |    |
   [ [ x     x   x     x      x    x ]       x    x    x ]
       |     |   |     |      |              |    |
       ʃ     r   a     ɪ      U°             ə    n
                              |
                              ʔ°
                              |
                              h°
                              |
                             (L⁻)
```

```
b.
     O        N       O   N   O   N
    / \      / \      |   |   |   |
  [ x   x   x   x     x   x   x   x ]
    |   |   |   |     |   |   |
    ʃ   r   a   ɪ     U°  ə   n
                      |
                      ʔ°
                      |
                      h°
                      |
                      L⁻
```

In (14), on the first cycle, the FOD obstruent is followed by a licensed empty nucleus. As just proposed, such a position has only limited licensing power. Here, the limited licensing power manifests itself in the fact that L^- cannot be licensed in the preceding onset. So, if what is contained in the inner set of brackets in (14a) were to be pronounced, we would hear [ʃraɪp]. However, the derivation continues and the final empty nuclear position is deleted under the OCP once the inner brackets have been erased. On the second cycle, in (14b), the FOD segment is now adjacent to a filled nuclear position. This position has full licensing power, which means that the L^- in the preceding onset can be licensed. The output of the derivation, therefore, contains a voiced [b] in ['ʃraɪb ən].

Before moving on to a discussion of Vennemann's variable items, I would first like to say a few words about those second terms in compounds which are vowel-initial in the orthography, but which still permit FOD to apply to a preceding obstruent. Consider the adjectival compound *farbecht* from (8). Its representation is shown in (15).

(15)
```
          R                        R
          |\                       |\
      O   N \    O   N      O   N \    O   N
      |   |  \   |   |      |   |  \   |   |
  [ [ x   x   x  x   x ] [  x   x   x  x   x ] ]
      |   |   |  |          |   |   |  |
      f   a   ɐ  p          ʔ   ɛ   ç  t
```

On the first cycle, the element L^- in the final bilabial stop of *farb-* cannot be licensed. Unlike in the derivation of *schreiben* in (14), later cycles do not provide a licenser for this element either. This is because the second domain is not actually vowel-initial phonologically, as the left-most onset position is not empty. It is occupied by a glottal stop. So, the OCP effect which eliminated the licensed final empty nucleus in *schreib-* is blocked. The empty nucleus remains adjacent to the labial stop in *farb-* and, consequently, L^- remains unlicensed at all levels of derivation. This, of course, does not just hold for compounds, but also for word-final FOD, in those cases where the relevant word is not utterance-final.

In fact, there appears to be a general constraint in German which prevents empty onsets from forming the left-most position in an independent domain. The onset has to be filled by a suitable consonant or, in the absence of such a segment, by glottal stop. As we shall see later, this constraint only holds if the onset is followed by a filled nucleus. In other words, the configurations in (16) are both ill-formed (α stands for any suitable segment).

(16)
```
a.                    b.
*  O   N              *  O   N
       |                 |   |
   [   x  ...          [ x   x  ...
       |                     |
       α                     α
```

German is not alone in failing to tolerate these configurations. Genetically unrelated languages such Wolof[5], for example, also exhibit this property[6]. English and French, however, do not. Charette (1988: 182ff.) provides ample evidence in favour of both configurations in (16) occurring in French. The abundance of domain-initial glottal stops carried over into English by many German speakers is perceived as foreign by native speakers of English. This suggests that domain-initial positions can indeed be empty in English. It seems likely that the German pattern is in some way connected with licensing, although further work would be necessary to establish the exact nature of this phenomenon. It would also be interesting to find out why this constraint should only apply at the left edge of an independent domain and, therefore, have no effect on analytic suffixes (such as B in [[A]B]). As it is not immediately relevant to the discussion of FOD, I will put this question to one side.

There is, however, one interesting point arising from the mere observation that domain-initial onsets which are followed by a filled nucleus must have segmental content in German, where glottal stop constitutes the 'default' segment if no other suitable non-nuclear segment is available. In the taxonomic-phonemic as well as in the SPE-based generative literature, the question of whether glottal stop should be treated as an underlying phoneme has received a certain amount of attention. The general consensus appears to be that glottal stop is not a phoneme of German (e.g. Fox 1990: 43f., Krech 1968: 13) and that its occurrence is predictable and should, therefore, be captured by an insertion rule (Kloeke 1982a: 46, Wurzel 1970: 261). The spirit of this view can be maintained in the GP framework, provided, though, that one is willing to

[5]See, for example, Dialo 1981: 40ff. and Dialo 1983: 20ff.

[6]Goldsmith (1990: 83ff.) discusses default glottal stop insertion in Sierra Miwok (Penutian; California), which, however, occurs stem-*finally*.

live with ambient glottal stops[7]. Then the derivation of the adjective *echt* would look something like (17), where the three stages are not meant to represent separate cycles (see also Kaye 1988 for a similar treatment of nasalisation in French).

(17) a.

```
          R
          |\
     O    N \      O    N
          |  \     |    |
[         x   x    x    x ]
          |   |    |
     ʔ    ɛ   ç    t
```

b.

```
          R
          |\
     O    N \      O    N
     |    |  \     |    |
[    |    x   x    x    x ]
     |    |   |    |
     ʔ    ɛ   ç    t
```

c.

```
          R
          |\
     O    N \      O    N
     |    |  \     |    |
[    x    x   x    x    x ]
     |    |   |    |
     ʔ    ɛ   ç    t
```

So, a domain-initial onset followed by a filled nucleus will always end up taking one of the two forms shown in (18), where C stands for any consonant[8].

[7]Recall that ambient elements are essentially in conflict with the GP principle of non-arbitrariness (see 3.2.2 for discussion).

[8]The theory of GP appears to be unable to define the sort of segments which can fill a domain-initial onset position. It is, for instance, not possible to describe them as all those which cannot constitute nuclear peaks, since I° (and only I°) is in fact able to do both.

(18)

```
a.     O   N          b.     O   N
       |   |                 |   |
     [ x   x  ...          [ x   x  ...
       |   |                 |   |
       ʔ   ɑ                 C   ɑ
```

To sum up, it appears that the hypothesis that L⁻ can only be licensed by a following filled nucleus accounts for FOD under a variety of circumstances. It correctly predicts the presence of word-final FOD, before consonant-initial suffixes and in compounds. Let me now turn to a more challenging data set, Vennemann's variable items.

4.4 FOD in Vennemann's variable items

4.4.1 Introduction

The data set which Vennemann (1968: 140) calls 'controversial items' and which I have referred to as 'variable items' was first introduced in 2.3.1.1. It is reproduced (in a modified and expanded version) here as (19), for convenience. These particular items are variable inasmuch as speakers who otherwise use FOD in identical ways systematically differ in the way they apply FOD to them. Those speakers who do devoice obstruents here are speakers of Northern Standard German (NSG; Vennemann's B-speakers), while those who fail to devoice are usually speakers of *Hochlautung* (Vennemann's A-speakers).

(19)

	Hochlautung	*NSG*	
Rodler	['ro:dlɐ]	['ro:tlɐ]	'tobogganist'
edler	['ʔe:dlɐ]	['ʔe:tlɐ]	'nobler'
Siedler	['zi:dlɐ]	['zi:tlɐ]	'settler'
Adler	['ʔa:dlɐ]	['ʔa:tlɐ]	'eagle'
handle	['handlə]	['hantlə]	'(I) act'
Handlung	['handluŋ]	['hantluŋ]	'action'
Pendler	['pɛndlɐ]	['pɛntlɐ]	'commuter'

eignen	['ʔaɪgnən]	['ʔaɪçnən]	'to suit'
regnet	['re:gn ət]	['re:çn ət]	'(it) rains'
Lügner	['ly:gn ɐ]	['ly:çn ɐ]	'liar'
Segnung	['ze:gnu ŋ]	['ze:çnu ŋ]	'blessing'
ebnen	['ʔe:bnən]	['ʔe:pnən]	'to level'
Ebnung	['ʔe:bnuŋ]	['ʔe:pnuŋ]	'levelling'
ordnen	['ʔɔɐdnən]	['ʔɔɐtnən]	'to arrange'
Ordnung	['ʔɔɐdnuŋ]	['ʔɔɐtnuŋ]	'order'
duslig	['du:zlɪç]	['du:slɪç]	'dizzy'

At first sight, it is not at all clear why these particular words should be treated differently by speakers of *Hochlautung* and by speakers of NSG. The only thing which is immediately apparent is the fact that virtually all of them are morphologically complex. With the exception of *Adler*, which is derived from MHG *adelar* (or *Edelaar*, where *Aar* means 'eagle'; see Drosdowski *et al.* 1976), they each end in one of the suffixes *-er* (nominal agentive, as in *Rodler* or *Lügner*, or comparative as in *nobler*), *-en* (infinitive, as in *eignen*), *-e* (1st sg., as in *handle*), *-t* (3rd sg., as in *regnet*), *-ig* (adjectival, as in *duslig*) or *-ung* (nominal, as in *Handlung*). However, the obstruent which undergoes FOD for NSG speakers is not actually adjacent to the domain boundary. Obviously, more detailed analysis is necessary. Consider the noun *Rodler* ('tobogganist'), for example. Its syllable structure (on the first and second cycles) is set out in (20). For the time being, I will simply represent what appears as [ɐ] in my transcriptions of the pronunciation of orthographic *-er* as /ər/ in phonological representations. Some ideas on how this alternation can be accounted for will be put forward in 4.5.

(20) a.

```
    O     N     O   N   O   N   O   N   O   N
    |    / \    |   |   |   |       |   |   |
[ [ x   x   x   x   x   x   x ]     x   x   x ]
    |    \ /    |       |           |   |
    r     o    d/t      l           ə   r
```

b.

```
    O     N     O   N   O   N   O   N
    |    / \    |   |   |   |   |   |
[   x   x   x   x   x   x   x   x   x ]
    |    \ /    |       |   |   |
    r     o    d/t      l   ə   r
```

The licensed final empty nucleus at the end of the stem in (20a) is, again, eliminated under the OCP. The output of the second cycle (before bracketing erasure) is shown in (20b). On both cycles, the representation contains an empty nuclear position which separates the FOD obstruent and the following lateral. Its presence may appear suspiciously convenient, considering that I am arguing that FOD is a direct result of the presence of a licensed empty nucleus (see 4.4.2.2 for details of licensed domain-*internal* empty nuclear positions). However, GP requires this empty nuclear position to be there, for reasons which are completely independent of FOD and which will become clear when we consider two alternative representations ((21) and (22)), as well as the careful pronunciation of the noun *Rodel* ('toboggan').

4.4.2 FOD preceding domain-internal licensed empty nuclei

4.4.2.1 Impossible alternative structures

Firstly, the FOD consonant could be syllabified into the rhyme, with the lateral occupying the following onset. This would yield the structure in (21).

(21)

```
        R
        |\
O       N \       O    N    O    N
|       |  \      |    |    |    |
x       x   x <-- x    x    x    x
|       |   |     |    |    |
r       ɔ  d/t    l    ə    r
```

This configuration is ill-formed because it implies vowel shortening. A long vowel in German (as in English) occupies two skeletal positions. In (21), however, only one skeletal point is available for the vowel, which means that the vowel is short. The predicted pronunciation *['rɔd/tlɐ], however, is not possible in either dialect, *Hochlautung* or NSG.

The second conceivable alternative to configuration (20) is shown in (22).

(22)

```
O      N        O      N   O   N
|     / \      / \     |   |   |
x    x   x    x   x    x   x   x
|     \ /     |   |    |   |
r      o     d/t  l    ə   r
```

In this structure, the FOD plosive and the following lateral are syllabified into a branching onset, which, at least theoretically, is a possibility, since German (like English and French, but unlike Turkish and Arabic) is a language which licenses branching onsets. However, there are quite severe constraints on the sort of segments which can occupy positions within a branching onset.

As Harris (1990: 277f.) observes, these segments have to meet certain complexity requirements, with the governee being *less* complex than the governor. A zero complexity slope is not tolerated in branching onsets. Complexity, however, is not the only consideration. There are also severe restrictions on the amount of segmental material which the two positions within a branching onset can have in common. Identical segments are not permitted (as witness the absence of initial geminates) nor are segments which share more than one element. Rice (1989: 12f.) captures this generalisation in terms of the theoretical construct of binding, to which both the place node and the laryngeal node (in her framework) are subject. She observes that consonants 'must not be bound for place within an onset' (ibid., p. 13). To avoid excluding the well-formed branching onset *tr*, she would, obviously, have to treat *r* as non-coronal, which may be a problem. Harris's (1990: 278) interpretation of the same point appears to be preferable. He states that 'segments within a branching onset can be bound for at most one element'.

In other words, *dl* and *tl*, as well as *dn* and *tn* cannot form branching onsets, since the two segments involved share the elements R° and ʔ° in both cases. The well-formed onset *tr*, however, escapes the effects of this constraint, as only the element R° is shared. Ruling out *tl* and *dl* means that the only possible syllable structure available for words such as *Rodler, Siedler* and *Adler* (and others like them, of course) is that shown in (20), where the FOD obstruent is separated from the following lateral by a licensed empty nucleus. The same arguments apply, *mutatis mutandis*, to *Ordnung* and *ordnen* as well as *handle, Handlung* and *Pendler*, where the coronal stop is prevented from occupying a coda position (similar to the configuration shown in (21)) by the fact that that position is already filled by the *r*[9] or the *n* respectively.

Further evidence in support of my claim that there is a licensed empty nuclear position present comes from schwa/zero alternations precisely where my

[9]Alternatively, one could say that the *r* is absorbed into the nucleus, which would yield a branching nucleus rather than a branching rhyme. The important point, namely that the FOD obstruent cannot be part of the rhyme consituent, remains unaffected. In both cases, this constituent would have reached its maximal number of skeletal positions (i.e. two) and would, therefore, be unable to accommodate the FOD obstruent.

analysis predicts them. Forms containing schwa in the crucial position[10] are listed in (23)[11].

(23)	Rodel	['ro:d əl]	'toboggan'
	edel	[' ʔe:dəl]	'noble'
	besiedeln	[bə'zi:d əln]	'to settle'
	handeln	['hand əln]	'to act'
	Pendel	['p ɛndəl]	'pendulum'
	ordentlich	[' ʔɔɐdəntlɪç]	'tidy'

Interestingly, both NSG speakers and speakers of *Hochlautung* fail to devoice here, in spite of the fact that NSG speakers do devoice the relevant obstruent in the alternants shown in (19). This suggests that whether FOD applies or not depends on the status of the nuclear position following the relevant segment.

Further evidence in support of the claim that [tl] and [tn] cannot constitute branching onsets and must be separated by a licensed empty nucleus comes from those accents of English which exhibit t-lenition before a licensed empty nucleus (such as London or Leeds, for example). In these accents, word-internal [tl] and [tn] sequences in words like *atlas* or *chutney* trigger t-lenition, which means that a licensed empty nucleus has to be present (see Harris 1989a: 43).

[10]The transcriptions show careful pronunciations of the relevant words. In rapid and/or casual speech, the schwa may not actually be realised. The precise mechanism of this event is not immediately relevant to the present discussion. What matters is the fact that the pronunication with schwa exists for the words in (23), while the presence of schwa in the alternants in (19) is judged impossible.

[11]*Adler* is not included in this list because there is no direct alternation involving this particular noun. However, as mentioned in the initial discussion of (19), there may be an etymological link with the adjective *edel* ([' ʔe:dəl], 'noble), where, following the pattern exemplified in (23), a schwa surfaces between the FOD obstruent and the following lateral.

So far I have accounted only for words containing [d/tl] and [d/tn] sequences. What of the remaining items in (19), which involve [g/kn], [b/pn] and [z/sl] sequences? Clearly, none of these forms can be analysed so that the FOD obstruent occupies a coda position. This is precluded by the maximally binary nature of constituents in GP, and the sort of arguments which were put forward in the context of (21) and on p. 217 apply to these forms as well.

However, it is less obvious why the [g/kn], [b/pn] and [z/sl] sequences should not form branching onsets. In his discussion of the constraints on segmental content within branching onsets, Harris (1990: 277f.) makes an additional statement to the effect that the governed position may be composed of maximally *two* elements, thus excluding nasals. To some extent, Harris is able to derive this constraint from constraints on binding (see discussion on p. 217). However, in the context of [g/kn] and [b/pn] sequences, it remains a mere stipulation, since the stop and the nasal are bound for no more than one element in these particular sequences.

As far as [z/sl] is concerned, not even a stipulation ruling out governed nasals in a branching onset can be invoked, let alone a constraint on binding. And yet, it is striking that among the words beginning in orthographic *sl-* sequences listed in the DUDEN pronouncing dictionary (Mangold *et al.* 1990), there is not a single one which is not immediately identifiable as a recent loan from English or a Slavic language (e.g. Russian). It is also worth noting that there are none at all which begin with [zl] - only [sl] is grammatical. Indigenous German words, by contrast, begin with [ʃl]. If [z/sl] were indeed a branching onset, then the prediction would be that this cluster should occur word-initially as well as word-internally. Vennemann's Law of Initials (see 2.3.1.2.3 for discussion) applies in GP to the extent that branching onsets can occur freely wherever the relevant licensing requirements are met (see 4.4.2.6). In German, this appears to be the case where a branching onset is immediately followed by a filled nucleus[12], which is the configuration we find at the beginning of any non-prefixed word. So, this is where we would expect to find [zl] and [sl], if they were branching onsets.

As far as the stop+nasal sequences are concerned, [bn] is not at all attested word-initially and [pn] is quite rare. The sequences involving velar stops occur more frequently in word-initial position, with [kn] being almost as common as the genuine branching onset [bl]. In the light of the fact that all these clusters follow the same pattern in terms of their FOD behaviour and that some of them are either unattested altogether in word-initial position ([bn], [zl]) or occur only in recent borrowings ([pn], [sl]), I propose to reject the hypothesis that they form branching onsets, a move which receives a certain amount of support both from Rubach (1990) and from Venneman (1968; see Chapter 2 for discussion of both). It is my contention that [b/pn], [g/kn] and [z/sl] (like [d/tl] and [d/tn]) contain a licensed empty nucleus which separates the FOD obstruent from the following sonorant consonant.

Again, additional evidence can be derived from schwa/zero alternations involving the same stems as in (19).

(24)	eigen	['ʔaɪgən]	'own' (adjective)
	Regen	['re:gən]	'rain'
	Segen	['ze:gən]	'blessing'
	eben	['ʔe:bən]	'level' (adjective)
	Dusel	['du:zəl]	'dizziness'

[12]A licensed empty nuclear position does not appear to be able to license the presence of a *branching* onset in languages such as English and German; hence the absence of final clusters such as *tr* or *fr*. According to Charette (1988: 251), the situation is different in French, where a branching onset can precede a licensed domain-final empty nuclear position.

The claim that [g/kn], [b/pn] and [z/sl] do not form branching onsets can, of course, only be maintained if an alternative analysis is available for those words which contain an initial sequence of this type. Some examples of such words are given in (25).

(25)	Knie	[kni:]	'knee'
	Knoten	['kno:tən]	'knot'
	Knute	['knu:tə]	'knout'
	Gnom	[gno:m]	'gnome'
	gnostisch	['gnɔstɪʃ]	'gnostic'
	Gneis	['gnaɪs]	'gneiss'
	Pneumatik	[pnɔɪ'ma:tɪk]	'pneumatics'
	Pnompenh	[pnɔm'pɛn]	'Phnom Penh'
	Slum	[slam]	'slum'
	Slice	[slaɪs]	'slice' (sport)
	Slalom	['sla:lɔm]	'slalom'

In an earlier paper (Brockhaus 1990), I proposed the following configuration for [g/kn] and [pn] sequences.

(26)
```
O   R
    |\
    N \      O
    |  \     |
    x   x    x
        |    |
       {g}   n
       {k}
       {p}
```

The domain-initial nucleus is empty and the coda position, which is governed by a coronal nasal, is occupied by one of [g], [k] and [p]. Considering what I said in Chapter 3 (see especially 3.4.3.2.2) about the restrictions on voicing for coda segments, it now seems that this solution is incorrect. The problem is that (26) predicts that a voicing contrast is expressible in the coda. Given the fact that coda positions cannot contain laryngeal elements (which would result in incorrect charm values for a governed position), this is impossible. Consequently, coda [g] cannot contrast with coda [k]. However, precisely this sort of contrast seems to be present in forms such as *Knie* vs. *Gneis* (see (25) for both). As far as I am aware, there are no actual minimal pairs in German which depend on this contrast, but they can easily be constructed for the purposes of an experiment. When asked to differentiate words such as [kni:] and [gni:] (nonsense word), in my experience, native speakers of German are able to perform this task with perfect accuracy and reliability. This suggests that these sort of words involve a lexical contrast between [k] and [g], that is a contrast which depends on laryngeal elements. This contrast could not be accommodated in the configuration shown in (26).

Considering that [g/kn] and [pn] clusters cannot be treated as branching onsets, nor as configurations where the obstruent occupies a coda position, the only remaining option is to posit a licensed empty nuclear position which separates the stop from the nasal. I have already put forward this sort of solution earlier, and it may well look as if I am using empty nuclei as a kind of stopgap, which can be employed whenever a hole appears in my analysis. This is not the case. Licensed empty nuclear positions occur only under very closely defined conditions, which will be discussed in the next section.

4.4.2.2 Proper government and the Empty Category Principle

The conditions under which licensed empty nuclear positions may occur domain-internally are captured in the Empty Category Principle (ECP), which was first proposed in KLV 1990 (p. 219). My version of this principle, which closely follows the spirit of Kaye 1990b (p. 314), is set out below.

(27) *Empty Category Principle*
i. A licensed empty nucleus has no phonetic realisation.
ii. An empty nucleus is licensed if (a) it is properly governed or (b) if it is parametrically licensed in languages which license domain-final empty nuclei.

As already observed, German is a language which parametrically licenses domain-final empty nuclear positions. In German, empty nuclear positions can then automatically remain without phonetic content, provided that they are domain-final. Domain-internal empty nuclear positions, however, receive phonetic content, unless they are properly governed. Proper government is defined by Kaye (1990b: 313) as follows.

(28) *Proper Government*
A nuclear position α properly governs a nuclear position β iff
(a) α is adjacent to β on its projection,
(b) α is not itself licensed, and
(c) no governing domain separates α from β.

If my claim that German [g/kn] and [b/pn] sequences, as well as the [d/tl], [d/tn] sequences which were discussed earlier, contain a licensed empty nuclear position is correct, then the conditions on proper government stated in (28) must be met in all cases. Before this can be checked, it is first of all necessary to establish the direction of proper government in German. Proper government is a form of government at some level of nuclear projection[13] and as such is parametrically variable in its directionality.

According to Kaye (1990b, endnote 21), proper government proceeds from right to left in all known cases. So, in the absence of strong evidence to the contrary,

[13]Charette (1990) proposes that proper government applies at the level of licenser projection. To keep things as simple as possible for the purposes of the present discussion, I will, however, not introduce this level.

I will assume that German conforms to the general pattern and has right-to-left proper government.

We can now return to the issue of whether the licensed empty nuclear positions posited for words such as those in (19) meet the requirements for proper government as specified in (28). Consider the representation of *Rodler* again. It was first introduced as (20) and is reproduced here, with the level of nuclear projection where proper government applies added, as (29) (second cycle only).

(29)

```
         R         R  ←  R     R
         |         |     |     |
O        N     O   N  O  N  O  N
|       / \    |   |  |  |  |  |
x      x   x   x   x  x  x  x  x
|       \ /    |      |  |  |
r        o    d/t     l  ə  r
```

The arrow indicates the proper governing relation which holds between the penultimate nuclear position and the empty nucleus which precedes it. All the relevant requirements are met, as the governor is not itself licensed (hence its phonetic content), the two are adjacent at the relevant level of nuclear projection and there is no governing domain intervening between the two. A glance at (19) will confirm that this is true also for all the remaining items.

It appears, then, that for NSG speakers it is not just parametrically licensed domain-final empty nuclear positions which are unable to license L^- in a preceding onset (and which thus trigger FOD), but also properly governed domain-internal empty nuclei. Speakers of *Hochlautung*, on the other hand, distinguish between the two types of licensed empty nuclei. For them, it is only parametrically licensed domain-final empty nuclear positions which cannot license L^-. The fact that the two behave in non-identical ways is by no means an idiosyncratic property of German. This is also true of these positions in French (see Charette 1990, 1988: 251ff.), where, however, it is the parametrically licensed final empty nuclei which have greater licensing power. In French, only licensed final empty nuclei can government-license a preceding onset, while properly governed empty nuclei have to receive phonetic content (i.e. behave as though they were unlicensed) in order to be able to govern.

4.4.2.3 An alternative solution: differences in morphological structure between *Hochlautung* and NSG

There is a possible alternative to this interpretation, which may well be worth considering. Suppose that for NSG speakers words such as those in (19) have a different morphological structure from the one they have for speakers of *Hochlautung*. In particular, they may have an agent suffix *-ler* instead of the standard *-er* in words like *Rodler* and *Pendler* and *-ner* instead of *-er* in *Lügner* etc. This assumption would be supported by productive use of the suffixes *-ler* and *-ner*. Before considering evidence from productivity in more detail, let me first provide some examples of nouns derived by means of these suffixes (transcriptions reflecting *Hochlautung*).

(30) a.

Künstler	['kʏnstl ɐ]	'artist'
Dörfler	['d œ ɐflɐ]	'villager'
Sportler	['ʃp ɔɐtlɐ]	'athlete'
Wissenschaftler	['vɪs ənʃaftlɐ]	'scientist'
Ländler	['l ɛntlɐ]	'country waltz'
Häusler	['h ɔɪslɐ]	'cottager'
Nachzügler	['na:xtsy:kl ɐ]	'straggler'

b.

Glöckner	['gl œknɐ]	'bell-ringer'
Rentner	['r ɛntnɐ]	'pensioner'
Schaffner	['ʃafn ɐ]	'conductor' (transport)
Redner	['re:dn ɐ]	'speaker'
Söldner	['z œldnɐ]	'mercenary'
Schuldner	['ʃʊldn ɐ]	'debtor'
Bildner	['bɪldn ɐ]	'sculptor'

If the difference in FOD behaviour between the two groups of speakers is indeed due to the fact that NSG speakers have domain-boundaries after every obstruent to which they apply FOD, then the prediction would be that only these speakers use the suffixes *-ler* and *-ner* productively. However, Fleischer (1975: 144ff.), who - as far as one can ascertain - describes the standard variety, observes that both of them are used productively, although *-ler* is more productive than *-ner*. In other words, the productive use of *-ler* and *-ner* is not restricted to NSG. There is, however, an interesting difference between NSG and *Hochlautung* with regard to *-ner* which is brought to light by the data in (30). The *Hochlautung* pronunciations shown are identical to the corresponding NSG pronunciations in (30a), but not in (30b). In (30b, second group), FOD applies for NSG speakers, but not (according to Mangold *et al.* 1990) in *Hochlautung*.

Assuming that speakers of *Hochlautung* apply FOD before licensed domain-final empty nuclei, but not before domain-internal licensed empty nuclei, the only conclusion one can draw from this is that for these speakers, the *-n* must be part of the stem (presumably a kind of complex stem consisting of the root and a non-analytic suffix *-(e)n*). Only if that is the case can the empty nucleus which precedes it be treated as domain-internal. In other words, these speakers interpret the relevant words as having stem-final *-n* followed by the familiar agent suffix *-er*. So, although *Hochlautung* speakers recognise and use the suffix *-ler*, the suffix *-ner* does not appear to exist for them, hence the very limited productivity. Apart from the limited productivity, there is a noticeable amount of variation in the FOD behaviour of words such as those in the second group of (30b), which also suggests that the status of *-ner* is uncertain for A-speakers. In my informant work, *Bildner*, for example, was pronounced both ['bɪltnɐ] and ['bɪldnɐ] by the same speaker in a single session.

To illustrate my point about the differences between *-ler* and *-ner*, I have added morphological bracketing (for speakers of *Hochlautung*) and formative boundaries (which are invisible to the phonology, as already noted) to the data from (30) in (31).

(31) a.

[[Künst]ler]	['kʏnstlɐ]	'artist'
[[Dörf]ler]	['dœɐflɐ]	'villager'
[[Sport]ler]	['ʃpɔɐtlɐ]	'athlete'
[[Wissenschaft]ler]	['vɪsənʃaftlɐ]	'scientist'
[[Länd]ler]	['lɛntlɐ]	'country waltz'
[[Häus]ler]	['hɔɪslɐ]	'cottager'
[[Nachzüg]ler]	['na:xtsy:klɐ]	'straggler'

b.

[[Glöck+n]er]	['glœknɐ]	'bell-ringer'
[[Rent+n]er]	['rɛntnɐ]	'pensioner'
[[Red+n]er]	['re:dnɐ]	'speaker'
[[Söld+n]er]	['zœldnɐ]	'mercenary'
[[Schuld+n]er]	['ʃʊldnɐ]	'debtor'
[[Bild+n]er]	['bɪldnɐ]	'sculptor'

What emerges from this discussion is that the morphological structure of certain words is not always as straightforward as it may appear at first. It seems that *Hochlautung* speakers work on the assumption that the words in (31b) are composed of a complex stem ending in *-n* followed by the suffix *-er*, instead of simple stem followed by *-ner*. Interestingly, all the words involved in this have common forms ending in *-n* in their inflectional paradigms, usually in the nominative plural for nouns (e.g. *Glocken* 'bells') or the infinitive for verbs (e.g. *bilden* 'to form'). It is, perhaps, this sort of suffix which provides the nasal at the end of the complex stem. The words in (31a), which contain the suffix *-ler*, by contrast, invariably lack the lateral in these inflected forms (e.g. *Künste* 'arts', nom. pl.; *Dörfer*, 'villages', nom. pl.), and only a small minority have a nasal (e.g. *Wissenschaften* 'sciences', nom. pl.).

It is also clear now that both *Hochlautung* and NSG have the suffix *-ler* and there appears to be no evidence to suggest that NSG speakers use this suffix differently from *Hochlautung* speakers. However, as far as *-ner* is concerned, things are less clear. This suffix does not appear to be present in *Hochlautung*, but it may be in NSG. Figures on productive use are, unfortunately, not available, and there is no phonological evidence, since the analysis predicts identical FOD behaviour for both *-er* (when preceded by [n]) and for *-ner*.

Returning to Vennemann's variable items (see (19)), though, referring to differences in morphological structure in order to account for the difference in FOD behaviour between NSG speakers and *Hochlautung* speakers does not seem to work at all well (with the exception of *Lügner*, which is amenable to the interpretation put forward in the preceding paragraphs). It is problematic because, as already discussed in 2.3.1.2.1, it requires us to posit stems (such as *pend-* or *eb-*) for NSG speakers which cannot be independently motivated.

This argument also militates against yet another alternative (also discussed in 2.3.1.2.1), which is to posit three morphemes to account for NSG speakers' pronunciations of the variable items. This proposal is made by Kloeke (1982a; see 2.3.3) for speakers of *Hochlautung*, but it would not work for these speakers given my analysis. It could do, though, for NSG speakers. *Pendler* would then be bracketed as *[[[Pend]l]er]*. The predictions for FOD would be correct, but the stem form would still be exceptional, just as it would have been under the assumption that only two morphemes are involved (see above).

To sum up, the difference in FOD behaviour illustrated in (19) can be attributed to one of two factors. Firstly, it can be due to a difference in parameter settings for the licensing power of properly governed as opposed to parametrically licensed empty nuclei. Secondly, it may be an effect of a different assignment of morphological structure between the two groups of speakers. I propose to reject the latter, as, among other things, it would predict the existence of stems such as *pend-*, *eb-*, *rod-*, etc., which cannot be motivated independently.

In the remainder of this chapter I will investigate the implications of adopting the former view.

4.4.2.4 More on problematic clusters

Let me now return to the problematic word-initial clusters [g/kn] and [pn] illustrated in (25). I proposed to analyse these clusters so that the obstruent was separated from the following sonorant by a licensed empty nuclear position. To see whether this proposal is compatible with the requirements in (28), consider the representation of *Gneis*.

(32)

```
        R   ←       R           R
        |           |           |
    O   N   O       N       O   N
    |   |   |      / \      |   |
    x   x   x     x   x     x   x
    |       |     |   |     |
    g       n     a   ɪ     s
```

Again, it is possible for proper government to hold, since the governor is unlicensed, the positions which enter into the governing relation are adjacent at the relevant level of nuclear projection and there is no governing domain separating them. This analysis makes the prediction that it should be impossible for the second onset position to be filled by a branching onset, since that would create a governing domain between the proper governor (the penultimate nucleus) and its governee (the left-most nucleus), which would destroy the proper governing relation. This is, trivially, correct, since branching onsets involving a governing nasal are, to my knowledge, not attested.

An intriguing additional argument in favour of the claim that there is a licensed empty nuclear position present is the way linguistically naive native speakers of English deal with these clusters when imitating German pronunciations of words beginning in [g/kn] clusters, e.g. *Knackwurst* (['knakvuɐst], (type of sausage)). These speakers insert a schwa between the stop and the nasal, exactly where my analysis predicts the presence of the empty nuclear position. The same kind of evidence comes from Quebec French, where the pronunciation [pənø] of the noun *pneu* ('tyre') is attested (alongside [pnø] and [nø]; see Lodge 1987). It may be, then, that initial [pn] clusters universally contain a licensed empty nuclear position. This solution does, however, have one drawback, namely the fact that it does not account for the absence of, say, *[bn], since, in principle, it should be possible for the empty nucleus to be preceded by any segment.

A more important problem with this analysis in the context of the present discussion of FOD, though, is the following. If NSG speakers apply FOD to obstruents preceding both types of licensed empty nuclear position (parametrically licensed and properly governed), then one would expect the initial [g] in words such as *Gneis* to undergo FOD. In fact, it should also spirantise, since that is what happens to underlyingly voiced velars in FOD environments. However, neither FOD nor spirantisation apply.

As far as the failure of FOD to apply is concerned, these words behave like the *Fremdwörter* discussed in 3.4.3.2.2. The representation of one of those *Fremdwörter (Signal)* is repeated here as (33).

```
(33)      R         R    ←    R          R
          |         |         |          |
     O    N    O    N    O    N      O   N
     |    |    |    |    |   / \     |   |
     x    x    x    x    x  x   x    x   x
     |    |    |         |   \ /     |
     z    ɪ    g         n    a      l
```

My analysis predicts that both FOD and spirantisation should apply in the configuration in (33) for an NSG speaker, just as they should in *Gneis.* Now consider the other *Fremdwörter* discussed in 3.4.3.2.2 and repeated here as (34)[14].

(34) a.

Lignin	[lɪ'gni:n]	L: lignum
Magnesia	[ma'gne:zia]	ML: magnesia, Gr: magnēsíē
Magnet	[ma'gne:t]	L: māgnēs, Gr: mágnēs
Magnolie	[ma'gno:liə]	F name: Magnol
Magnitude	[magni'tu:də]	L: māgnitudo
Dignitar	[dɪgni'ta:ɐ]	F: dignitaire, ML: dignitārius
prägnant	[prɛ'gnant]	F: prégnant, L: praegnāns
Signal	[zɪ'gna:l]	F: signal, L: sīgnālis
designieren	[dezɪ'gni:ɐn]	L: dēsīgnāre
Diagnose	[dia'gno:zə]	F: diagnose, Gr: díagnōsis
Prognose	[pro'gno:zə]	L: prognōsis, Gr: prógnōsis
ignorant	[ʔɪgno'rant]	L: īgnōrāns
Stagnation	[ʃtagna'tsio:n]	L: stāgnāre

[14]The transcriptions reflect both *Hochlautung* and NSG pronunciations in (34a), but only the former in (34b).

Fragment	[fra'gm ɛnt]	L: frāgmentum
Pragmatik	[pra'gma:tɪk]	Gr: pragmatikē
Segment	[zɛ'gm ɛnt]	L: segmentum
Pigment	[pɪ'gm ɛnt]	L: pigmentum
b.		
Magma	['magma]	L: magma, Gr: mágma
Dogma	['d ɔgma]	L: dogma, Gr: dógma

(Abbreviations: L = Latin, ML = Middle Latin, Gr = Greek, F = French)

Throughout (34a), the licensed empty nuclear position which fails to trigger FOD precedes the nucleus which bears the main stress. This is, of course, also true of words such as *Gneis*, where the crucial nucleus is the left-most nuclear position of the domain. In the relevant words (*eignen*, *regnet*, *Lügner* and *Segnung*) in (19), that is, words where FOD and spirantisation do apply to a [gn] cluster, however, this is not the case. On the contrary - the crucial empty nucleus *follows* the nucleus which bears the main stress. It seems, then, that it is not only the source of the licensing which determines the licensing power of a given empty nuclear position, but also its role within the metrical structure of the relevant domain. FOD, for NSG speakers at least, applies only post-tonically. This observation makes the prediction that NSG speakers devoice the /g/ in *Magma* and *Dogma* (in (34b)), where the main stress falls onto the first nucleus, so that the FOD segment occurs post-tonically. This prediction is correct, as far as I am aware, although many educated NSG speakers tend to suppress spirantisation (but not FOD) in obvious *Fremdwörter* such as *Magma* and *Dogma*.

Before concluding this section with a discussion of the implications of my analysis for Charette's notion of government-licensing, I would like to return to the remaining '"unpronounceable" cluster' from (19), [z/sl], the discussion of which is still unfinished. I observed earlier that word-initial *[zl] does not occur and that [sl] in this position is restricted to recent borrowings, such as the ones listed in (25). There is no evidence from other languages which would suggest that there is an empty nucleus separating the fricative and the lateral. Furthermore, it has been shown by KLV (1990) that word-initial *s* in clusters such as *str-* can occupy a coda position. This analysis can easily be extended to similar clusters in English and German, where it appears not to be restricted to s+*stop* clusters. I would claim that, in the case of [sl], too, the *s* occupies a coda position. The resulting configuration is shown in (35)[15].

```
(35)   O   R
           |\
           N \      O
           |  \     |
           x   x    x
               |    |
               R°   R
               |    |
               |    ʔ°
               h°
```

If the coronal fricative occupies the coda position, this means that it is impossible for it to contain a laryngeal element. As discussed in 3.4.3.2.2, neutral obstruents are interpreted as 'voiceless', so that [sl] is the predicted result. The cluster *[zl] is excluded on the grounds that it would require a charmed obstruent (containing L^-) to occupy the coda position.

Incidentally, a configuration where *s* occupies an initial coda position appears to be the only case which permits empty domain-initial onsets. Apart from the

[15]This configuration raises the issue of how the licensed empty nucleus is actually licensed. In an [sl] cluster, this could happen through proper government from a nucleus to the right. However, this is impossible for [str], since the presence of the branching onset means that there is a governing domain intervening between the proper governor and the empty nucleus, so that no proper governing relation can be established. This is a problem for all phonologists working in the GP framework, which, as yet, is unresolved.

empty onset, such a structure also invariably contains an empty nucleus in languages such as English and German. Provided this nucleus is empty, German will tolerate an empty onset as well. It is for this reason that I referred to the presence of segmental content in the following nucleus when stating the constraint which prohibits empty domain-initial onsets which are followed by *filled* nuclei (see (16)).

An additional piece of evidence in favour of the configuration in (35) comes from those speakers of English who pronounce a palatal glide [j] after stops preceding [u:] or [ʊə] (Jonathan Kaye, p.c). These speakers have [pju:], [tju:n] and [kjʊə] (*pew*, *tune* and *cure*). In other words, a non-branching onset can be followed by [j] for them. Things, however, are different after a *branching* onset, where the palatal glide is absent, e.g. in ['plu:vɪəl] *(pluvial)*. It seems to be a general property of the phonology of this particular dialect that all and only non-branching onsets can be followed by the palatal glide. So, in this dialect, the presence or absence of the palatal glide can be taken as a diagnostic for branching onsets. Any word-initial segment cluster which is followed by [j] (preceding [u:] or [ʊə]) has to be interpreted as a non-branching onset, whereas a cluster preceding [u:] or [ʊə], but not [j], is likely to be a branching onset. Initial [sl] sequences *do* have a following [j], so they constitute non-branching onsets, as witness the pronunciation [slju:] (*slue*). If [sl] is a non-branching onset, as these facts suggest, then it must have the structure in (35), so (35) is further supported by evidence from a language other than German.

4.4.2.5 Summary

On the preceding pages I have argued that the sort of clusters which Vennemann (1968) refers to as 'unpronounceable' (e.g. [gn bn dn dl zl], see (19)) contain a licensed empty nuclear position. I have shown that this position derives its licensing from being properly governed by an unlicensed nuclear position which is adjacent to it at the relevant level of nuclear projection and which is not separated from it by a governing domain.

The difference in pronunciation between speakers of NSG and speakers of *Hochlautung* concerning Vennemann's variable items (which contain these '"unpronounceable" clusters', see (19)) can be explained under the assumption that the two speaker groups treat properly governed empty nuclear positions differently. Speakers of *Hochlautung* distinguish these positions from parametrically licensed domain-final empty nuclear position by attributing to them the necessary licensing power for licensing L^-. So, FOD does not apply next to these positions for *Hochlautung* speakers. NSG speakers, on the other hand, do not distinguish between the two types of licensed empty nuclear positions, at least not for the purposes of FOD. For them, neither can license L^-, so FOD is triggered by *any* licensed empty nuclear position.

One potential problem for my analysis is the fact that it is only coronal sonorants which can follow the domain-internal licensed empty nuclei identified in this chapter, rather than any conceivable segment. Assuming that there is a licensed empty nucleus present, one would expect there to be no restrictions on the segment types which can follow it. One may speculate that, for some reason, proper government in German cannot cross anything stronger than a sonorant, but, given the present state of our knowledge, this sort of 'reasoning' is unlikely to go very far, since (a) it cannot be formalised in the theory of GP (yet) and (b) it fails to take into account the conspicuous absence of non-coronal nasals in these positions.

As far as this particular problem is concerned, Rubach's (1990) analysis does slightly better to the extent that it depends on the presence of sonorants. It does, however, fail to account for the absence of non-coronal nasals and it makes incorrect predictions with regard to *r* (see 2.3.4.2.2). Although it is not possible to deal with all the intricacies of the behaviour of *r* in a thesis such as the present, the GP approach to be put forward in 4.5 can give us at least some idea of why *r* should exhibit certain properties which set it apart from the remaining coronal sonorant consonants, *l* and *n*.

What I have said so far about domain-internal licensed empty nuclear positions in German has certain implications for Charette's (1988: 195ff., 1990) notion of government-licensing, which will be discussed in the next section.

4.4.2.6 Implications for government-licensing

According to Charette (1990), government-licensing is subject to the following constraint (ibid., p. 242).

(36) *Government-licensing*
For a governing relation to hold between a non-nuclear head A and its complement B, A must be licensed to govern by its nucleus[16] ...

This constraint covers two types of governing relations between non-nuclear positions, constituent and inter-constituent government, both involving onsets. Firstly, it states that the governing position within a branching onset can only discharge its governing responsibility if it itself is licensed to govern by its nucleus (i.e. the nucleus which follows it). Secondly, it says that an onset can only govern a preceding coda position if it (i.e. the onset) is licensed to do so by its nucleus. A nucleus which can government-license its onset is a licenser, and licensers are characterised as follows by Charette (ibid., p. 242).

[16]I have deleted the phrase 'at the licenser projection level' from the original, since, for reasons of exposition, I am not making reference to this level. I believe that it is still possible to represent Charette's ideas reasonably faithfully.

(37) *Licenser*
The government-licenser of an onset is an unlicensed nucleus

This definition is designed for French, but it appears that it only works for this language if parametrically licensed domain-final empty nuclear positions are left out of the discussion, which is apparently what Charette intends (ibid., endnote 9). As already mentioned, both branching onsets and consonant clusters involving codas can occur domain-finally in French (see Charette 1988 *passim*). This means that parametrically licensed final empty nuclei *can* government-license in spite of being themselves licensed. To include these positions in the discussion and capture the difference between properly governed empty nuclei and parametrically licensed empty nuclei, the definition of licensers could be revised like this.

(38) *Licenser* (revised)
Any nucleus other than a properly governed empty nucleus is the government-licenser of an onset

This revised definition may now be a serviceable definition of licensers in French, but it would still need further revision to do the job for English and German, where it appears that no empty nucleus whatsoever can license constituent government. In other words, branching onsets can never precede empty nuclei, be they unlicensed, parametrically licensed or properly governed.

Putting branching onsets to one side, what are the predictions the Government-licensing Constraint (36) makes for onsets governing codas in German? German, like French, licenses final consonant clusters involving such positions, so a parametrically licensed final empty nucleus is a government-licenser in this language. The noun *Wald* ([valt], 'forest') illustrates this observation in (39). The double arrow indicates that the final empty nucleus licenses its onset to govern. The level at which I have positioned it is not meant to have any theoretical implications. It is simply dictated by the fact that the licenser projection is not included in my presentation. The governing relation between that onset and the preceding coda position is captured by a single arrow at the skeletal level.

(39)

```
        R
        |\
  O     N \       O ⇐ N
  |     |  \      |   |
  x     x   x ← x     x
  |     |   |   |
  v     a   l   t
```

If German behaves like French (and Tangale; see Charette 1990), then a similar configuration should be ruled out domain-internally, since the licenser would be properly governed rather than parametrically licensed. As stated in (38), no properly governed empty nucleus can be a government-licenser. In other words, there should be no syllable structure such as that shown in (40), where α stands for any appropriate segment.

(40)

```
  *  R
     |\
     N \       O ⇍ N    O    N
     |  \      |   |    |    |
     x   x ← x     x    x    x
     |   |   |          |    |
     α   α   α          α    α
```

According to Charette (1988: 207ff., 1990), one would expect either the nucleus to receive phonetic content (i.e. to behave as though it were unlicensed itself and thus turn into a licenser) or the governing domain to be broken up in some way. The former solution is chosen by, for example, French and the Kaltungo dialect of Tangale, the latter by the Billiri dialect of Tangale and Korean. Thus, the same word, /landa+zi/ ('your (fem.) dress'), is pronounced [landuzi] in the Kaltungo dialect and [lanzi] in the Billiri dialect of Tangale (see Charette 1988: 214, 1990). The stem-final [a] is dissociated from its skeletal point by a general vowel deletion process, resulting in the presence of an empty nucleus, which is properly governed by the following nucleus. In [landuzi], this properly governed (penultimate) nucleus is given phonetic content, which enables it to government-license its onset. In [lanzi], on the other hand, the governing domain is broken up. The potentially governing onset *(d)* is not linked to a constituent and the properly governed nucleus can remain without phonetic content, because it is not required to government-license its onset.

Do configurations such as (40) exist in German and, if so, how does the language deal with them? *Pendler* (see (19)) is indeed such a case. Its syllable structure (on the second cycle) is set out in (41).

(41)

```
          R
          |\
  O       N \       O <= N    O    N    O    N
  |       |  \      | ?  |    |    |    |    |
  x       x   x <-- x    x    x    x    x    x
  |       |   |     |         |    |    |
  p       ɛ   n    d/t        l    ə    r
```

This is the very configuration the Government-licensing Constraint (36) is designed to rule out. Assuming that the representation in (41) is correct, this can only mean that in German, unlike in French, any nucleus can license inter-constituent government, even if that nucleus itself is properly governed. This can be so for one of two reasons. Either that aspect of the Government-licensing Constraint (36) which is concerned with inter-constituent government is wrong or it is vacuous because the definition of a licenser for inter-constituent government is so broad that (36) has simply no effect at all. If we assume the latter, the Government-licensing Constraint can be salvaged, which seems an attractive option. All that has to be said is that the definition of a licenser in German is rather different from that of a licenser in French. As far as inter-constituent government is concerned, the constraint is much laxer in

German. 'Anything goes', that is, any nucleus is a government-licenser. The requirements of a government-licenser responsible for constituent government, by contrast, are much stricter in German than in French. Only filled nuclei will do.

It may be, then, that the Government-licensing Constraint (36) itself is universal, but that the definition of a government-licenser which fleshes the constraint out is parametrically variable down to a considerable degree of fine detail. The following decisions would have to made for each language.

Firstly, it has to be determined whether the language treats inter-constituent government the same as constituent government. If so (as in French), all that needs to be done is to define the licenser for both types. If not (as in German), two different sets of licensers have to be defined, one for inter-constituent government and one for constituent government.

Before I can bring the discussion of the implications of Vennemann's variable items to a close, I need to account for the fact that not all words which are structurally similar to Vennemann's variable items (as listed in (19)) actually contain a licensed empty nucleus after a potential FOD obstruent and before [l] or [n]. Some examples of such words are given in (42).

(42)	Bündelung	['bʏndəluŋ]	'bunching'
	Verkieselung	[fɛɐ'ki:zəluŋ]	'silification
	Verkabelung	[fɛɐ'ka:bəluŋ]	'wiring'
	Ankurbelung	['ʔankuɐbəluŋ]	'boosting'

Where Vennemann's variable items have a licensed empty nuclear position, these words contain an obligatory schwa. Given what has been said about proper government in German so far, the presence of this schwa cannot be attributed to the failure of a proper governing relation to be established, since the syllable structures involved in (42) are identical to those in (19), as far as the factors which are relevant to proper government are concerned. The difference has to lie in the segmental representations. Consider the relevant portion of the representation of *Handlung* ('action'), as shown in (43) (second cycle only). This time, the empty nuclear position is not written in an abbreviated form, i.e. with a blank on the melody tier, but, instead, it is given its full representation, which is the cold vowel v°, the identity element.

(43)
```
                 O    N    O    N
                 |    |    |    |
            ...  x    x    x    x   ...
                 |    |    |    |
  h    a    n   d/t   v°   l    ʊ    ŋ
```

This contrasts with the same portion of the representation of *Bündelung* (in (44)), where the corresponding nuclear position is not actually occupied by an empty nucleus, but by the segment [ə], which is not the manifestation of an unlicensed empty nucleus, but which is lexically present, as illustrated in (44).

(44)
```
                 O    N    O    N
                 |    |    |    |
            ...  x    x    x    x   ...
                 |    |    |    |
  b    ʏ    n    d    v°   l    ʊ    ŋ
                      |
                      A+
```

The presence of schwa is frequently reflected in the spelling. It appears as an *e* in *Bündelung*, while the corresponding position in *Handlung* indicates no segment. The spelling of *Handel* ('trade'), a noun consisting solely of the stem from which *Handlung* is derived, also indicates the presence of schwa, which is indeed what we find in the careful pronunciation ['handəl]. This schwa, however, differs from that in *Bündelung* in that it is the realisation of an unlicensed empty nuclear position. The representation of *Handel*, which illustrates this point, is set out in (45).

(45)
```
        R
        |\
  O     N \     O    N    O    N
  |     |  \    |    |    |    |
  x     x   x   x    x    x    x
  |     |   |   |    |    |
  h     a   n   d    v°   l
```

The penultimate empty nuclear position cannot be properly governed because the potential governor is itself licensed (see (28)). This structure, however, cannot be interpreted as it stands. In German (as in French; see Charette 1988: 157f.) the cold vowel cannot manifest itself in isolation. To be able to become audible, it needs to fuse with an ambient A^+, thus yielding [handəl].

The existence of lexical schwa (as in *Bündelung*) and 'variable' schwa (as in *Handel*) also accounts for the existence of the following set of words, which contain a [gən] sequence in initial position. They contrast with those nouns and adjectives in (25) which have initial [gn] sequences (e.g. *Gneis*) in that the set in (46) has lexical schwa and the group in (25) exhibits 'variable' schwa.

(46)	gebrauchen	[gə'braʊx ən]	'to use'
	Gedanke	[gə'da ŋkə]	'thought'
	Gekritzel	[gə'krɪts əl]	'scrawling'
	genug	[gə'nu:k]	'enough'
	gerade	[gə'ra:d ə]	'straight'
	Gehör	[gə'hø: ɐ]]	'hearing'
	Gepäck	[gə'p ɛk]	'luggage'
	Getreide	[gə'traɪd ə]	'grain'
	Gefühl	[gə'fy:l]	'feeling'
	Geschäft	[gə'ʃɛft]	'business'

For some of the items in (46) one could argue that they consist of an analytic prefix *ge-* and the stem. This alone, however, would not account for the presence of [ə]. After all, it would still be possible for a proper governing relation to be established between the nucleus of the prefix (governee) and the initial nucleus of the stem (governor) in those words where the two are not separated by a governing domain (e.g. in *Gedanke*).

4.5 Understanding and overcoming the problems of Rubach's analysis

In the course of the preceding sections I have shown how data from Vennemann (1968, 1978) and Kloeke (1982a, b; see Chapter 2 for discussion of both Vennemann and Kloeke) can be handled by the present analysis without any of the problems arising from the earlier analyses. I have, however, not yet tackled explicitly part of the data which plays a crucial role in the Lexical Phonology accounts of FOD (especially Rubach 1990), nor have I dealt with the points which were raised in the context of the discussion of Rubach's approach to syllabification and native speaker judgments of syllabification (see 2.3.4.2).

I will begin with the latter and discuss the reliability of native speaker judgments of the location of syllable boundaries in the light of what has been said about syllable structure in GP in this chapter and in Chapter 3. As reported in 2.3.4, Rubach's analysis is designed to account for two things, speakers' unmonitored 'phonological behaviour' *and* the sort of syllabifications which these speakers produce when asked to divide a given word into syllables. As I have shown in 2.3.4.2.2, however, these judgments are relatively unreliable and, on occasions, actually conflict with the unmonitored 'phonological behaviour' of the speaker concerned. For example, a speaker who pronounces the adjective *neblig* ['ne:blıç] ('foggy') may, when asked to divide it into syllables, produce ['ne:p.lıç]. There are other cases where speakers find it very difficult to actually make a decision about the location of syllable boundaries, e.g. in *fester* (['fɛstɐ], 'harder'). A closer look at the syllable structure of this word in GP reveals why.

(47)

```
        R
        |\
  O     N \     O     N     O     N
  |     |  \    |     |     |     |
  x     x   x   x     x     x     x
  |     |   |   |     |     |
  f     ɛ   s   t     ə     r
```

The *s* is in the coda, and many German speakers intuitively put the syllable boundary after it. This, however, is not what the hyphenation rules codified in that volume of the DUDEN which is devoted to orthography (Drosdowski *et al.* 1973: 48f.) suggest. In a section entitled *Silbentrennung* ('syllable division'), we find a rule which states that *st* sequences are never separated in the spelling. The existence of a little educational rhyme to this effect proves that keeping *st* together has to be drummed into school children against their intuitions[17]. So, the clash between intuitive syllabifications and syllabifications imposed by orthographic norms leads to uncertainty.

The DUDEN syllable division rules may also be responsible for the inconsistency just described in the context of *neblig*. It suggests the syllabification *neb.lig*, which, with each syllable pronounced as an individual domain, necessarily triggers the application of FOD to the bilabial stop. The same arguments, *mutatis mutandis*, also hold for words such as *Handlung*.

Another important point which has to be borne in mind here (and which I already touched upon in 2.3.4.2.2) is that metalinguistic tasks, such as dividing words up into syllables, may require a different kind of competence from that

[17]This rhyme goes, 'Trenne nie *st*, denn es tut ihm furchtbar weh!' [Never separate *st*, for it hurts it terribly/WGB].

which accounts for the speaker's performance in unmonitored everyday speech situations.

In the light of these facts it hardly seems surprising that there is no perfect match between unmonitored phonological behaviour and the metalinguistic task of syllable division. So, any analysis which aims to reconcile the two is bound to run into problems. The GP analysis presented here is designed to capture the former, although it can also give some indication as to why there should be a conflict between the two on occasions.

In 2.3.4.2.2 I identified another drawback of Rubach's analysis, namely the fact that extending it to NSG speakers creates further problems. Specifically, I suggested that the correct output for a word such as *Handlung* for NSG speakers could be derived by reversing the order in which Rubach's rules of Sonorant Desyllabification and Final Devoicing apply. For NSG speakers, Sonorant Desyllabification has to precede Final Devoicing (although even this is not without its problems; see 2.3.4.2.2). This solution, however, makes incorrect predictions for all those lexical items which involve a stem-final extrasyllabic *r* immediately following the FOD obstruent. The derivation of *Rudrer* (['ru:dr ɐ], 'rower') the agent noun related to the verb *rudern* (['ru:d ɐn], 'to row'), which illustrated that point in Chapter 2, is repeated here as (48).

(48) r u: d r

Cycle 1

```
  σ
 / | \
r u: d *r          Syllable Structure Algorithm

  σ        σ
 / | \     |
r u: d     r       Sonorant Syllabification
```

```
σ    σ
/\   /\
r u:  d r                     Syllable Structure Algorithm
```

Cycle 2

```
σ    σ    σ
/\   /\    |
r u: d r + r                  (according to Rubach (1990: 90), by a rule
                              other than Sonorant Syllabification )

---                           Syllable Structure Algorithm
```

Postcyclic

```
σ          σ
/\         |
r u: d r + r                  Sonorant Desyllabification

 σ       σ
/ | \  /   \
r u: d  r + r                 Syllable Structure Algorithm
```

*[ru:trər][18]   Final Devoicing

This derivation counterfactually predicts that Final Devoicing applies, but neither NSG speakers nor speakers of *Hochlautung* can devoice here. The important point to bear in mind in this context is the fact that this failure of Final Devoicing to apply cannot be observed before segments other than *r*, which suggests that it is due to a special property of this particular segment.

Consider now the derivation of *Rudrer* in the framework of GP, as shown in (49).

[18]As mentioned in Chapter 2, the full derivation would have generated *[ru:trɐ].

(49) a.

```
      O      N      O   N   O   N   O   N   O   N
      |     / \     |   |   |   |       |   |   |
[ [   x    x   x    x   x   x   x ]     x   x   x ]
      |     \ /     |       |           |   |
      r      u      d       r           ə   r
```

b.

```
      O      N      O   N   O   N   O   N
      |     / \     |   |   |   |   |   |
[     x    x   x    x   x   x   x   x   x ]
      |     \ /     |       |   |   |
      r      u      d       r   ə   r
```

The FOD obstruent is followed by a licensed empty nuclear position, just as in *Rodler*, *Ordnung* and other words from (19). If my claim that, for NSG speakers, no licensed empty nuclear can license the element L^- is correct, then L^- (in the coronal stop /d/) is also unlicensed in (49), and the pronunciation *['ru:tr ɐ] is predicted. As already observed, however, this is ungrammatical. The actual form, ['ru:dr ɐ], can only be derived if, for some reason, the nuclear position following the FOD obstruent is not treated as empty by NSG speakers. To get some idea of how this can come about, let me briefly recap a few facts about *r* in German[19]. But before doing so, I would first like to explain what the discussion of *r* is meant to achieve.

The behaviour of *r* is very complex, and a detailed analysis of all its various aspects could well fill a PhD thesis of its own. So, I will not attempt to investigate every single fact about *r*, let alone give a full analysis of its behaviour. Instead, I would like to sketch the most important properties of this segment, as they relate to my analysis of FOD, and simply suggest avenues that might be pursued in future research.

[19]See Harris 1991 and Broadbent 1991 for a discussion of English *r* in the GP framework.

As observed in 3.3.4, *r* is the only German consonant which can alternate with a vowel. The environment where this alternation occurs is remarkably similar to that where FOD occurs, i.e. preceding a licensed empty nuclear position. Establishing whether *r* is vocalised before a properly governed empty nuclear position would require further research. What I can say with confidence, however, is that, in my dialect, *r* is invariably vocalised when it precedes a licensed domain-final empty nuclear position, the very position which triggers FOD in both NSG and *Hochlautung*. This is illustrated in (50), which is reproduced here from 3.3.4, for convenience.

(50)	a.	schwer	[ʃve:ɐ]	'heavy'
		bohr'	[bo:ɐ]	'(I) drill'
		ihr	[ʔi:ɐ]	'you' (pl., familiar form)
		hör'	[hø:ɐ]	'(I) hear'
		stur	[ʃtu:ɐ]	'stubborn'
		führ'	[fy:ɐ]	'(I) guide'
	b.	schwere	['ʃve:r ə]	'heavy' (nom. pl.)
		Bohrer	['bo:r ɐ]	'drill'
		ihre	[' ʔi:rə]	'their'
		hörig	['hø:rɪç]	'(be) enslaved (to someone)'
		sture	['ʃtu:r ə]	'stubborn' (nom. pl.)
		Führer	['fy:r ɐ]	'guide'

Given the analysis of FOD as an instance of autosegmental licensing proposed earlier in this chapter, it would be advantageous if the same sort of analysis could be used for the *r*/vowel alternation. This would allow us to keep the overall analysis of German phonology simpler and it would lend a certain amount of support to the analysis of FOD by showing that the autosegmental licensing power of an empty nucleus is indeed limited. All that would have to be said is that there is an element X (still to be identified) such that the expression which is interpreted as [ɐ] contains an unlicensed X. In environments where X is licensed, the same expression (but now with a licensed X) is realised as [r].

At this point some of the complex problems associated with *r* come to light. Firstly, how is [ɐ] to be represented? As far as I know, it is uncontroversial that [ɐ] is a central unrounded vowel, like [ə], but slightly lower (between open-mid and open, in recent IPA parlance). There is no obvious way of representing such a vowel in the framework of GP, if [ə] is assumed to consist of v° (head) and A^+ (operator). An alternative to treating schwa as being composed of v° and A^+ is to interpret it as the cold vowel (v°) itself, with no other elements. This option, however, is not available, since [ə] can occur word-finally in German, something which is impossible for the cold vowel in a language where domain-final empty nuclei are parametrically licensed. A final empty nucleus which is parametrically licensed can never be audible[20]. At the same time, it seems that both v° and A^+ are also required for [ɐ], to account for both its centrality and its relative lowness. Given that the spectra of [ə] and [ɐ] are so similar as to be almost indistinguishable[21], I shall, for the purposes of the present discussion, simply assume that [ɐ] consists of these two elements (plus an unlicensed element X) only, bearing in mind that this representation is incomplete.

Assuming that the question of what [ɐ] is can be resolved, we have to find out which element can take us from [ɐ] to [r], as it were. My own informal investigation of the spectra of these two segments (using the Loughborough

[20]See Kaye 1990b for a detailed discussion of this point, with reference to Turkish.

[21]This information is derived from my own (informal) experiments, using the Loughborough Sound Images Speech Workstation and a single speaker (myself). Obviously, more extensive experimental work is required to confirm or refute this finding.

Sound Images Speech Workstation) suggests that we are looking for an element which completely changes the spectrum, as opposed to just adding, say, noise to it. Given the fact that the coronal segments [ɾ] and [r] (representing an alveolar trill in this case) are possible realisations of [r] (any realisation of German *r*), the element R° seems as good a candidate as any for this. However, choosing R° raises the problem of how to account for uvular realisations of *r*, which leads on to the question of whether the phonology should capture the various realisations of what is the same phonological unit in the first place.

Putting all these problems to one side, we can speculate that R°, like L^-, requires a special form of autosegmental licensing which can only be provided by a certain type of nucleus, most commonly a filled nuclear position. This assumption may, however, be too simplistic as it stands, since R° appears to be licensed with no special requirements when it is present in, say, coronal stops or fricatives. Perhaps it is the fact that it is the cold vowel which is the head in the expression which is realised as both [r] and [ɐ], which causes the need for special licensing. If that were so, then there would be a link with the occlusion element ʔ°, which also appears to require special licensing when occurring in an empty-headed expression (see Ch. 6 for details).

Let me now return to the derivation of *Rudrer*, which sparked off this discussion. Consider the representation in (51), which shows the domain of the stem only, on the first cycle. Only a domain-final licensed empty nuclear position is available to license R°, with the result that R° remains unlicensed. It is not only R°, however, which is unlicensed in this domain. So is the empty nucleus separating the /d/ from the /r/. As already observed earlier, an unlicensed empty nucleus has to be realised as a vowel which contains both v° (head) and A^+ (operator) in German. Where there is no local source for the A^+, an ambient A^+ has to be posited. In (51), however, there is a local source, the neighbouring onset. It is conceivable, then, that the unlicensed empty nucleus identifies with the neighbouring onset. This is indicated by the symbol < in (51).

(51)
```
  O      N      O   N   O   N
  |     / \     |   |   |   |
[ x    x   x    x   x   x   x ]
  |     \ /     |   |   |
  r      u      d   v°  v°
                    |   T
                      < A+
                        |
                      (R°)
```

I assume that the element R° can occupy a nuclear position in German. This is suggested by the fact that coronal sonorants frequently become 'syllabic' (see e.g. Rubach 1990 for a discussion of this phenomenon), which I would interpret as spreading from an onset into a preceding nucleus. The schwa-less pronunciation of *Handel* (i.e. [handl]), which can be observed in anything other than careful or emphatic speech, is an example of this. So, it is possible for R° to spread along with A^+ (although one would probably have to further investigate the mechanism which allows this to happen). Assuming that R° does spread, we get the representation in (52).

(52)
```
  O      N      O   N   O   N
  |     / \     |   |   |   |
[ x    x   x    x   x   x   x ]
  |     \ /     |    \ /
  r      u      d    v°
                     T
                     A+
                     |
                    (R°)
```

At this point, another assumption comes into play. Say, there is a constraint which prevents this kind of segment from being doubly linked to an onset and the *preceding* (as opposed to the following) nucleus. Then the segment would have to be delinked from the onset, so that the final syllable is completely empty. Empty syllables have no place in a representation, so that we end up with (53)[22].

(53)
```
   O     N     O   N
   |    / \    |   |
 [ x   x   x   x   x ]
   |    \ /    |   |
   r     u     d   v°
                   T
                   A+
                   |
                  (R°)
```

If this were the final output of the derivation, we would hear ['ru:dɐ]. The R° is still unlicensed, since it has to be licensed by a following filled nucleus, regardless of whether it is attached to an onset position or a nucleus. In (53), however, no such nuclear position is present.

We can now move on to the second cycle of the derivation of *Rudrer*. Obviously, what has just been described for the stem also happens to the *-er* suffix. Recall that the suffix takes the form shown in (54).

(54)
```
O   N   O   N
    |   |   |
    x   x   x
    |   |
    v°  v°
    T   T
    A+  A+
        |
     < (R°)
```

[22] I would claim that the loss of an entire syllable is not in conflict with the Projection Principle (see 3.2.2), since no governing relations between *existing* skeletal positions are altered. The skeletal positions disappear and take the relevant governing relation(s) with them, so to speak. Resyllabification is not involved.

The R° spreads to the left, yielding the ill-formed doubly linked segment shown in (52), which is delinked from the onset, resulting in the loss of the right-most syllable. So, the state of affairs at the end of the second cycle is this:

```
(55)  O      N      O   N   O   N
      |     / \     |   |       |
      x    x   x    x   x       x
      |     \ /     |   |       |
      r      u      d   v°      v°
                        |       |
                        A+      A+
                        |       |
                        R°      (R°)
```

At the end of the derivation, what started out as a lexically empty nucleus (the penultimate nucleus in (51) and now the penultimate nucleus in (55)) contains a full-blown consonantal [r]. This is the case because the element R° which is associated with this skeletal point is licensed by the following position, namely a filled nucleus. That filled nucleus (the right-most nucleus in (55)) also contains an R°. This R°, however, is not licensed, due to the absence of a licenser (i.e. a following filled nucleus). So, the predicted output is ['ru:drɐ]. Why FOD fails to apply in *Rudrer*, even for NSG speakers, is suddenly obvious. The crucial nucleus is not empty at all, and the illusion that there is an empty nuclear position present is created by the fact that a segment which is also found in onset positions occupies this nucleus.

Of course, there are far too many (as yet) unsubstantiated assumptions in what I have proposed for the derivation of *Rudrer* for it to be taken all that seriously as a complete explanation of what goes on. It is, however, a fact that some of the properties of *r* which play a crucial role in this derivation are the very properties which distinguish it from *l* and *n*. Specifically, the fact that its head is the cold vowel (which may be the cause of the special licensing requirements for R°) and perhaps also that it contains A^+ seems to be quite important here.

I am not claiming that my account of the behaviour of *r* is in any way definitive, but I do think that it may contain a few ideas which go at least some way towards accounting for the special properties of *r*, while it seems that, in earlier work, these properties were not even noticed, let alone tackled.

4.6 Apparent failure of FOD to apply word-finally

Before concluding this chapter, I need to deal with a small number of cases which appear to be in conflict with my view that, in *Hochlautung*, FOD applies before a licensed domain-final empty nuclear position. Given that word-boundaries and domain-boundaries normally coincide in German, any word where FOD fails to apply to a final consonant constitutes a counterexample to my analysis. Consider the data in (56).

(56)	hab' ich	[ha:b ɪç]	'have I'
	glaub' ich	[glaʊb ɪç]	'do I believe'
	werd' ich	[ve:ɐd ɪç]	'do I become'
	wurd' ich	[vʊɐd ɪç]	'did I become'
	find' ich	[fɪnd ɪç]	'do I find'
	fand' ich	[fand ɪç]	'did I find'
	sag' ich	[za:g ɪç]	'do I say'
	frag' ich	[fra:g ɪç]	'do I ask'
	kurv' ich	[kuɐv ɪç]	'do I drive round'
	reis' ich	[raɪz iç]	'do I travel'
	les' ich	[le:z ɪç]	'do I read'

The forms in (56) are arrived at by subject-verb inversion (for example in question formation) and by apocopation of the 1st sg. suffix *-e* (realised as schwa), an event which is common in casual speech and, as already mentioned, is indicated by an apostrophe in the orthography. What is of particular interest here is the fact that FOD does not apply to any of the word-final obstruents, which are word-final due to schwa apocope. This is particularly remarkable in the light of the fact that FOD *does*, in fact, apply where the same verb form is followed by a different personal pronoun, a pronoun which, like *ich*, is vowel-initial in the orthography. The relevant data is shown in (57)[23].

(57)	wurd' er	[vʊɐt ʔe:ɐ]	'did he become'
	fand' er	[fant ʔe:ɐ]	'did he find'
	sag' er	[za:k ʔe:ɐ]	'may he say'
	kurv' er	[kuɐf ʔe:ɐ]	'may he drive round'
	les' er	[le:s ʔe:ɐ]	'may he read'
	wurd' es	[vʊɐt ʔɛs]	'did it become'
	fand' es	[fant ʔɛs]	'did it find'
	sag' es	[za:k ʔɛs]	'may it say'
	kurv' es	[kuɐf ʔɛs]	'may it drive round'
	les' es	[le:s ʔɛs]	'may it read'

In (57), FOD applies just as predicted by my analysis. From a purely phonological point of view, there is no reason, however, why this difference between the phrases in (57) and in (56) should exist. I would argue that we are dealing with a phenomenon which goes beyond the phonology *per se*. Specifically, the personal pronoun *ich* behaves like a bound morpheme in (56); it does not appear to be in a separate domain from the preceding verb, which suggests that we are looking at a kind of inflectional affix or a clitic[24] (see also Charette 1988 (pp. 332ff.) for a discussion of clitics in French).

Zwicky & Pullum (1983) propose six criteria for distinguishing clitics from inflectional affixes. A detailed discussion of these would be beyond the scope of this thesis. Suffice it to say that, by Zwicky & Pullum's criteria, the *ich* in (56) exhibits characteristics of both affixes and clitics. What is more important in the context of the present discussion, though, is the question of what sort of

[23]The translation with *may* is intended as an approximation of *Konjunktiv I*.

[24]See Wiese 1988: 176ff. for a discussion of a different area of alleged cliticisation in German.

morphological structure we are dealing with. A compound structure of the type [[A][B]] is ruled out because, due to the constraint on onsets discussed in 4.3, this would predict the presence of a filled onset in *ich* ([ʔɪç]). This filled onset would separate the final empty nucleus in domain A from the left-most nucleus in domain B (occupied by [ɪ]), so that, even on the second cycle, the final empty nucleus in A would remain intact and no L^- could be licensed in a preceding obstruent, as illustrated in (58).

(58) a.

```
      O     N     O   N     O   N   O   N
      |    / \    |   |     |   |   |   |
  [ [ x   x   x   x   x ] [ x   x   x   x ] ]
      |    \ /    |         |   |   |
      h     a     p         ʔ   ɪ   ç
```

b.

```
      O     N     O   N   O   N   O   N
      |    / \    |   |   |   |   |   |
  [   x   x   x   x   x   x   x   x   x   ]
      |    \ /    |       |   |   |
      h     a     p       ʔ   ɪ   ç
```

This would yield [ha:p ʔɪç], a pronunciation which is possible in relatively careful speech, but which does not involve cliticisation (or affixation, as the case may be) of *ich*.

Alternatively, one could assume an analytic structure with two domains rather than three, i.e. [[A]B], which would enable the OCP to apply and thus produce a filled nucleus to license an L^- in a preceding obstruent, while, at the same time, capturing something of the partial independence of *ich* from the verb. The relevant derivation is shown in (59).

(59) a.
```
        O     N     O   N   O   N   O   N
        |    / \    |   |       |   |   |
  [ [ x    x   x    x   x ]     x   x   x ]
        |    \ /    |           |   |
        h     a     p           ɪ   ç
```
b.
```
        O     N     O   N   O   N
        |    / \    |   |   |   |
  [     x    x   x    x   x   x   x     ]
        |    \ /    |   |   |
        h     a     b   ɪ   ç
```

Yet another alternative would be to assume that what may have started out as cliticisation (or affixation) has found its way into the non-analytic morphology of German, so that forms such as /ha:b+ɪç/ actually constitute separate lexical entries.

Be that as it may, the discussion in this section illustrates the point that domain-boundaries and (orthographic) word-boundaries do not *necessarily* coincide. In German, the two do coincide in the vast majority of cases, but this cannot be taken for granted, and the failure of FOD to apply word-finally is an indication of the fact that a different configuration w.r.t. domain-boundaries is involved. In this case, *ich* does not occupy a domain of its own.

4.7 Conclusion

In this chapter I have investigated the question of where FOD occurs, in the framework of Government Phonology. I have observed that an FOD environment contains an FOD obstruent immediately preceding a licensed empty nuclear position. In the light of the fact that such positions appear to have limited licensing power in terms of government-licensing and, possibly, in terms of licensing segmental content (Korean, English), I have proposed to reinterpret FOD as an instance of autosegmental licensing. Specifically, I have argued that there are two elements in German which can only be licensed by a filled nuclear position, L^- and R°. The former accounts for FOD and the latter for *r*-vocalisation. German is a language which parametrically licenses domain-final empty nuclear positions, and I have shown that these positions cannot license L^- (or R° when in an expression with v° as the head)[25], so that FOD (and *r*-vocalisation) apply domain-finally, provided that no filled nucleus becomes available during the derivation.

By reanalysing Vennemann's variable items in the GP framework, I have also been able to account for the pronunciation difference between speakers of *Hochlautung* and speakers of NSG. This is due to the fact that *Hochlautung* speakers distinguish between parametrically licensed empty nuclear positions and properly governed nuclear positions. For these speakers, only the former are unable to license L^-. This distinction between the two types of licensed empty nuclei is not unique to German, as it has been described for other languages (e.g. French; see Charette 1988). NSG speakers, on the other hand, fail to draw this distinction between the two types of nuclei, so that FOD applies preceding both.

The GP analysis has also enabled me to shed light on some of the problems with Rubach's (1990) account and to show how some of these can be overcome.

[25]In Chapter 6 I will discuss the spirantisation of underlyingly voiced velar stops in FOD environments. It may be that ʔ° is another element which, under partially similar circumstances to those discussed for R°, cannot be licensed by a licensed empty nucleus.

CHAPTER FIVE

WHY FINAL OBSTRUENT DEVOICING?

5.1 Introduction

'Any attempt to explain non-assimilatory neutralization rules [such as FOD/WGB] must necessarily concede the inexplicability of the rule's occurrence and function.' (Dinnsen 1980: 176) Dinnsen makes this rather depressing statement with 'phonetic explanations' in mind, but I suspect that his view is shared by many linguists, quite irrespective of any particular explanatory angle. In other words, it would be presumptuous to expect to understand why FOD should have appeared in grammars all over the world and what it is there for. I have no intention of being presumptuous, but I would like to be a little less pessimistic. It seems to me that, as our understanding of the cognitive processes involved in speech grows, adopting a cognitive view of phonology can lead us at least some way towards finding some of the answers.

In this chapter, I would like to explore several aspects of the motivation for FOD and its potential function, beginning with a look at a possible cognitive function in parsing, followed by an account of physiological and physical conditions which encourage devoicing and ending with Parker's functional-perceptual analysis of the process.

I will adopt the view that, although there appear to be certain articulatory and aerodynamic factors which result in some degree of final devoicing, these are in no way sufficient to account for the existence and the particular properties of FOD. Instead, I will argue that FOD, as a phonological event which is related to, and yet distinct from, the effects of physical and physiological factors, is part of the grammar (specifically the phonology) of many languages because of its cognitive benefits. My interpretation of FOD is then teleological[1], in the sense that I believe that FOD can be better understood when one considers its *function* (as opposed to its *purpose*[2]).

5.2 The cognitive view

5.2.1 The function of phonological processes in general

I take the view that phonological events have certain functions to perform within a wider cognitive framework[3]. Kaye (1989: 156ff.) suggests that one of these functions is to make the speech signal more robust. According to him, cues which aid the hearer in processing the signal more efficiently, i.e. faster and more accurately, are plastered all over the signal because of the application of phonological processes. The non-analytic English prefix *in-* is a good example of how this works. Consider the two verbs *implode* and *include.* Leaving contextual cues for disambiguation, which are, of course, normally present in most actual utterances, to one side, the similarity between the two could well lead to misunderstandings if, say, the middle portion (i.e. the stop+liquid cluster and the vowel) were obscured by noise or some other source of interference. Both of them share the syllable structure shown in (1).

[1]See Vincent 1978 for a discussion of the theoretical issues involved in a teleological view of sound change. Lass 1980 (especially chapter 3) also contains a number of important points germane to this issue, in the more general context of language change (rather than sound change).

[2]See Andersen 1973 for a discussion of the distinction between teleology of function and teleology of purpose.

[3]See Kaye 1989 for a cognitive view of phonology.

(1)
```
        R
        |\
    O   N \       O       N      O   N
        |  \     / \     / \     |   |
        x   x   x   x   x   x    x   x
        |   |   |   |    \ /     |
        ɪ  m/ŋ  ?   ?   ?(?)     d
```

The segments that were obscured in the utterance we are interested in are marked with a ? in (1). Without the application of the phonological process which spreads the elements U° or v° respectively from the governing position of the branching onset onto the preceding coda position, it would be more difficult for the hearer to infer reliably which of the two words had been uttered. What happens, however, is that the hearer makes use of his knowledge of English morphology and the effects of phonological processes. He can identify the prefix as non-analytic and thus know that the place of articulation (if non-coronal) is necessarily the same as that of the obstruent following the nasal. In other words, a bilabial nasal signals the presence of a bilabial plosive (as in *implode*) and a velar nasal that of a velar plosive (as in *include*). Given the choice between these two words only, then, the success rate for identifying the right one would be 100%. Even in situations where the hearer has no idea what to expect, the likelihood of a correct guess would be very high, as *impede* is probably the only other English word which a hearer would include in the list of possible choices.

No doubt, innumerable other and better examples could be found to illustrate my point, but what is important here is to see how the cognitive mechanism of processing a speech signal is facilitated through the existence of phonological processes.

5.2.2 Specific phonological processes, including FOD

By the same token, one could claim that FOD provides certain cues which can be used in parsing. Specifically, I will argue that FOD helps the hearer locate domain-boundaries and thus makes it easier for him to parse a string of speech. The question begged by this line of argument is, of course, that knowing where a domain-boundary can be found is crucial for efficient parsing in the first place. This cannot necessarily be taken for granted - it very much depends on which model of speech recognition, or rather word recognition, one subscribes to. This area of research has witnessed major developments over the past decade, and, consequently, a wide range of theories is available, several of which are examined in Aitchison 1987[4] (chapter 16), on which much of the present discussion is based.

Consider, for example, the 'cohort' model of word recognition[5]. According to this model, words are identified, roughly speaking, on a segment-by-segment basis. As soon as the first segment is heard, a whole cohort of words sharing this initial segment is activated in the brain. This 'word-initial cohort' is then reduced as some of its members are eliminated when the second segment is perceived. This process is continued until the whole word is identified, which can be well before the whole word has actually been uttered, depending on the length of the word and the degree of rarity of its segment combinations.

Let me illustrate the workings of this model with the example used in the previous section. Suppose the hearer perceives the segment [ɪ]. He will immediately activate the word-initial cohort, i.e. all suitable words beginning with this sound. In theory, the list could be immensely long, e.g. *endear,*

[4]I am indebted to Dick Hudson for drawing my attention to her work.

[5]Aitchison (1987: 185) attributes this to Marslen-Wilson & Tyler (1980, 1981).

endanger, enclose, enrage, economy, elope, evade, idiom, idiot, idyll, if, iffy, igloo, ignite, ignore, ill, illegal, ilk, illegible, image, imbibe, imitate, immense, immerse, imp, impact, in, invade, inveigh, incense, insane, enrol, invert, it etc. etc. In practice, of course, it can never get to such huge dimensions because it will be constrained by the context. If the sentence preceding the word we are trying to identify is, *This proposal has to ...*, it is clear that a verb has to follow. In other words, only those verbs which begin with an [ɪ] will form part of the word-initial cohort. If [ŋ] is the next segment, the new cohort will contain a much smaller number than the word-initial cohort, as verbs like *enrol, inveigh, incense* etc. will have been suppressed again. The next segment, [k], decimates the cohort further and the segment after that, [l], reduces it to probably no more than four items, viz. *incline, e/inclose, include* and *enclasp*. The fifth segment finally clinches the matter, and *include* will be the only word to remain activated. The word has been identified before the final segment was even uttered, and there was certainly no need to refer to domain-boundaries at all. It seems, then, that if we adopt the cohort model of word recognition, domain-boundaries are of no importance, as the work may already be done by the time we get to the boundary.

As Aitchison points out, however, the cohort model does not account for the facts of word recognition as well as it might appear from this one example. Firstly, she observes (1987: 186f.) that many short words are not identified until another two or three words have been spoken. Clearly, a sequence such as [ɪn] could be part of a longer word (such as *endear*) or it could form an independent preposition. To be able to distinguish the one from the other in the phrases *incense him until he goes through the roof* and *in cents and other small coins* one has to hear more than just the segments [ɪ] and [n] before one can make a decision either way. It is only the arrival (and identification) of the next word, or next few words, which makes it possible to identify [ɪn] as occupying its own domain in the second phrase. The final decision depends on the presence of a domain-boundary.

Secondly, the cohort model makes the strong prediction that word recognition will be severely impaired or, more likely, break down altogether if the first segment of a word cannot be identified because it has been obscured by some form of interference. Aitchison (1987: 178) cites research work which shows clearly that word recognition can still take place under such circumstances, apparently without any particular difficulty. The experiment which led to this conclusion was the following. Hearers listened to the three sentences in (2), where the first sound of the final word was obscured.

(2) Paint the fence and the *?ate.*
Check the calendar and the *?ate.*
Here's the fishing gear and the *?ate.*

The subjects reported that they had heard *gate* in the first sentence, *date* in the second and *bait* in the third. Apparently, none of them had any problems in filling in the missing segment, which, even though there was a particularly helpful context available, should have been quite a tricky task if the cohort model did indeed reflect the actual mechanism involved in word recognition.

From these two points of criticism I would conclude that it is not enough to go through words from left to right on a segment-by-segment basis, even if one has the benefit of the context of an utterance and even if signal distortions were less common than they actually are. Some segment clusters may or may not constitute individual words and any cues which will make it easier for the hearer to find out where a domain (or analytic morpheme, such as a word or analytic affix, for example) begins and ends are bound to increase the efficiency of speech recognition. In other words, the need to refer to domain-boundaries is more than a mere assumption.

There is an incipient theory of lexical access and lexical representations (Kaye & Vergnaud 1989) which makes this necessity explicit in its system. According to this theory, parallel searches are carried out which cover individual domains. Once a domain has been identified, searches for each of the domains this larger domain is composed of (if any) are initiated. A word consisting of a single domain will be identified simply by lexical look-up. This method applies to all unanalysable words (e.g. *boy*) and those with non-analytic morphology (e.g. *parental*). Words with internal analytic domains, that is, of the structure [[A]B] or [[A][B]], e.g. *[[peep]ed]* and *[[black][bird]]*, trigger two and three separate searches respectively, depending on the number of domains they contain.

For this procedure to be able to take place, it is necessary to identify the boundaries of the relevant domains first. Beginning with word-boundaries, the hearer has to work his way into the structure from the outside, as it were. To do this, he needs certain clues which point towards the boundaries involved. To an extent, FOD can provide these clues.

Consider the following example, which is purely hypothetical, but which illustrates this point quite neatly. The two German nouns *Handlungen* and *Handlungen* appear to be identical at first sight. They do, however, differ in where the domain-boundaries fall. One of them is the plural form of the noun *Handlung* ('action'), i.e. *[[[Handl]ung]en]*, while the other is the plural form of a nonce compound[6] made up of *Hand* ('hand') and *Lunge* ('lung'). It is rather hard to interpret semantically, but most native speakers would probably guess something like 'handy, pocket sized artificial lung'. What matters is the bracketing, which is a lot less controversial than the meaning of this compound, i.e. *[[[Hand][lunge]]n]*.

[6]Compounding is highly productive in German.

Due to the differing locations of the domain-boundaries, the two compounds behave non-identically in German *Hochlautung* as far as the application of FOD to the coronal plosive is concerned (but not in NSG, see Chapter 4). *[[[Handl]ung]en]* is realised as ['handluŋən] and *[[[Hand][lunge]]n]* as ['hantluŋən]. The fact that *Hand* occupies its own domain in the nonce compound makes the application of FOD obligatory, whereas the domain-internal licensed empty nucleus separating the alveolar plosive from the following lateral fails to trigger the process in *[[[Handl]ung]en]*. It will be obvious to the hearer when he hears ['handluŋən] that searching for a domain *Hand-* would be futile. Instead, he accesses *Handl-*, the nominal suffix *-ung* and the plural suffix *-en*. The pronunciation ['hantluŋən], on the other hand, suggests quite unequivocally to a speaker of *Hochlautung* that a domain *Hand-* is involved, given that the underlying form has /d/. Obviously, semantic (and syntactic) information is also exploited.

Knowing where domain-boundaries are located is important for making parsing more efficient. I would argue that, as a consequence, the languages of the world employ a number of devices to signal the presence of such a boundary. French and Hungarian, for example, use stress for this purpose, domain-final in the case of French and domain-initial in the case of Hungarian. Similarly, the presence of a nasalised vowel followed by a nasal consonant invariably indicates that the end of a domain has been reached in French[7]. *Son ami* [sõnami] ('his/her friend'), for example, must have the morphological bracketing [[*son*][*ami*]], whereas the orthographically similar *bon ami* [bonami] ('good friend') has no internal analytic morphological structure. What has been said about FOD in the context of the *Handlungen/Handlungen* example suggests that FOD may work in a similar way.

[7]See Kaye 1988 for a detailed discussion.

Saying that speakers can recognise those obstruents which have been affected by the application of FOD as being different from those which are underlyingly voiceless would probably be too strong a claim to make, although there is some empirical evidence which suggests that the distinction between 'underlyingly voiced' obstruents and their 'underlyingly voiceless' congeners in FOD environments is perceptually salient to some extent. This issue is discussed in detail in Chapter 6. It may be, though, that hearers are not able to perceive the distinction reliably enough for it to be any help with parsing.

Moreover, the absence of a voiceless obstruent does not necessarily indicate the absence of a domain-boundary. After all, there are words which end in a vowel (e.g. *Frau* [frau], 'woman') or a sonorant consonant (e.g. *Ball* [bal], 'ball'). However, one can definitely say that a voiced obstruent will never be adjacent to a right-hand domain-boundary (strictly speaking, to a licensed domain-final empty nuclear position), regardless of what follows it. It seems, then, that FOD cuts down on the number of cues hearers have to listen for when trying to locate domain boundaries and thus facilitates parsing. Given that, in German, around 75% of all speech sounds are voiced (see Stock 1971: 52), it may be that hearers pay more attention when encountering a voiceless segment. At the same time it is also clear that FOD by itself can hardly be a sufficient cue to the presence of a domain-boundary. My guess is that there are other phenomena at work which provide further clues for the hearer, but which are not well enough understood in this context yet[8].

[8]For NSG speakers, it is not just domain-boundaries which are pointed to by the application of FOD, but any licensed empty nuclear position (the majority of which will be domain-final, it seems). It would be interesting to further investigate the significance of domain-internal licensed empty nuclei for parsing.

5.2.3 Why are there languages without FOD?

The question could be raised why it is that languages such as English, French etc. do not exhibit FOD. This is essentially the same as the questions of why English and German do not have nasalised vowels (at least not in a phonologically significant way) and why stress is not strictly fixed with regard to domain boundaries in a considerable number of languages. Consequently, all three of them would require the same response. What, however, this response should be is not at all certain. Phonological theories, on the whole, have very little, if anything, to say on this topic. In fact, it seems to be more of a philosophical than a phonological issue.

One might speculate that the choice of how to delimit domains is purely a matter of historical accident, which, of course, amounts to little more than conceding defeat altogether. Whatever the answer, if one can ever be found, may turn out to be, there is at least one testable prediction contained in this view of FOD and other phonological processes. Languages will exhibit some device capable of facilitating parsing by indicating the presence of a domain boundary. This may well turn out to be true, although a massive typological research programme would be necessary for checking the facts. One would also expect that where such a device is lost, for whatever reason, (as FOD was in Yiddish[9], English and French) some other means of carrying out this function will emerge or have emerged before the loss of the original device.

5.2.4 What makes FOD preferable to other conceivable voicing processes?

The next question which immediately suggests itself as a result of this cognitive functional account of FOD is, 'Why final obstruent devoicing?' What prevents

[9] See King 1969 and Kiparsky 1968, for example.

possible (or rather, impossible) processes such as sonorant devoicing[10] or obstruent voicing from fulfilling this function instead? The former option is excluded by the fact that sonorants lack laryngeal elements (except, of course, in tone-languages) and are, therefore, unable to undergo devoicing processes in the strict phonological sense.

Why the second choice, final obstruent *voicing*, should never manifest itself is a question which requires a slightly more complex response. Recall that FOD is confined to typical lenition sites, along with other processes which are generally accepted as phonological weakening[11], such as spirantisation and glottalling[12] (see Chapter 3 for discussion). A consistent analysis in the framework of Government Phonology would, consequently, require the process to involve the loss of an element. The only element whose loss could possibly result in a voiceless segment becoming voiced is the laryngeal element H^-. Final obstruent voicing would then involve a segment containing lexical H^- to lose this in the course of the derivation.

Imagine a language German', which is identical to German, except for the fact that it has FOV (final obstruent voicing) instead of FOD. This language German' would have non-alternating obstruents with no lexical laryngeal element (e.g. the [d] in *Bunde* ('league'), which would remain charmless throughout the derivation) or, perhaps, non-alternating voiced obstruents with lexical L^-, which would be undelinkable. By contrast, its alternating obstruents would have lexical H^-, which would be lost in FOV environments (e.g. the [t] in *bunte* ('colourful'), which would alternate with [d] in *bunt*).

[10]See discussion of possible counterexamples to this claim in 3.4.2.

[11]See Escure 1975, 1977 for a survey of properties shared by weakening processes.

[12]See Harris 1990 and Harris & Kaye 1990 for a discussion of t-lenition in English.

This assumes that a neutral t° can actually be interpreted as [d]. This is denied by my analysis of FOD as presented in Chapters 3 and 4, but let's assume that this can happen, for the sake of argument. Then it is fair to say that the theory of GP is just as capable of accommodating this unattested process as the one which actually occurs, i.e. final *de*voicing. This is bad news, since it suggests that GP is not sufficiently constrained. An unattested process such as FOV should not be expressible.

Although it may be possible to manipulate GP elements in such a way that FOV effects can be created, things are probably not quite as bad as they seem (especially if t° cannot be [d] in final position in German', as in real German). It may well be that there is a constraint to handle this problem which, so far, has not been formulated because of our limited understanding of voicing/devoicing processes. H^-, for example, may be an element which, for reasons yet to be explored, is universally prevented from delinking. If that were a constraint contained in the theory, it would indeed be unable to accommodate final *voicing* processes. Whether such a constraint could be included without weakening the theory, or would even reflect the facts of language, remains to be seen.

Two potential counterexamples, obstruent voicing sandhi in Polish and in some northern accents of English as well as high tone delinking in tone languages, could well be spurious. Obstruent voicing sandhi results from the spreading of L^- from an adjacent obstruent, or, in the absence of an obstruent, perhaps even from the loss of the noise element h°. As far as high tone delinking is concerned, it may be necessary to distinguish between delinking an H^- in a nuclear position (which it would occupy in a tone language) and in a non-nuclear position, an onset, to be precise (which it occupies when attached to an obstruent, as in German, for example). Again, further research would be needed to see whether there is sufficient evidence for such a distinction.

What is clear though, is that we would like the theory to give us principled reasons for the absence of final obstruent voicing. This is a goal which is yet to be achieved, but one can be hopeful that, as our understanding of universal constraints grows, it, too, will be within our reach.

5.3 The physiological/physical motivation for FOD

5.3.1 The idea: voiceless obstruents are easier to produce

We may, at least for the time being, have failed to come up with compelling phonological evidence for FOD being preferable to FOV. Once we turn to the phonetics, i.e. the physiological and/or physical aspects of speech, however, the reasons for the actual state of affairs become more apparent. In fact, we cannot only see why, given the as-yet-unexplained need for some kind of word-final process, it is FOD rather than FOV that occurs, but also why there should be a word-final process affecting the voicing of obstruents in the first place. The questions I want to try to answer in this section are these. Are there physiological and/or physical conditions which cause obstruents to devoice under certain circumstances? Is a devoiced obstruent in some ways easier to produce or perceive than its voiced congener when occurring domain-finally?

Treating production facts as purely physiological/physical is not particularly controversial, I believe. Perception, on the other hand, seems to be in a very different league. Where do the physiological and physical aspects of perception end and where does cognition begin? Are some sounds harder to perceive because of the way the human ear is constructed or because speakers are not used to distinguishing them from other, similar sounding ones in their particular language?

To my knowledge, there are no human speech sounds which pose serious physical audibility problems. However, there are myriad which are problematic for cognitive reasons. Speakers of English, for example, find distinguishing a high front rounded vowel from its back congener notoriously difficult. Anyone who has attempted to get a linguistically untrained English hearer to distinguish between the German words *Brüder* ['bry:dɐ] ('brothers') and *Bruder* ['bru:dɐ] ('brother') will be familiar with this problem. In other words, when considering perception, there is little point in investigating the physiological/physical aspects of speech. What is crucial here is cognition. Production, on the other hand, is much more strongly influenced by physiological/physical conditions and so it makes sense to confine the discussion of the physiological/physical motivation for FOD to production facts.

Let me begin with some basic and quite widely accepted facts about voicing obstruents, as summarised by Dinnsen (1980: 185). Voicing an obstruent involves, among other things, a differential in the air pressure above the glottis and below it. For the vocal folds to be able to vibrate adequately, the supraglottal pressure has to be lower than the subglottal pressure. However, the articulation of stops involves occlusion above the glottis, which results in an increase in supraglottal pressure. This increase eventually neutralises the pressure differential, causing the airflow from the subglottal area to stop and, as a result, voicing to cease, unless special adjustments which restore the pressure differential, such as lowering of the larynx, are made. As we shall see in 5.3.3, this view is somewhat simplistic, but it is widely accepted and will do for our purposes.

It seems, then, that the production of a voiced obstruent, at least a stop, is a fairly complex matter, more complex than the production of its voiceless congener. We know from language typologies[13] that the presence of voiced obstruents invariably implies that voiceless obstruents are represented in the sound inventory of a language as well. From whatever angle one looks at it, the special (marked) status of voiced obstruents seems undisputed (see, for example, Waugh 1979 for discussion). If we took the aerodynamic facts described above as evidence that voiced obstruents are harder to produce than voiceless obstruents and the fact that there is a clear universal preference for voiceless obstruents as a reflection of this, then we could interpret FOD as a process designed to eliminate phonetically 'difficult' (and hence phonologically marked) segments.

If that were so, then one would have to ask why FOD only applies domain-finally (or, for NSG speakers, next to a licensed empty nucleus). There is no obvious reason why it would be preferable to get rid of marked segments in these positions only.

5.3.2 A spurious reason why FOD is not universal in spite of the 'problems' with voiced obstruents

Secondly, we would want to know why FOD is not a universal process. After all, universality could be expected, given that the physical/physiological 'problems' with voiced obstruents are universal. Vennemann (1972b: 241) attributes this fact to 'its inescapable neutralization effect', which, however, fails to explain why some languages (i.e. those which exhibit FOD) give precedence to articulatory/markedness considerations and attach less importance

[13]Greenberg 1978 and Maddieson 1984, for example.

to questions of lexical recognition, while others (those without FOD) have reversed priorities. This question becomes particularly vexing when one takes a closer look at the actual effects of neutralisation. Vennemann's argument implies that languages avoid neutralisation effects in order to keep words distinct. The more homophones there are in a language, the more difficult a task lexical recognition becomes - this seems to be the bottom line of his argument.

Apart from the fact that it is not at all clear by what means the language (or the speakers) are supposed to have resisted the development of FOD in order to avoid excessive homophony[14], this argument is further weakened by findings from recent research into the structure of the mental lexicon and the mechanisms involved in lexical access and lexical recognition. To see how Vennemann's argument stands up to these recent insights, let us consider the processes involved in speech production and recognition with regard to the mental lexicon.

Following Fay & Cutler (1977), we can envisage a sequence of events looking something like this for production. The production device puts together a grammatical structure which can carry the meaning the speaker intends to convey. This structure contains the syntactic properties of the sentence to be produced and the meanings of the words that sentence contains. It does not, however, hold any phonological information, which has to be retrieved by accessing a particular representation by means of syntactic information (the syntactic category required, e.g. adjective, noun, verb) and information on the meaning of the intended word. Clearly, neutralisation of phonological contrasts could not possibly lead to a mix-up during this process, as the word is selected solely on the basis of non-phonological considerations.

[14]This sort of problem, though, is not unique to Vennemann's approach. See Lass 1980 (3.5) for discussion.

It is for the purposes of speech *recognition* that neutralisation becomes really important. Speech recognition in general seems to work roughly like this. Individual words/domains in an utterance are identified by the hearer and become activated in his brain. Which particular words are activated (until eventually the correct one wins out) depends to a large extent on the phonological representations of the words involved, because it is the phonological representations which provide the means of accessing the lexical representation. The similarity between the two is great enough to make this possible.

Apart from the phonological representations, the other decisive factor in word recognition is the context, as syntactic and semantic information provided by the context is also exploited in the recognition process.

Only under exceptional circumstances do human utterances come without a context, and it is then that communication is most likely to break down. This has been shown in experimental work[15] and can easily be verified in everyday life. People who know one another well (members of the same family, close friends and the like) are usually able to do without detailed introductions to particular topics. They have enough shared experience and intimacy for such introductions to be socially and practically unnecessary. In spite, or rather because, of this, occasional brief periods of misunderstandings can arise very easily. Sometimes the speaker's mind moves on to a different subject (maybe during a pause in the conversation), without any outward indication of this happening. She may then simply talk about the new subject without explaining this fact to the hearer. The hearer frequently either has no idea at all what to make of the utterance or interprets it wrongly, in spite of the fact that he has

[15]Aitchison (1987: 178f.) describes a study where hearers had to write down the sentence, *'In mud eels are, in clay none are'*, which was uttered with no explanatory context. None of the subjects were able to transcribe it correctly.

managed to identify most of the words (with the possible exception of some of the crucial content words) correctly.

The provision of a context for an utterance is crucial to successful speech communication. Investigating only how individual, isolated words are interpreted is not just an oversimplification. This approach is perfectly acceptable for studying phonological representations and phonological processes *per se*, but as soon as one moves into the realm of lexical recognition, which Vennemann's argument does by implication, it becomes positively misleading.

To see why this is so, consider the processes involved in recognition in a little more detail. The recognition device receives an input signal which it has to divide into suitable domains and then match against representations in the lexicon. The division into domains has already been adumbrated, so let us concentrate on the matching process.

It has been proposed (Fay & Cutler 1977, Kaye & Vergnaud 1989) that the recognition device is deliberately imprecise in its accessing of lexical representations. There are two reasons for this. Firstly, the signal is frequently distorted, so that, in spite of the application of phonological processes for extra robustness (see 5.2), it is not always possible for the hearer to be sure exactly what was uttered. The recognition device, therefore, accesses several lexical representations which match the portion of the signal which the hearer managed to identify. Having accessed these representations, the recognition device can check the syntactic and semantic properties of these entries (all of them in parallel), which will result in the deactivation of unsuitable words, until the correct word wins out eventually.

The second reason for the lack of precision in picking out lexical representations is that non-analytic morphology can be dealt with more efficiently if a whole set of similar representations is selected. A string consisting of [swVm], for example, will trigger the accessing not just of the representation of *swim*, but also of *swam*, thus enabling the hearer to make the connection between the two very quickly, should this be required.

If the signal comes across with no distortions, one can envisage that the particular representation which is associated with that signal forms the core, the centre of the set of lexical representations being accessed by the recognition device. It is perhaps even possible for this representation to be activated more strongly, while the other members of the set are still activated, but not to the same extent. This can be most easily visualised if one imagines that those lexical representations which have been activated 'light up'. The light intensity will be greatest for the representation at the centre of the set and decrease gradually towards its edges. More energy for pursuing the semantic and syntactic properties of the most brightly lit representation is then available, although all the other activated representations are searched at the same time, but, maybe, at a slightly lower speed. This would account for the fact that it is possible to identify words in isolation, in spite of the inaccuracy of the recognition device and the absence of syntactic and semantic information.

Be that as it may, the odds are that members of minimal pairs will be accessed together anyway. In other words, not just the members of the practically homophonous[16] pair *Bund* ([bunt], 'league') and *bunt* ([bunt], 'colourful') are accessed in a single operation, but so are the members of the minimal pair consisting of *Bunde* (['bundə], 'league', dat. sg.) and *bunte* (['buntə], 'colourful', fem. sg.). This means that loss of a minimal contrast makes no difference at all to the efficiency of recognition, and, to the extent that the

[16]As I will show in Chapter 6, there is evidence which suggests that the members of this pair are not completely homophonous.

models of lexical recognition and lexical access used here are sound, Vennemann's (1972b) argument is invalidated. It does not appear to be the case that FOD makes things 'decidedly less than optimal from what we might call an information-transfer point of view' (Westbury & Keating 1986: 161). So, this cannot be the reason why FOD is not universal. Another explanation has to be found for this fact, and I will put forward an idea regarding this point towards the end of this chapter.

5.3.3 The physiological/physical 'explanation' of FOD is unsatisfactory

Let me now return to the original discussion which led on to this excursus on neutralisation and lexical recognition. I was in the process of examining the hypothesis that FOD's sole purpose is to eliminate voiced obstruents, as these are universally less favoured than their voiceless congeners. Possible objections to this included that there was no obvious reason for FOD applying domain-finally, as there was nothing to suggest why it should be preferable to have no domain-final voiced obstruents, but to retain them, say, initially. Secondly, it was unclear why FOD should not be a universal process, given that the physical/physiological conditions which make the voicing of obstruents such a complex task are obviously bound to be universal, considering that 'there are no significant anatomical differences insofar as our articulatory organs are concerned within the human species' (Kaye 1989: 44). The question why FOD is not universal is still unanswered, but will be tackled again shortly (in 5.5).

A third argument against this simplistic view of FOD as a phonological event designed to facilitate articulation is the well-known phenomenon of intervocalic voicing. This process has been described as occurring both synchronically and diachronically. Intervocalic obstruents in Korean, for example, allegedly undergo a synchronic voicing process[17], and t-lenition in English (tapping in particular) has also been treated as a voicing process[18]. Diachronically, references to language change involving intervocalic voicing abound in the literature[19]. The lenition trajectory t → d → ð → ∅ for Romance languages is but one example of this. Actually, it is far from clear whether these so-called voicing processes ever resulted in the affected obstruents acquiring voice in the phonological sense (i.e. the laryngeal element L^{-}). As my concern in this part of the discussion is not the phonology, but some very basic physical/ physiological aspects of obstruent voicing, that is not important. What does matter here is the fact that some sort of obstruent voicing process (be it phonologically significant or not) is attested. So there seem to be two processes working in opposite directions, as it were, FOD away from obstruent voicing and the voicing processes just described towards obstruent voicing. This is surprising, to say the least, if FOD is really conditioned by physical/ physiological factors.

It seems, then, that there must be more to FOD than simply eliminating voiced obstruents at any cost. Perhaps we need to adopt a more differentiated view of the phenomenon by taking factors other than those which are immediately involved in voicing an obstruent into account. As pointed out by Ní Chasaide in a recent paper (Ní Chasaide 1989), both basic factors affecting the

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[17]Current research in the framework of GP (S.J. Rhee, p.c.), however, suggests that these segments do not acquire L^{-}. They are not phonologically voiced, but give the appearance of being voiced due to aerodynamic facts involving the unoccluded state of the vocal tract caused by the adjacent vowels. The absence of an active laryngeal gesture in these segments is further supported by evidence from experimental studies such as Hirose *et al.* 1974 and Kagaya 1974.

[18]See Harris 1990 and Harris & Kaye 1990 for evidence that 'voicing' plays no role whatsoever here, but that tapping, in fact, consists in the loss of the noise element h° and the occlusion element ?°.

[19]See, for example, Hyman 1975: 170, Escure 1975: 53 and Lass 1984: 180.

production of a segment *and* the conditions created by the environment in which it occurs need to be considered. Basic factors comprise articulation (i.e. muscular gestures) and aerodynamics, while environmental factors may consist in temporal compression and destressing. A reduction in the amount of time available to a particular segment (temporal compression) and the absence of stress, which tends to bring about a reduction in respiratory effort and, therefore, a lower potential rate of airflow through the vocal tract (destressing), have an effect on how 'well' particular segment types can be produced in certain environments.

As a result of the vocal tract being unoccluded, voicing is very easy to achieve in the articulation of an intervocalic obstruent, certainly easier than voicelessness. This is one aerodynamic reason for the common occurrence of the process of so-called intervocalic voicing (note that frequently this is not phonological voicing, but simply an aerodynamic effect, as already mentioned in footnote 17). Ní Chasaide (1989), however, points out that articulatory factors are even more important in this context. She argues that 'the relative complexity of the laryngeal gesture, the comparative sluggishness of laryngeal muscles and the intrinsic brevity of this positional variant' (p. 3) conspire to make the articulation of an intervocalic voiceless segment particularly difficult and hence susceptible to target undershoot. Intervocalic voicing constitutes such a target undershoot, and the likelihood of this occurring is especially high where the segment is exposed to further temporal compression.

FOD, on the other hand, occurs mainly in VC#-type environments[20]. As already mentioned, certain adjustments in the vocal tract (such as lowering the larynx, for example) are required to prevent the build-up of pressure in the oral cavity from neutralising the transglottal pressure drop necessary for attaining the target of voicing. The build-up of pressure in the oral cavity which results from complete oral occlusion obviously militates against voicing stops, whereas fricatives, due to the more open nature of their constriction, are less difficult to voice. At the same time, the VC# environment (where FOD occurs) requires more respiratory effort for voicing than, say, VCV. In other words, voicing obstruents, especially stops, is difficult for aerodynamic reasons anyway, irrespective of environmental factors, but it becomes even harder when the obstruent occurs in an environment where more respiratory effort for voicing is required.

Westbury & Keating's (1986) investigation of the naturalness of stop consonant voicing, which is based on a model of the physical and physiological conditions relevant to the voicing status of stops, runs along very similar lines and comes to essentially the same conclusions. Furthermore, Dinnsen (1980: 186) observes that the closure duration of final stops tends to be greater than in other positions[21], so aerodynamically occasioned cessation of voicing is particularly likely in this environment. To sum up, aerodynamic *and* environmental factors combine to make the production of word-final voiced stops comparatively difficult, with voiced fricatives being slightly less demanding.

[20]If one interprets the #-boundary as a word-boundary (rather than an analytic domain-boundary), 'mainly' in this sentence refers to the fact that FOD can also apply word-internally (before a domain-final empty nuclear position). Apart from this, FOD is also attested after sonorants, e.g. in a word such as *Hand* ([hant], 'hand').

[21]Dinnsen's source is Ohala 1972.

These arguments make very good sense in the context of words pronounced in isolation, but they are meaningless in connected speech. Word-boundaries in a normal utterance are not detectable aerodynamically, nor are domain-boundaries within a word. The phonetic explanation of FOD (in the sense of Ohala 1974) in terms of the aerodynamics of speech collapses like a house of cards when confronted with connected speech. As Keating (1988: 298) puts it,

> final devoicing of obstruents can be motivated physically by aerodynamic considerations, but only for utterance-final position; languages that employ devoicing rules in word-or syllable-final positions are no longer responding only to physical considerations.

The point is that all physiological/physical explanations can only account for a *tendency* towards loss of voicing in obstruents, and particularly in stops, under certain circumstances. This, however, is not FOD as such; it is a physical fact which can go some way towards resolving the question of why there should be final obstruent *de*voicing (rather than final obstruent *voicing*), but which has little to say about the *phonological* event which is the subject of this thesis.

The fact that, unlike these physical properties of the vocal tract and the associated aerodynamic effects, FOD is not universal is a reflection of this. If FOD were simply a physical effect, one would have to explain why some speakers are perfectly able to overcome these articulatory and aerodynamic obstacles and still produce final voiced fricatives, and even stops. What is particularly striking is the fact that these especially adept vocal gymnasts are not rare exceptions, but belong to overwhelming majorities in certain speech communities. Virtually all healthy speakers of many dialects of French, for example, perform these articulatory feats every day.

This brings me to a general point about phonetic explanations of synchronic phonological processes or diachronic sound change, with which I would like to conclude this section. The assumption that phonological processes and sound change can be motivated with reference to constructs such as 'articulatory effort' (see e.g. Ohala 1974, Bluhme 1981) is essentially absurd (see Lass 1980 (ch. 2) and Kaye 1989 (ch. 3) for further arguments). It predicts that, given enough time, all languages will eventually evolve very similar sound patterns, namely those which are most advantageous from an articulatory effort point of view. This, however, is not at all what we find. On the contrary, some languages develop the very sort of segments/clusters which have disappeared from another, allegedly because they were too difficult to articulate.

Another prediction 'phonetic explanations' make is that, once a sound change has removed certain problematic sounds or clusters, they will never be reintroduced into the language, since this would be a retrograde step which would be unexplainable in phonetic terms. Precisely those sort of retrograde steps, however, are well attested (although not well understood). FOD is a case in point, since, according to Kiparsky (1968: 177), although it was once common to all dialects of German, it is now no longer present in some dialects spoken in Northern Switzerland and in certain varieties of Yiddish. This is quite unexpected, given the sole parameter of articulatory effort.

It seems clear, then, that physiological factors alone cannot account for FOD, and it is likely that looking into its cognitive benefits is more revealing. In 5.2 I argued that FOD can help with parsing by making it easier for the hearer to locate domain-boundaries. In the next section, I will present an account which claims that FOD can also aid recognition at the level of segmental structure.

5.4 Parker's functional-perceptual account of FOD

According to Parker's functional-perceptual account (Parker 1980, 1981), perception facts are crucial to an understanding of FOD. Parker argues that word-final voiced stops are much harder to identify than their voiceless congeners, and that the application of FOD provides the hearer with additional acoustic cues to help him recognise the final segment.

His argument goes roughly as follows. The hearer relies on acoustic cues (ACs) for the identification of segments. These ACs vary to some extent, depending on the context in which the segment occurs. Word-final stops[22], for example, more often than not are unreleased (i.e. the AC contained in the release will be lost). Release is usually sufficient for the identification of the presence or absence of voicing in a stop, but where this particular AC is missing, hearers are cued for the voicing value of post-vocalic stops by the termination of the preceding vowel. Termination is defined by Parker 'in terms of the period of vocal cord vibration during the transition from vowel to stop. Before a voiced stop the period gradually lengthens; no such change occurs before a voiceless stop' (Parker 1980: 261f.). In other words, the fundamental frequency of a vowel drops to some extent when it precedes a voiced stop, but it remains unchanged when a voiceless stop follows. The former type of transition is known as *gradual* termination, while the latter is referred to as *abrupt*.

Both word-final vowels and vowels preceding a voiced stop are marked by gradual termination, so this AC is in fact ambiguous. As a result, a word ending in an unreleased voiced stop, such as *card*, may easily be confused with a

[22]It would be interesting to find out whether this applies only to word-final vowels where the relevant word is also utterance-final. Parker's story would be substantially weakened if the ambiguity of the AC of gradual termination were restricted in this way. There is no information on this point in his papers.

similar vowel-final word, e.g. *car*[23]. If an unreleased voiced stop is preceded by a nasal, there is no AC whatsoever to distinguish a word ending in a nasal+unreleased voiced stop cluster from a word with a final nasal, e.g. *stunned* vs. *stun*.

Nasals have stronger ACs than stops, voiced or voiceless, quite irrespective of where they occur. Finally, unreleased voiceless stops following nasals have one unambiguous AC, abrupt termination of the preceding vowel. According to Parker, the nasal intervening between the vowel and the voiceless stop only manifests itself as nasalisation on the vowel and there is, in fact, no separate nasal segment present. On the basis of these observations, Parker derives the AC hierarchy reproduced in (3) below (Parker 1980: 263).

(3)

Strongest	VN	*can*	[kæ̃n˺]	- ACs present throughout vowel and closure
	$VC_{[-vce]}$	*cat*	[kæt˺]	- one unambiguous cue, abrupt vowel termination
	$VNC_{[-vce]}$	*can't*	[kæ̃t˺]	- same as above
	$VC_{[+vce]}$	*cad*	[kæd˺]	- one ambiguous cue, gradual vowel termination
Weakest	$VNC_{[+vce]}$	*canned*	[kæ̃nd˺]	- no AC

V = vowel, N = nasal, C = stop

Parker's point is clear from (3). Final voiced stops are harder to perceive than, at least, voiceless stops and nasals, and replacing them by their voiceless congeners makes life a lot easier for the hearer.

[23]Parker's observations on ACs are based on research on English, but he assumes that the findings hold for German as well, since both German and English are Germanic languages. This assumption seems reasonable, especially since much of what Parker says refers to historical developments which English and German have in common. Moreover, studies carried out specifically on German data (e.g. Kohler 1982) provide support for Parker's claims.

It is not too difficult to find fault with Parker's proposals. For one thing, his claim that nasals sandwiched between a vowel and a voiceless stop are lost and only result in the nasalisation of the vowel seems too sweeping a statement to make, at least as far as articulation is concerned. It may, however, be true that there is no *perceptual* distinction between $\tilde{V}C_{[-vce]}$ and $VNC_{[-vce]}$. Secondly, it is not at all clear what happens after *l* and *r* (in rhotic accents). Thirdly, what Parker has to say about stops does not apply to fricatives, at least not to the same extent. After all, unreleased fricatives do not exist[24]. Why is it, then, that fricatives also devoice in most languages which exhibit final devoicing of stops? Parker has nothing to say on this subject, but one may speculate that some kind of extension from stops to fricatives may have taken place. This explanation would make the prediction that languages either devoice stops only or both stops and fricatives, but never fricatives only. This, to my knowledge, is actually true, Ferrarese Italian (see Dinnsen & Eckman 1978) being but one example of a language/dialect which gives preference to stop devoicing.

Parker himself (1981: 129), however, comes up with one possible counterargument to this line of reasoning. According to him, fricatives were devoiced *before* plosives in German, as far as the historical development of the process is concerned. The possibility of this happening seems to be further strengthened by King's (1969: 47) independent claim that final devoicing in German is (synchronically) limited to fricatives in some dialects. Unfortunately, Parker does not name his sources.

As already mentioned in Chapter 1, most historical works on German are much more concerned with the other changes the language underwent during its

[24]Kohler (1982), though, cites evidence which indicates that voiced fricatives, like voiced stops, are associated with gradual termination of the preceding vowel, while voiceless fricatives, like voiceless stops, trigger abrupt termination of the preceding vowel.

transition from Old High German to Middle High German than with final devoicing[25]. Those which devote more than a few words to it, tend to be somewhat vague on the question of which obstruent type (stops or fricatives) underwent the process first. None, of them, however, explicitly mention fricatives without referring to the devoicing of stops[26] as well. In fact, several[27] refer to stops only, from which I would conclude that stops may well have preceded fricatives, or, possibly, that both stops and fricatives were devoiced at the same time, but not that fricatives could have undergone the process before stops did.

As far as the dialects alluded to by King are concerned, I have no personal experience of such dialects, nor have I seen any detailed treatment of them in the literature. For the time being, I have nothing more to say on the subject, except that I feel inclined to believe that what is happening in these dialects may be different from FOD as described here and/or that these dialects may not have any voicing contrasts in stops anyway, as is the case in a number of Bavarian-Austrian dialects, for example.

My conclusion would be that an implicational hierarchy exists which requires stops to devoice if fricatives do. This conclusion is further supported by Dinnsen's (1980: 187) Atomic Devoicing Rule, which is based on 'a range of languages' (*ibid.*) and which is restricted to stops. The idea is that, this being the most tightly constrained application of final devoicing attested, the rule specifies 'all the necessary initial conditions from which any variation on that

[25]Bach 1961 and Keller 1978 have particularly little, if anything, to say on the subject.

[26]Priebsch & Collinson (1958: 119) provide examples of devoiced forms, involving both stops and fricatives.

[27]E.g. Chambers & Wilkie 1970 (p. 115), König 1978 (p. 73) and Penzl 1975. Kiparsky (1965: 7) also has a devoicing rule which refers to non-continuant obstruents only.

process can be predicted by universal principle(s)' (*ibid.*). The claim that fricative devoicing presupposes devoicing of stops is also made by Wheeler (1983: 65) for Catalan.

Let me now return to my three points of criticism of Parker's proposal (no doubt, the list could be extended). It seems to me that none of them are so fundamental as to call Parker's basic idea into question. I feel that all of them could probably be resolved in one way or another, and, even failing that, the crucial observation, that voicelessness in obstruents is perceptually more salient than voicedness and hence voiceless obstruents are easier to recognise as such, seems to be a valid one. An extension of this argument to the place of articulation is provided by Dinnsen (1980), who states that 'voiceless obstruents are perceptually more distinct from one another, at least as regards point of articulation, than are voiced obstruents' (p. 177)[28]. In other words, voiceless obstruents are less difficult to identify for the hearer in more than one respect, which makes Parker's analysis even more plausible.

However, if all this is indeed so, how can one account for the fact that there are languages, such as English and French, which do not take advantage of FOD? This question has already been touched upon repeatedly in this chapter, and I will tackle it in the next section.

[28]For evidence, Dinnsen refers to Greenberg & Jenkins 1964, Mohr & Wang 1967 and Schane 1972.

5.5 How did FOD get into the grammar of some languages - but not others?

To try and understand the fact that FOD, in spite of all its cognitive benefits, is not universal, we have to begin by investigating how a phonological process gets into the grammar in the first place. This is an extremely tricky undertaking, which, as yet, has defied anyone who has attempted it, so that anything I can say here is necessarily speculative.

The main problem with establishing the precise mechanism and causes of language change (or sound change, in this case) is what Lass (1980: 94ff.) calls the 'unobservability paradox'. What is meant by this term is roughly this. When observing a sound change, one can identify three stages. The first stage is the pre-change stage, when it is impossible to say wether there will be a sound change at all (or precisely what it will be). Stage II is the stage when the change happens, its point of actuation. Stage III, finally, is the stage when it becomes apparent that a sound change has taken place. It is now possible to pinpoint a difference in pronunciation between Stage I and Stage III. The problem is, that, by the time Stage III is reached, Stage II is already over. By the time we can tell that a change has taken place, the actual change has already happened. It is possible for scholars to watch it spread and so on, but it is not possible to know precisely what is involved in the actuation of the change.

I think that, although logically attractive, Lass's view is probably too pessimistic, since it seems to depend on the assumption that individual speakers switch from Stage I to Stage III in a single one-fell-swoop operation which takes a split second, as it were. This, however, is not the case. The fact that there can be variation in the speech of an individual, that is, that a single speaker's speech can exhibit properties both of Stage I and of Stage III, suggests that Stage II may, to some extent, be observable after all (see some of the papers in Labov 1980 for a discussion of the factors involved in the application of variable rules, which capture this kind of variation). So, although there is hope that we will eventually get to grips with Stage II, what happens there is still not completely understood at present.

As a consequence, we are still unable to fully account for the precise mechanism of sound change, which means that an answer to the second part of the question which makes up the heading of this section is not yet within our reach. Perhaps, though, I may be allowed some brief speculative remarks concerning this issue anyway.

Assuming that some speakers (however and for whatever reason) incorporated FOD into their grammars, we can safely conclude that this made their speech distinctive. Presumably, other members of the same speech community followed their example, and this is how the phonologisation of FOD spread (a grossly simplified account, by any standards). Members of groupings which were socially separate from the speech community *with* FOD[29], however, consciously or subconsciously may have resisted FOD in order to express their membership of, and loyalty towards, their own group (without FOD) by means of their pronunciation[30]. Perhaps it is social factors, then, factors which are independent of the grammar itself, which are responsible for the fact that FOD is not universal.

[29]See Andersen 1973 for a detailed discussion of how sound change, such as incipient use of FOD, for example, is likely to be resisted by (usually older) speakers observing the received norms for their language or accent and how the innovating speakers cope with this problem.

[30]A similar argument is put forward by Harris (1986: 137f.) with regard to vowel length variation in Hiberno-English.

Although we do not fully understand all the details of sound change in general, and the rise (and fall in some languages, such as English, French and Yiddish) of FOD in particular, we can still make some tentative predictions based on the various functions of FOD, as argued for in 5.2 and 5.4. I already made the point that languages without FOD appear to have alternative strategies for identifying domain-boundaries in 5.2. Now, as far as segmental structure is concerned, how do languages without FOD cope with the fact that gradual termination of a vowel cues both zero and a voiced obstruent, and with the fact that voiced obstruents are perceptually less distinct with regard to place of articulation than voiceless obstruents?

According to Parker, we can expect two things in such languages. Firstly, they will have a relatively small number of words ending in a voiced stop and, secondly, minimal pairs which differ only in their final segment, will be less likely to contrast final vowels with final voiced stops (e.g. *row-rogue*) than final vowels with final voiceless stops (e.g. *see-seek*). Both these predictions are borne out in English, he claims.

His 'cursory examination of English' (Parker 1981: 136) shows that words of the shape CVC ending in a bilabial plosive have [p] in 70% of the cases and [b] in the remaining 30%. Exactly the same ratio holds for words of the same type which have final velar stops. Parker excludes words ending in alveolar plosives from his survey because '/d/ is the only productive past tense marker in English for verbs ending in a voiced segment. This fact alone will raise the number of words ending in /d/ dramatically' *(ibid.)*.

Concerning the second prediction made by his analysis, Parker reports that, of all minimal pairs which contrast a vowel-final word with a stop-final one in English, only 7% involve voiced stops (e.g. *row-rogue*), whereas 93% contain one member with a voiceless stop (e.g. *see-seek*).

It seems, then, that English may have reduced the proportion of voiced obstruents in certain environments. It is, however, not clear what the mechanism involved in this process may be.

5.6 Conclusion

In this chapter I have considered several possible motivations for the existence and special properties of FOD. I have shown that some degree of devoicing of final stops and fricatives is essentially an effect of the physical and physiological constraints on speech production. However, these constraints in themselves do not suffice to motivate the systematic distribution of devoicing within different speech communities or the considerable extent to which the underlying contrast is neutralised. This can only be accounted for by the phonologisation of the phonetic facts, a process which, in itself, is not yet completely amenable to study.

This phonologisation, I have argued, has some advantages in cognitive terms. Firstly, parsing is facilitated by FOD, since domain-boundaries can be located more easily. Secondly, the perception of certain segments is made more efficient because FOD creates voiceless obstruents, which, due to their special acoustic cues, are more readily identifiable than their voiced congeners.

This interpretation makes predictions related to both types of cognitive gains to be derived from FOD. Firstly, languages which do not exhibit FOD would be expected to have alternative strategies for locating domain-boundaries and, secondly, such languages should have a comparatively small number of words ending in voiced obstruents and should contrast words ending in voiced obstruents with vowel-final words only in rare cases. Both of these predictions, on the whole, seem to be correct, as suggested by the stress and nasalisation facts discussed for French and Parker's statistical data for English.

FINAL OBSTRUENT DEVOICING AND NEUTRALISATION

6.1 Introduction

For over 50 years, the phonological event of FOD has been cited as one of the prime examples of phonological neutralisation. This view of it, however, has become quite controversial over the past decade. A lively debate about whether it is mistaken or not fills much of the experimental literature of this period (see, for example, Port *et al.* 1981, O'Dell & Port 1983, Dinnsen & Charles-Luce 1984, Fourakis & Iverson 1984, Charles-Luce 1985, Port & O'Dell 1985, Port & Crawford 1989; also Dinnsen 1985 and Fourakis 1984 for discussion).

In this chapter[1], I will try and unravel some of the issues intertwined in this debate and see what can be learnt from it.

I will begin with a brief overview of parts of the history of the theoretical construct of neutralisation, which will be followed by a discussion of the most important findings of the experimental work on FOD in German in the context of phonological neutralisation. I will point out some of the implications of this research for the phonological theory which inspired this work in the first place, but which does not appear to have benefited from it.

I will then provide a brief reminder of the relevant aspects of the GP analysis of FOD, as presented in Chapters 3 and 4. From the vantage point of this element-based (rather than binary feature-based) analysis, I will be in a position to identify some problems raised by the experimental studies as being artifacts of the phonological framework the studies took as their point of departure.

[1]An earlier version of this chapter appeared as Brockhaus 1991.

I will show that some of the basic tenets of GP make it possible for the remaining problems arising from the experimental work to be resolved.

6.2 Neutralisation and the traditional place of FOD

6.2.1 Two views of neutralisation: Trubetzkoy and Kiparsky

The notion of neutralisation was first introduced by Trubetzkoy in two 1933 papers (see Davidsen-Nielsen 1978: 27). In his seminal work *Grundzüge der Phonologie*, published six years later (Trubetzkoy 1939 [1969]), he uses the term neutralisation to cover a much wider range of possibilities than most writers on the topic after him. This high degree of differentiation is made possible through his use of the concept of the archiphoneme (first introduced by Roman Jakobson in 1929), which he defines as 'the sum of distinctive properties that two phonemes have in common' (Trubetzkoy 1939 [1969]: 79). In his view, there are four different cases of neutralisation to be found in natural languages.

In the first case, neither of the opposition members involved in the neutralisation is actually identical with the realisation of the archiphoneme in the position of neutralisation. In other words, given an opposition between segments α and β, what appears in the neutralisation environment will be a third segment γ, where γ has some properties of both α and β, without being identical with either of them. An example of this type of neutralisation would be the English flapping rule which merges the contrast between /t/ and /d/ into a new segment (often transcribed as [D]) which differs from both the two input segments (see Dinnsen 1985: 266).

In the second case, one of the opposition members is identical with the phonetic realisation of the archiphoneme in the position of neutralisation. The choice of which member occurs here is conditioned 'externally', in Trubetzkoy's terms, i.e. is dependent on the phonological properties of an adjacent phoneme. Voicing assimilation of obstruents (e.g. in Polish or Russian) would be an example of this case.

The third case is like the second, except for the fact that the choice of which member of the opposition represents the archiphoneme is conditioned 'internally', that is, in a privative opposition, the unmarked member of the pair will be chosen in the neutralisation environment by virtue of its being unmarked. FOD could serve as an example here, provided, of course, that the realisation of final /d/ is actually identical with the realisation of /t/ in the same environment.

The fourth case, which Trubetzkoy admits is rather rare and very often consists of a combination of the second and third cases, has *both* members of the neutralised opposition representing the archiphoneme in the neutralisation environment, one in one type of environment and the other in another. He gives the opposition of German [s] - [ʃ] as an example of a genuine (i.e. non-combinatory) instance of Case IV. He argues that this opposition is neutralised before consonants, with [ʃ] occurring root-initially and [s] root-medially and finally (p. 82).

A much more restrictive definition of neutralisation is advanced in Kiparsky 1976 (p. 169), where the concept of neutralisation plays a crucial role in the phrasing of the Alternation Condition (see Kiparsky 1976: 167f.). It takes the following form.

Suppose we have a phonological process P:

(P) A → B / XC __ DY

where C and D represent a (phonological and/or morphological) context, and X and Y are arbitrary strings. Then,

a. ...
b. P is NEUTRALIZING if there are strings of the form CBD in the immediate input of P; otherwise P is NON-NEUTRALIZING. (emphasis his)

What this definition says is that for a process to be neutralising the output B which it generates must already be present in the system. If B (or, more precisely, CBD) is not available as a potential input to P, then the process is non-neutralising. In other words, Trubetzkoy's Case I is excluded. So, English flapping, for example, would no longer qualify as a neutralisation process. This definition of neutralisation appears to have been accepted fairly generally in generative phonology, and some analyses crucially depend on it (e.g. Houlihan & Iverson 1979).

Kiparsky 1982b, however, marks the beginning of a substantial decline in the importance of neutralisation as a theoretical construct. The Alternation Condition, to which neutralisation was so important, is exposed as being seriously flawed, for, among other things, 'it is ... not a formal condition of the desired sort because the property of being a "neutralization rule" is not determinable from inspection of the grammar' (Kiparsky 1982b: 152). Except for informal use (which I will briefly touch upon at the end of this chapter), the term 'neutralisation' seems to have all but disappeared from phonological discussion.

Its spirit, though, lives on in the regulative principle of Structure Preservation in Lexical Phonology (see, for example, Pulleyblank 1986 (p. 7), Kaisse &

Shaw 1985, Kiparsky 1985). A structure-preserving rule is very similar indeed to a neutralisation rule by Kiparsky's 1976 definition. Structure Preservation may be somewhat less restrictive in that it does not require elements C and D of Kiparsky's 1976 definition of neutralisation. For B to be underlyingly present is sufficient. Also, neutralisation can be interpreted as a special case of Structure Preservation in that it relates to segmental structure only. Structure Preservation (at least in its more recent formulations; see Borowsky 1989[2]) also covers prosodic structure, such as constraints on the number of positions within a coda for example.

6.2.2 SPE-type analyses of FOD and their implications for FOD as a neutralisation process

In this section, I will summarise briefly the position adopted in, to my knowledge, practically all published work since Vennemann 1968 (see Chapter 2 for a more detailed discussion of earlier analyses).

FOD has essentially been dealt with in an SPE-type rule which specifies obstruents as being voiceless in some environment E. This is usually expressed in the rewrite rule [– son] → [– voice] / E. The rule predicts that what appears as [b] in one environment will emerge as [p] in an FOD environment and so on. This is illustrated for German in the data set in (1), which covers all obstruents exhibiting voicing alternations.

[2]She observes that the definitions of Structure Preservation advanced by Kiparsky and herself in 1985 and 1986 respectively suggested (without being entirely clear on this) that only segmental constraints were structure preserving. In her paper, she makes a strong case for explicitly including prosodic structure in the domain of Structure Preservation.

(1)

Spelling	*No FOD*	*FOD*	*Gloss*
gelbe	['gɛlbə]		'yellow' (fem. sg. nom.)
gelb		[gɛlp]	'yellow'
gelblich		['gɛlplɪç]	'yellowy'
Kinder	['kɪndɐ]		'children'
Kind		[kɪnt]	'child'
Kindchen		['kɪntçən]	'little child'
bergig	['bɛɐgɪç]		'mountainous'
Berg		[bɛɐk]	'mountain'
bergarm		['bɛɐkʔaɐm]	'lacking in mountains'
Hause	['haʊzə]		'house' (dat. sg.)
Haus		[haʊs]	'house'
Hausecke		['haʊsʔɛkə]	'corner of the house'
brave	['bra:və]		'well-behaved' (nom. pl.)
brav		[bra:f]	'well-behaved'
Bravheit		['bra:fhaɪt]	'good behaviour'

Given this SPE-type analysis, FOD obviously qualifies as a neutralisation process in Trubetzkoy's terms, an instance of Case III. That it also meets the requirements of Kiparsky's more restrictive 1976 definition is made clear by the data set in (2). The left-hand column shows words which would constitute 'strings of the form CBD' as input to P and the right-hand column contains words with apparently identical CBD strings (as far as the pronunciation, but not necessarily the morphological structure is concerned) which, in fact, were changed from CAD to CBD by the application of FOD. The relevant environment is emboldened and italicised in the orthography.

(2)

A***lptr***aum	ha***lbtr***ocken
['ʔalptraʊm]	['halptrɔkən]
'nightmare'	'medium dry'
a***ltb***acken	Wa***ldb***eere
['ʔaltbakən]	['valtbe:rə]
'old-fashioned'	'fruit of the forest'

We***rkw***ohnung	Be***rgw***acht
['vɛɐkvo:nuŋ]	['bɛɐkvaxt]
'company-owned flat'	'mountain rescue service'
Sch***afh***erde	Br***avh***eit
['ʃa:fhe:ɐdə]	['bra:fhaɪt]
'flock of sheep'	'good behaviour'

The SPE-type analysis of FOD, then, leaves no doubt about its neutralising status, regardless of whether one chooses to subscribe to a broad (Trubetzkoy) or a narrow (Kiparsky) interpretation of that concept.

The period of increased importance for neutralisation as a theoretical construct which began in the early 70's and came to a close with Kiparsky 1982b partly overlapped with a time of change in phonetics. There was a marked shift in the attitude of phoneticians towards the relationship of their science with the more theoretical aspects of linguistics, and phonology in particular. Well into the 1970s, the general consensus had been that phonetics was charged with establishing how exactly the linguistically determined categories were borne out in the 'real world' of speech sounds. This view met with increasing dissatisfaction from practising phoneticians, resulting in a conscious effort to establish 'experimental phonetics as a serious contribution to theory and explanation in phonology rather than as a mere field of additional concrete descriptive statements' (Kohler 1984: 151). The title of Ohala's 1974 paper (phonetic explanation in phonology) constitutes a kind of manifesto of this new approach to phonetics. Neutralisation was one of the first issues to be tackled, with final devoicing in German, *the* textbook example of it, attracting most attention (see 6.1 for references).

6.3 The neutralisation debate in the experimental literature

6.3.1 The studies and their findings

Most of the work was carried out in the United States. As far as one can tell, all researchers based their work on Kiparsky's 1976 definition of neutralisation, although only a small minority state this explicitly. What is clear, though, from the ways the studies are conducted is that neutralisation is interpreted as a devoiced obstruent becoming indistinguishable from its underlyingly voiceless congener.

It turned out that it was extremely difficult to establish this reliably. The most important problems were connected with the set-up of the relevant experiments and the choice of test words (and, occasionally, the voicing status assigned to the underlying segments; e.g. Mascaró 1987b). One of the objections taken most seriously was that experiments which involved reading lists encouraged so-called spelling pronunciations. The problem was that, in a language such as German, the spelling of the alternating segment remained unchanged, regardless of whether it was pronounced as voiced or voiceless (see (1) for examples). It was argued (e.g. in Fourakis & Iverson 1984) that this 'voiced' spelling suggested to the experimental subject a voiced sound or at least some residue of voicing, which then led to a distortion of the results. The researchers explored two different ways of overcoming this problem. Firstly, in studies on German, test words were elicited without reading lists by orally cueing subjects for an infinitive form of a verb which had to be conjugated. The preterite form contained the desired FOD obstruent (see Fourakis & Iverson 1984). Secondly, experimental work was carried out on languages, such as Catalan, where the spelling of FOD obstruents generally changes with their voicing value (see Dinnsen & Charles-Luce 1984, Mascaró 1987b and Charles-Luce & Dinnsen 1987).

The findings were less clear-cut than the researchers had hoped. Some studies had negative results, i.e. no statistically significant differences between underlyingly voiceless obstruents and their devoiced congeners were identified (e.g. Fourakis & Iverson 1984 for German and Jassem & Richter 1989 for Polish). Others, however, reported positive results, i.e. statistically significant differences between these groups of voiceless obstruents had been observed (e.g. Port *et al.* 1981, O'Dell & Port 1983, Port & O'Dell 1985 and Port & Crawford 1989 for German; Slowiaczek & Dinnsen 1985 for Polish and Dinnsen & Charles-Luce 1984 and Charles-Luce & Dinnsen 1987 for Catalan). It is hard to say what exactly the reasons for the differing results were, but it appears that the details of the experimental set-up and the statistical methods of analysis may have been decisive.

There can be no doubt that the differences in the production of devoiced obstruents and underlyingly voiceless obstruents are very small indeed, but, in my view, those researchers who observed these differences and showed that they are statistically significant have a better case than those who argued that the differences are non-existent or not significant. Firstly, the former used a much wider range of different experiments and statistical methods than the latter, and still succeeded in consistently coming up with similar findings. Secondly, as Dinnsen (1985) points out, the failure to find statistically significant differences does not necessarily mean that they are not there. Perhaps the researchers were looking in the wrong place. It seems reasonable, then, to conclude that, at least for the languages examined and as far as production is concerned, neutralisation may not be complete.

Before discussing the findings and the issues they raised further, let me first describe the general pattern of the experimental design to which most of the studies conformed, to show how these findings were actually arrived at. This section covers studies on German only.

Words containing alternating obstruents in FOD environments (i.e. realised as voiceless) were elicited from native speakers together with similar words with underlyingly voiceless obstruents, so that sets of minimal pairs (e.g. *Rad* 'wheel' and *Rat* 'advice') or near-minimal pairs were recorded (the focus of the experiment was usually disguised by mixing these words with others not relevant to the study). These recordings were then used for measurements of various temporal aspects of the pronunciations of these words. Most commonly, the researchers measured the duration of the vocalic nucleus preceding the obstruent under investigation, the duration of the period for which glottal pulsing continued from the preceding nucleus into the closure or friction phase of the obstruent itself and the duration of the closure or friction phase of that obstruent.

As shown in (3), it was generally found that underlyingly voiced obstruents differed from their underlyingly voiceless congeners in that the preceding vowel was longer, the duration of voicing into closure or friction was greater and the duration of the closure or friction phase was shorter. It was not necessarily the case that each study found statistically significant differences for *all three* variables at the same time.

(3)

Phonetic variables	*Most common findings*	
	Underlyingly	
	voiced	*voiceless*
Duration of preceding vocalic nucleus	longer	shorter
Duration of voicing into closure/friction (from the left)	longer	shorter
Duration of closure/friction	shorter	longer

To see whether the contrast which was maintained in the production of obstruents was also perceptually salient, listening tests were carried out. For this purpose, recordings of a large number of tokens (usually the words used in the production experiments) were played to native speakers of German (not those used in the production experiments, of course), whose task it was to pick out the form they believed they had just heard from two choices presented to them on an answer sheet. The overall percentages for correct responses are shown in (4). In some cases, these are the means of results from several experiments conducted as part of a single study.

(4)

Study	*Percentage of correctly identified tokens*
Port *et al.* 1981	70%
O'Dell & Port 1983	63%
Port & O'Dell 1985	59%
Port & Crawford 1989	69%

The relatively wide range of these results is due to differences in the experimental set-up (in one case, for example, speakers were told to dictate the words to someone when the recording was made, so their pronunciation was exaggerated to reflect the spelling - interestingly, however, not to such an extent that the listeners were able to identify much more than about 70% of the words correctly). Whatever the most representative figure may be, it is clear that the level of correct responses cannot be due to mere guessing. The performance of the subjects may have been poor, but it was still consistently better than chance. The researchers concluded that the underlying voicing distinction is maintained to the extent of being perceptually salient. However, it is not clear whether it is salient enough to be relied upon in normal communication.

Apart from the original issue of neutralisation, to which I shall return shortly, a number of other questions were raised by this experimental research.

Most of them fall into one of two categories, the question of the relationship between production and perception, and the issue of how exactly the output of the phonology is implemented phonetically. I shall discuss them in turn, starting with the issue of production vs. perception.

6.3.2 The relationship between production and perception

It is clear from (3) and (4) that there is a certain mismatch between production and perception concerning the distinction between underlyingly voiceless vs. devoiced obstruents. The production facts suggest that the two are different, as do the perception facts - but only to a point. Even if 60-70% of all word-final voiceless obstruents can be correctly identified as underlyingly voiceless or devoiced by native speakers/hearers, that may still leave too great an error margin for anyone to wish to say that this distinction is used to carry information crucial for successful communication.

If the perceptual contrast between the two groups of voiceless obstruents, then, is too small to be important, one could argue that, as far as perception is concerned, neutralisation is perhaps complete after all. One conclusion one could draw from this is that the statistically significant differences in production are linguistically not significant. How can this mismatch between production (where consistent differences have been observed) and perception (where the difference is only marginally salient) be captured in a grammar which is neutral with regard to speaker vs. hearer? This neutrality is, after all, one of the basic assumptions about the grammar in current mainstream thinking in generative phonology[3]. The question of how to deal with this mismatch is discussed by Dinnsen (1985) as part of his review of the concept of neutralisation.

He concludes that it is impossible to reconcile such differences between production and perception, and suggests that production and perception should be seen as being at least partially independent of one another (see also Klatt 1981 for detailed arguments in favour of the dual-lexicon hypothesis).

Obviously, the dual-lexicon hypothesis is far too big an issue for a satisfactory discussion in the present chapter. What matters for our purposes is that, from the phonologist's point of view, it would be preferable to be able to work with a single lexicon. This would avoid additional problems, such as a substantial complication of the grammar, concerns about storage space and questions regarding the interaction between the two lexicons. Ideally, one would hope that a single lexicon could accommodate both production *and* perception (see Fay & Cutler 1977 for evidence from production errors which supports the view that there is just one lexicon).

Whatever one's view of other arguments advanced in favour of the dual-lexicon hypothesis may be (e.g. in Klatt 1981), as far as FOD is concerned, it is my contention that the mismatch between production and perception can be resolved without resorting to the dual-lexicon. I will discuss this below, in the context of my GP analysis of FOD.

[3]A mismatch between production and perception has also been reported in the context of historical mergers (see, e.g. Harris 1985: 334ff., Nolan 1986). Of the explanations advanced for this I find the view that fine auditory distinctions made by the child are not maintained later in life most interesting (attributed to Drachman by Linell (1979: 42)). The idea is that children perceive any consistent distinctions present in adult articulation and form articulatory habits of their own which incorporate these distinctions. The ability to discriminate so finely is, however, lost with age, so that adult speakers who produce two distinct segment types are unable to tell them apart. As I am not familiar with conclusive arguments concerning this view, I shall not pursue it further. In any case, Drachman's ideas are compatible with my own proposals (see 6.4.4), so that it is not vital to make a decision here.

6.3.3 The implementation of FOD

The second additional issue raised by this experimental work concerns the phonetic implementation of FOD. The researchers wondered how the systematic production difference between underlyingly voiced obstruents and their underlyingly voiceless congeners in FOD environments could be reconciled with the prevailing assumption that the two are identical phonologically (see Nolan 1986 for a brief discussion of some possible answers to this question).

One way of dealing with this problem is by means of phonetic implementation rules[4]. Specifically, it was suggested (in Port & O'Dell 1985) that phonetic implementation rules should not just be understood as implementing segments and segmental features, but as implementing properties of whole syllables as well. In the context of FOD the idea was that an underlyingly voiced syllable-final obstruent would not undergo a devoicing rule in the phonology, but would become the input to the relevant implementation rule with its [+ voice] specification intact. The syllable implementation rule would then initiate 'a gesture that resembles the segmental implementation of [– voice]' (p. 468). This would guarantee that both [– voice] and syllable-final [+ voice] segments were pronounced in a very similar way, but not identically.

Implementation rules, like the dual-lexicon hypothesis, are a complex and widely-debated issue (at least in the phonetic literature), an issue that cannot be done justice to in a thesis such as the present. I will, therefore, consider only how FOD would fare in a grammar incorporating both phonological rules and phonetic implementation rules.

[4]Phonetic implementation rules, which appear to amount to the same thing as phonetic realisation rules, are, of course, nothing new. They have been discussed in the literature at least since the days of SPE (see Hewlett 1981 for a survey of different approaches to these rules).

An important question which has been discussed by proponents of such implementation rules is how exactly they interact with phonological rules. One of the clearest recent statements of this relationship I am aware of comes from the phonological (Lexical Phonology) rather than the phonetic literature. Pulleyblank (1986: 7f.) suggests that the phonetic rules (I believe that these are essentially the same as Port & O'Dell's (1985) implementation rules) should apply after all phonological rules, that is, the input of the phonetic component is the output of the postlexical phonology[5]. According to Port & O'Dell's (1985) proposal, FOD would not be dealt with by the phonology, so that FOD obstruents would proceed without change to the phonetic component, where the syllable implementation rule would initiate the correct gesture.

Intriguingly, however, this is not the approach adopted by those phonologists who have developed an analysis of FOD in the theoretical framework in which Pulleyblank operates, that of Lexical Phonology. Both Rubach (1990) and Hall (1989a, b) account for FOD in terms of a phonological rule (a postcyclic rule in Rubach's case and a postlexical rule in Hall's). In other words, the currently available Lexical Phonology approaches to FOD are beset by the very problems which led to Port & O'Dell's proposals about implementation rules in the first place. Both underlyingly voiced and underlyingly voiceless obstruents enter the phonetic component with a [– voice] specification, which, counterfactually, predicts identical realisations for both in FOD environments.

For the present discussion of implementation rules, however, choices made for existing analyses (such as Rubach's and Hall's) are not crucial. What really matters is whether it is possible *in principle* to deal with FOD in the phonetic

[5]See also Mohanan 1986 (chapter 6) for a much more detailed discussion of issues associated with phonetic implementation.

(as opposed to the phonological) component. Consider the following words taken from Rubach 1990 (p. 84).

(5)	*Voiced obstruent*	*Voiceless obstruent*
	Handl+ung 'act' (handel+n 'to act')	hand+lich 'handy'
	Ordn+ung 'order' (ordn+en 'regulate')	Bild+nis 'portrait'
	ebn+en 'flatten' (eben 'flat')	Ergeb+nis 'result'
	Begegn+ung 'meeting' (begegn+en 'meet')	Wag+nis 'boldness'
	eign+en 'own' (eign+en 'to own')	Zeug+nis 'testimony'
	nebl+ig 'foggy' (Nebel 'fog')	glaub+lich 'believable'

As far as I know, it is uncontroversial among phonologists who have dealt with data of this kind in a syllabic framework that the FOD obstruents in all these words are syllabified into the coda[6]. This syllabification is obligatory (or at least strongly preferred, according to Vennemann's Law of Initials (see Vennemann 1972a, 1988)), except for *Begegnung, eignen* and *neblig,* where an alternative syllabification into *Bege.gnung, ei.gnen* and *ne.blig* is possible[7]. However great the differences between various phonological analyses may be, the general consensus is that these words (and others like them, of course) leave the phonological component with a syllable-final obstruent.

The implementation rule proposed by Port & O'Dell takes such syllable-final obstruents as its input and hence initiates the appropriate gesture for devoiced

[6]Note, however, that this view differs fundamentally from the GP approach to the syllable in general and to words such as those in (5) in particular (see Chs. 3 and 4).

[7]See Ch. 4 for a discussion (in the GP framework) of the clusters involved here.

obstruents in these words. This, however, is wrong for ***Handlung, Ordnung, ebnen*** and so forth, where FOD does not actually apply in *Hochlautung*. In other words, implementation rules which take their input from the output of the phonology generate incorrect forms for the pronunciation of a number of German words in the standard variety.

It seems, then, that implementation rules are unable to solve the problems with FOD. Perhaps something more fundamental is amiss, which makes it impossible for an SPE-derivative framework using binary features to handle the phenomenon of FOD.

Having discussed two issues arising from the experimental studies of FOD, which are essentially independent of the original question to be answered, let me now return to that original question and see what conclusions were drawn with regard to neutralisation.

6.3.4 Experimental studies and phonological neutralisation

Given that most of the experimental studies were based on Kiparsky's 1976 definition of neutralisation, it is clear that those which reported differences between underlyingly voiced and voiceless obstruents in FOD environments could only conclude one thing: FOD was not a neutralisation process. In fact, even by Trubetzkoy's broader classification, FOD would have lost its status as a neutralisation process.

Dinnsen (1985) even went so far as to argue that not only was FOD not a neutralisation process, but that *all* putative neutralisation processes turned out to be non-neutralising under closer scrutiny. The consequences of this for the sort of phonological theory which depended on neutralisation as a theoretical construct could have been serious. However, Dinnsen's claims seem to have had no perceptible effect on phonological debate. Part of the reason for this may have been the fact that, by the time Dinnsen made his claims, neutralisation by that name was already playing a substantially reduced role in mainstream phonological thinking (see Kaisse & Shaw 1985: 24f.). Also, the notion of Structure Preservation (which had been introduced in Kiparsky 1982c) was being used to capture what had previously been handled by neutralisation (segmental structure), and possibly even more than that (prosodic structure; see footnote 2).

As far as Dinnsen's observations were concerned, though, the new Lexical Phonology broom of Structure Preservation swept only slightly better than the old one of neutralisation. The implication would have been that Structure Preservation was limited to prosodic structure only (if that). This, of course, would have meant substantial erosion (or even complete wiping out) of this theoretical construct. In fact, a considerable amount of evidence has come to light in recent years which suggests that Structure Preservation is much more limited than previously assumed (see, for example, Borowsky 1989, Hall 1989b and Harris 1987, 1989b) - something which could be interpreted as a vindication of Dinnsen 1985. So, work in phonology could perhaps have benefitted from taking on board some of the concerns arising from phonetic research.

6.3.5 Summary

To summarise, experimental studies which set out to establish whether FOD was a neutralisation process came to the conclusion that it was not, a fact which, when taken together with similar findings for other alleged neutralisation processes, could have had important repercussions for phonological theory, but which was generally ignored in phonological debate.

These studies also found evidence that there is a mismatch between production and perception, with speakers being largely unable to reliably perceive distinctions which other members of their speech community (and presumably they themselves) produced. This problem was seen as a strong argument in favour of the dual-lexicon hypothesis, a highly controversial issue which, on the whole, has not been addressed in the phonological literature.

Finally, in the light of the fact that the predictions made by the phonology were not borne out by the production facts, some researchers suggested that special implementation rules should handle FOD. This meant that FOD was thus interpreted as a phonetic, as opposed to a phonological, process. However, as I have shown, it does not appear to be possible to accommodate FOD in such a system, at least not when employing the particular syllabifications and rules discussed in 6.3.3.

In the next section, I will contrast the analyses available in the SPE-derivative frameworks discussed so far with my GP analysis of FOD, as presented in Chapters 3 and 4. It will become apparent that some of the problems just summarised are simply artifacts of an unsuitable theoretical framework and that the remainder can be resolved in the framework of GP.

6.4 The GP analysis

6.4.1 The proposals

As discussed in Chapters 3 and 4, I propose to treat FOD as an effect of autosegmental licensing. Specifically, I have argued that the laryngeal element L^- has to be licensed by a following nucleus. Just as nuclei have to discharge their government-licensing responsibilities, they also have to account for the licensing of certain elements within the preceding onset. The autosegmental licensing powers of certain types of nuclei are parametrically variable. In German *Hochlautung*, for example, parametrically licensed domain-final empty nuclear positions are unable to license L^-, whereas properly governed domain-internal empty nuclei do have the power to license this element.

As a result, L^- is only licensed when preceding a filled nuclear position or a properly governed empty nuclear position, so that voiced obstruents (i.e. those which contain L^-) only surface next to vowels (e.g. in *Rade* ['ra:də], 'wheel' (dat. sg.)) or next to a stem final consonant which is separated from the FOD obstruent by an empty nucleus (e.g. in *ebnen* ['e:bnən], 'to level'). The relevant segmental representations are shown in (6), with an unlicensed element appearing in brackets, as in Chapter 4.

(6)

x	x	x	x	x	x	x	x	x	x
$\underline{U}^{\circ}$	$\underline{U}^{\circ}$					U°	U°		
		$\underline{R}^{\circ}$	$\underline{R}^{\circ}$					R°	R°
				$\underline{v}^{\circ}$	$\underline{v}^{\circ}$				
ʔ°	ʔ°	ʔ°	ʔ°	ʔ°	ʔ°				
h°	h°	h°	h°	h°	h°	$\underline{h}^{\circ}$	$\underline{h}^{\circ}$	$\underline{h}^{\circ}$	$\underline{h}^{\circ}$
L^-	(L^-)	L^-	(L^-)	L^-	(L^-)	L^-	(L^-)	L^-	(L^-)
[b]	[p]	[d]	[t]	[g]	[k]	[v]	[f]	[z]	[s]

These representations, which contain L^- (licensed or unlicensed) throughout, contrast with those of non-alternating voiceless obstruents, that is, those which appear as *p, t, k, f* and *ß* (or *s* in certain positions) in the German orthography. These are characterised by the laryngeal element H^-, which requires no special licensing and is, therefore, always licensed, regardless of the properties of the following nucleus. The relevant segmental representations are repeated here from 3.4.3.2.1 as (7), for convenience.

(7)

x	x	x	x	x
$\underline{\mathrm{U}}^{\circ}$			U°	
	$\underline{\mathrm{R}}^{\circ}$			R°
		$\underline{\mathrm{v}}^{\circ}$		
ʔ°	ʔ°	ʔ°		
h°	h°	h°	$\underline{\mathrm{h}}^{\circ}$	$\underline{\mathrm{h}}^{\circ}$
H^{-}	H^{-}	H^{-}	H^{-}	H^{-}
[p]	[t]	[k]	[f]	[s]

The transcriptions used in (6) and (7) suggests that the voiceless segments are completely indistinguishable from one another phonetically, in spite of the fact that their phonological representations differ (those which are underlyingly voiceless contain H^{-}, while devoiced obstruents have an unlicensed L^{-}). This is not what is intended. It is simply an artifact of the IPA symbols. On the contrary, my analysis predicts that devoiced obstruents (i.e. those with unlicensed L^{-}) differ from underlyingly voiceless obstruents (i.e. those with H^{-}) at all levels of derivation, including the final output. In other words, my analysis implies that FOD is not a process of neutralisation in the sense of Kiparsky 1976 (and Trubetzkoy 1939 [1969]). If this is true, then both phonological and phonetic evidence should be available to support my claim. Indeed, such evidence can be found.

6.4.2 Phonological evidence

6.4.2.1 Spirantisation of velars: two analyses

The phonological evidence comes from Northern Standard German (NSG), a dialect which, as already mentioned, is relatively similar to *Hochlautung*, as far as FOD is concerned. Speakers of both dialects use FOD in identical ways, except for the fact that speakers of *Hochlautung* restrict the application of FOD to environments with parametrically licensed domain-final empty nuclear positions, while NSG speakers fail to license L^- also before other licensed empty nuclei (see Chapter 4 for details). This difference affects only a relatively limited number of words of a certain structure.

Another difference between the two dialects which, by contrast with the restriction on FOD environments in *Hochlautung* just described, manifests itself throughout the vocabulary consists in the spirantisation of devoiced velar stops in NSG. *Hochlautung* has no general spirantisation processes to speak of[8], but NSG speakers systematically spirantise all those underlyingly voiced velar stops which occur in FOD environments. Spirantisation of underlyingly voiceless velar plosives, however, is blocked. This is illustrated in (8). The contrast between the NSG pronunciation of devoiced velar plosives[9] and the corresponding *Hochlautung* pronunciation is shown in (8a). The absence of spirantisation from underlyingly voiceless velar stops makes the relevant NSG and *Hochlautung* pronunciations identical, as exemplified in (8b).

[8]But see Hall 1989b for a Lexical Phonology account of the spirantisation of the velar stop in the suffix *-ig* in *Hochlautung*. In my view, the question of whether this is a genuine phonological process or an artifact of prescriptive grammars merits further investigation. The fact that spirantisation is restricted to this suffix only, with speakers of *Hochlautung* being notoriously unsure about whether to spirantise here or not suggests that we may be dealing with the latter.

[9]Whether a palatal or a velar fricative is chosen as the spirantised reflex of a devoiced velar stop is governed by the same principles as the pronunciation of orthographic *ch*, which has been widely discussed in the literature (see, for example, Hall 1989b and the references there).

(8) a.

		NSG	Hochlautung
Berg	'mountain'	[bɛɐç]	[bɛɐk]
Tag	'day'	[tax]	[ta:k]
trug	'(he/she/it) carried'	[tru:x]	[tru:k]
Sog	'suction'	[zo:x]	[zo:k]
lag	'(he/she/it) lay'	[la:x]	[la:k]
Sieg	'victory'	[zi:ç]	[zi:k]
Weg	'path'	[ve:ç]	[ve:k]
Zeug	'stuff'	[tsɔɪç]	[tsɔɪk]

b.

		NSG/Hochlautung
Werk	'factory'	[vɛɐk]
schrak	'(he/she/it) shrank (back)'	[ʃra:k]
buk	'(he/she/it) baked'	[bu:k]
Pik	'spades' (cards)	[pi:k]

Now, if the claim that these spirantisation facts from NSG support my analysis is to have any force at all, then it is incumbent on me to show that my analysis works better than possible alternative accounts of the same facts.

As far as I know, there is no recent account of these particular facts available, but it is easy enough to develop a Lexical Phonology analysis on the basis of published work dealing with related phenomena. I will present such an analysis in this section and contrast it with the GP account outlined above.

There are two rules which need to be included, spirantisation and FOD, both of which feature in Hall 1989b. Hall's paper deals with *Hochlautung* only, so the spirantisation rule is restricted to apply to the suffix *-ig* alone (see also footnote 8). It can be adapted for our purposes by changing the environment specification to enable the rule to apply to *all* underlyingly voiced velars appearing in an FOD environment. This environment is defined by Hall as being the syllable coda. Both rules apply postlexically. They are shown in (9).

(9) a. *g-spirantisation*

$$\begin{array}{c}\begin{bmatrix} -\text{ son} \\ +\text{ voice}\end{bmatrix} \\ | \\ \text{C} \\ | \\ [+\text{ high}]\end{array} \quad \rightarrow [+\text{ cont}] \: / \: \_\_ \:]_{\sigma}$$

b. *Final Devoicing*

$$[-\text{ son}] \rightarrow [-\text{ voice}] \: / \: \_\_ \:]_{\sigma}$$

G-spirantisation and FOD have to apply in a counterbleeding order to generate the correct output [x]. If FOD preceded *g*-spirantisation, i.e. if the rules applied in a bleeding order, *g*-spirantisation would not have access to that part of the derivational history which is crucial for ensuring that only underlyingly voiced velars spirantise, i.e. the [+ voice] specification which is removed by FOD. It would, counterfactually, end up being blocked altogether. Now consider the derivation of *Sog* ('suction'), where the two rules apply in the order just established.

(10)	*Sog*
	/zo:g/
Postlexical rules	
1. *g*-spirantisation	zo:ɣ
2. Final Devoicing	zo:x
	[zo:x]

The derivation in (10) clearly generates the correct output, [zo:x]. However, it has two disadvantages. The first is a matter of how well-motivated each stage of the derivation is and the other is a question of whether the theory should be permitted to produce derivations such as that in (10). Let me begin with the former.

The application of *g*-spirantisation in (10) generates [ɣ]. This makes it abstract inasmuch as [ɣ] never surfaces in NSG[10]. The only velars this dialect permits are [g] (obviously only in non-FOD environments), [k] and [x]. In other words, there is no surface motivation for deriving [ɣ]. A derivation which generated only [k] and [x], both of which are part of the NSG inventory, would be more constrained.

The second disadvantage of the approach exemplified in (10) is that it relies on extrinsic rule ordering[11]. In order to enable *g*-spirantisation to distinguish velars with an underlying [+ voice] specification from those without, it is necessary to state that *g*-spirantisation precedes FOD. As already mentioned, this, of course, is also necessary in order to prevent FOD from bleeding *g*-spirantisation, which would, counterfactually, generate [k].

GP does not countenance extrinsic rule ordering, that is, in this respect, it is more highly constrained than any framework which does. Moreover, the GP analysis of FOD and spirantisation proposed here can overcome the disadvantages of the Lexical Phonology solution described in the preceding paragraphs. To show how this works, let me attempt to recast the ordered-rule approach illustrated in (10) in terms of the GP framework.

---

[10]There are, of course, northern German dialects which exhibit [ɣ], e.g. in *sagen* (['za:ɣən], 'to say'), such as *Berlinisch*, for example. NSG, however, is not one of them.

[11]Extrinsic ordering, of course, is only one way of giving a particular rule (*g*-spirantisation in this case) access to crucial parts of the derivational history of a segment. Alternatively, one could have proposed a global rule. This device, however, has, on the whole, been rejected in the literature (see, for example, Kiparsky 1976).

In GP, spirantisation can be interpreted as loss of the occlusion element ʔ°[12] (see Harris 1990: 285). To capture the fact that *g*-spirantisation precedes FOD (as required by the Lexical Phonology account just presented), one could propose that only certain segments are subject to the loss of ʔ°. These segments would have to contain L^-, which would roughly[13] correspond to the [+ voice] specification mentioned in Hall's *g*-spirantisation rule. Obviously, one would also have to specify the environment in which ʔ° could be lost from a segment containing L^-. For an NSG speaker, this would be the same environment as that where FOD applies, i.e. preceding any licensed empty nuclear position. That, of course, is the very environment where L^- is unlicensed.

In Chapter 3 I argued that an unlicensed element does not manifest itself, either in the pronunciation or in terms of the charm or complexity of the relevant segment. To the extent that this is the right move, the most consistent - and therefore the best - approach in the present context would be to say that an unlicensed L^- is *never* visible. So, as far as *g*-spirantisation (i.e. loss of ʔ°) is concerned, L^- is not visible either if it is unlicensed. This means that it is impossible to express the conditions under which ʔ° is lost, if one wants to maintain that the loss of ʔ° precedes final devoicing. In other words, a derivation where *g*-spirantisation precedes FOD is impossible, given the GP analysis presented so far.

[12]It may, of course, be the case that the occlusion element is not actually delinked, but becomes unlicensed. I will ignore this point, which would lead too far away from the issues of the present discussion.

[13]This correspondence is very rough indeed, as the area of overlap between [+ voice] and L^- is quite small. For example, the feature [+ voice] can be associated with vowels, glides and sonorant consonants in a language such as English, whereas L^- cannot. This is only possible in tone languages, where L^- indicates a low tone rather than a voiced sonorant.

There is, however, an alternative available. This alternative involves delinking ʔ° from a velar plosive with no visible (i.e. licensed) laryngeal element in an FOD environment. This implies the opposite ordering, if one wants to think in terms of ordered rules. The fact that L^- is unlicensed (i.e. that FOD applies) turns a velar plosive into suitable input to the loss of ʔ°. FOD, if you will, then absolutely feeds spirantisation[14]. The derivation of *Sog* illustrating this approach is shown in (11).

(11) a.

```
O     N     O   N
|    / \    |   |
x   x   x   x   x    zo:k
|    \ /    |
z     o     v°
            |
            ʔ°
            |
            h°
            |
           (L⁻)
```

b.

```
O     N     O   N
|    / \    |   |
x   x   x   x   x    zo:x
|    \ /    |
z     o     v°
            |
            h°
            |
           (L⁻)
```

At no stage does the derivation in (11) generate the unattested voiced velar fricative [ɣ], which means that it is less abstract than (10). Like the Lexical Phonology approach, it can also handle cases where spirantisation is suppressed. Suppression of spirantisation occurs when NSG speakers make an effort to

[14]This means that FOD is *intrinsically* ordered before spirantisation.

conform to the prestige dialect of *Hochlautung* (say, in a formal setting with speakers from different parts of Germany present or in *Fremdwörter*, such as *Magma*; see 4.4.2.4), and these speakers use [k] (rather than [g]) on those occasions. This can very easily be captured by simply treating (11b) as optional.

To recap briefly, I have argued that the occlusion element ʔ° can be delinked from the representation of a velar plosive in an FOD environment, provided that the affected plosive is neutral, i.e. contains no licensed laryngeal elements. This correctly predicts that /g/ in a non-FOD environment (as in *Tage* ['ta:gə] 'days', for example) and /k/ fail to spirantise.

The claim that a neutral segment is subject to delinking receives additional support from the fact that spirantisation of neutral obstruents is attested in languages other than German. T-lenition in English has been analysed along these lines (see Harris & Kaye 1990 and Harris 1990), as has the spirantisation of velars and labials in Greek (Stamatoula Pagoni, p. c.).

6.4.2.2 Why do only velars spirantise?

Before leaving the phonological evidence (i.e. the spirantisation of velars in NSG), I would like to address the question why it should be velars only that undergo this process.

Asking why velars (rather than alveolars or bilabials) should spirantise in NSG means invoking the notion of segmental strength. There is a general consensus that segments which are most susceptible to weakening processes (such as spirantisation) tend to be the weakest segments in a particular system or, perhaps, even universally. To express this and other properties which suggest that some segments are stronger than others, phonologists working in the widest conceivable range of theoretical frameworks have set up scales or hierarchies of phonological strength.

Such hierarchies can be arrived at in various ways, e.g. some are based on historical studies of sound change (e.g. Foley 1977), others on investigations of syllabification rules (e.g. Vennemann 1972a) and yet others on research into clustering behaviour (e.g. Sigurd 1955). Many of them take both major class membership and place of articulation of the relevant segments into account. As far as the former variety is concerned, there seems to be a considerable amount of common ground. Obstruents are usually considered as stronger than sonorants which, in turn, are treated as having greater phonological strength than vowels[15]. Escure's hierarchy of major class and manner features (see 3.4.3.1) is an example of such a strength scale. Discordant voices, however, make themselves heard when one gets down to finer details and/or makes place of articulation the crucial parameter on the scale.

To keep this section as brief as possible, I will simply ignore important general issues germane to strength scales or hierarchies, that is, I will not ask whether setting up such hierarchies is necessarily a theoretically sound move, specifically whether they can be anything other than circular. This issue has, in any case, already been discussed in detail by Harris (1985, chapter 2). Another major question, how such hierarchies could be integrated into any phonological theory, will also be put to one side. Instead, I will home in on a particular aspect of strength scales, namely place of articulation, and investigate how well the claims made by hierarchies based on this particular parameter match the facts of human language. Finally, I will discuss the implications which the results of this investigation have for my analysis.

[15]E.g. Hooper 1976 (ch. 10), Escure 1977, Lass 1984 (p. 177), Lass & Anderson 1975 (p. 159), Vennemannn 1972a.

Let me begin with Foley (1977), whose strength scales are some of the most detailed, most elaborate and well-argued I am aware of, although one may disagree with some of the premises they are based on. He sets up a scale (his scale of relative phonological strength α) which 'refers to the propensity to spirantization, with the weakest element being most inclined to spirantization' (*ibid.*, 28). This scale is reproduced in (12) below[16].

(12) g d b

$\longrightarrow$

1 2 3

It expresses Foley's contention that 'lenition of consonants typically starts with the velar consonant and then generalizes to other consonants' (*ibid.*, 27f.). According to Foley, then, there is an implicational hierarchy which says that we can expect to find systems where only velars lenite, others where velars, bilabials and coronals weaken, but none where, say, only coronals undergo this process. The North German accents we are interested in here fit this pattern perfectly, as do, according to Foley (*ibid.*, 31f.), Buriat Mongolian (Altaic; USSR), Czech, Sanskrit, Kasem (Niger-Congo; Ghana, Burkina Faso), Modern Greek, Danish, Spanish and French. Further support for Foley's assessment is provided by Escure's (1977) universal hierarchy of cavity features, which identifies velars as the weakest of the three segment types considered by Foley[17]. This view is echoed by Kenstowicz (1981), who quotes Chen's

[16]The particular α-scale shown here is the first he introduces. He later refines the notion of phonological strength further and identifies this scale as the correct α-scale for Romance languages (pp. 49ff), while the appropriate scale for Germanic languages (based on evidence from strengthening) has coronals and labials appearing in reverse order. The point which is crucial to the present discussion, i.e. that velars are weakest, however, remains unaffected by this refinement.

[17]She does not acknowledge any debt to Foley here, but the fact that she uses exactly the same example words from German to illustrate her claim as he does in his 1977 work suggests to me that the two statements are not entirely independent of one another.

(1975) observation that 'weakening of consonants ... seems to invariably proceed from the back of the oral cavity towards the front so that velars are most susceptible to weakening ...' (p. 433). Ní Chasaide (1985: 325) speculates that the comparative sluggishness of the articulator responsible for velars (the tongue body) is likely to make velar segments particularly susceptible to temporal compression (i.e. a reduction in the amount of time available for the articulation of a particular segment). Target undershoot, which manifests itself as spirantisation in the case of velar plosives, is the expected result. So far, the consensus seems to be that velars are indeed universally the weakest of all obstruent stops and hence most likely to weaken further.

Not everyone, however, agrees with this view. Other workers in the field, many of them critical of the fundamentals of Foley's approach, have adduced a considerable amount of evidence to expose this claim as false. Lass & Anderson (1975: 184) point out that Proto-Uralic **-k-* remains unchanged in Hungarian, while **-p-* and **-t-* are weakened. At the same time, although they are strong intervocalically, velars weaken in initial position, so that Hungarian exhibits two different positional strength hierarchies for two different environments. Smith (1981) mentions a Danish dialect (S.E. Scania) where *g* apparently only lenites under certain conditions, while *b* is *invariably* weakened to [v], and Harris (1985: 81) cites Viennese as another example of a dialect which has weakened *b* (to [β]), but retains *g*. The fact that *t* is often the only segment to lenite in a number of English dialects (including London and New York city speech; see Harris 1990, Harris & Kaye 1990) could be interpreted as evidence for the claim that coronals, not velars, are weakest there[18]. Finally, according to Hyman (1975: 167), Luganda (Niger-Congo; NEC Africa), has intervocalic weakening of all its obstruent stops, with the sole exception of *g*.

I have only considered some of the evidence concerning the status of velars. Yet, even this limited evidence is contradictory. One can infer from this that any attempt to set up a universal strength hierarchy on the basis of place of articulation is probably doomed. Perhaps one can go as far as to say that certain tendencies exist within language groups, e.g. that velars tend to be weakest and coronals strongest in Germanic languages - but exceptions are always possible. The fact of the matter is probably that 'actual hierarchies by position are language-specific' (Lass & Anderson 1975: 184).

The framework of GP is in a position to capture common lenition trajectories (i.e. strength hierarchies) in terms of segmental complexity. It does not, however, appear to have anything to say on scales involving place of articulation - with the possible exception of the fact that it predicts 'empty-headedness' for velars. Velars are the only segments which have the cold vowel, the maximally unmarked element, as their head. Technically speaking, they share this empty-headedness with any empty position, including licensed empty nuclear positions. One may speculate that it is this fact which particularly encourages spirantisation of velars. On the other hand, one would then have to explain why it is coronals which are particularly prone to decomposition in many dialects of English. So, it seems that this speculation is on extremely

[18]On the other hand, well-known asymmetries, such as the existence of words like *apt* and *act*, but not **atp* or **atc*, lead to the conclusion that coronals are strongest in terms of governing ability. Intuitively, it seems that governing strength and the kind of strength (or weakness) which makes a segment more susceptible to decomposition should be related, especially since decomposition reduces governing power. There is, however, the possibility that the two are completely independent of one another (as suggested by the preferred decomposition of velars in North German accents). Further research is clearly necessary.

shaky ground. It may be better not to read anything into empty-headedness and to accept that the theory makes no predictions regarding positional hierarchies. This is the strategy adopted by Anderson & Ewen (1987: 232) for Dependency Phonology, and probably the best strategy available to any phonologist at the moment.

Let me now return to the second type of evidence in support of my analysis of FOD as a non-neutralising process, the experimental evidence.

6.4.3 Experimental evidence

The experimental evidence which supports my analysis of FOD in the framework of GP was presented in 6.3.1, so I will give only a very brief summary of the most important points here.

A number of production studies found that there are statistically significant temporal differences between devoiced obstruents and their underlyingly voiceless congeners. Perception studies carried out in conjunction with the production studies also showed that hearers are able to distinguish between these two segment types, but only to a limited extent. The proportion of correctly identified tokens was consistently better than chance, but it is unclear whether the distinction is sufficiently salient for it to play a crucial role in normal communication.

6.4.4 The general implications for earlier problems

Some of the problems with the orthodox analysis of FOD as [– son] → [– voice] appear to have been resolved by the new analysis in the GP framework. The conflict between the phonological predictions and the production facts no longer exists. The phonological analysis itself makes the claim that underlyingly voiced obstruents differ from their underlyingly voiceless congeners even in FOD environments. In other words, there is no need for phonetic implementation rules. In fact, the framework of GP does not recognise a separate phonetic component which is ordered after the phonology. Phonological representations are phonetically interpretable at all levels, so such a phonetic component would be redundant.

This, however, does not mean that the mismatch between production and perception has disappeared, too. The silver lining of this cloud is that, unlike practically all phonological theories available today, GP does not use primarily articulatory categories to define the phonological elements it employs (see 3.3.1 for a brief discussion). The GP approach maintains the original SPE assumption that the grammar is neutral with regard to the speaker/hearer. At the same time, though, it captures the fact that perception precedes production in language acquisition and that it is with reference to cognitive categories based on *sound* patterns that the child makes sense of what she hears.

By implication, the prediction is made that the difference between phonologically distinct units has to be perceptually salient for a child to be able to acquire it. The only conceivable exceptions to this must either themselves be part of UG or be deducible from evidence provided by alternations. For example, it may not be necessary for the distinction between a governed (i.e. neutral) obstruent and a governing (charmed) obstruent to be perceptually salient, as charm requirements are contained in UG. Also, some phonological differences may not be perceptually salient in certain environments or may only be salient to a limited extent (such as the difference between a devoiced obstruent and its underlyingly voiceless congener in an FOD environment), but the child will be able to establish the phonological distinction by reference to alternation facts, together with her innate phonological 'tool-kit', which, of course, is also part of UG.

The specific claim for FOD which I want to make here is that FOD belongs to UG. It may not be controlled by its own parameter, but it is conceivable that it is captured by a condition which is parasitic on the parameter which is responsible for determining whether a language parametrically licenses domain-final empty nuclear positions. Only languages which do this (such as English, German, French, Wolof, Catalan, Polish, Russian etc.) have the potential of having FOD. So, this condition is only activated if the parameter is set to the YES position. In languages where it is not (such as Italian, Japanese, Hawaiian etc.), FOD is obviously not an option. However, where the parameter is set to YES, the unmarked case would be for FOD to apply.

This claim is supported by the fact that children, when learning a language with domain-final empty nuclear positions, go through a stage of applying FOD (usually at the point when final obstruents are first acquired), even in languages where adult speakers don't. Similarly, native speakers of languages which do not parametrically license final empty nuclei characteristically apply FOD to foreign words with final obstruents (i.e. words from a language with final empty nuclei), even if the source language does not exhibit FOD (see Stampe 1969 (p. 445) for both these points).

6.5 Conclusion

In this chapter I have briefly traced parts of the history of the theoretical construct of neutralisation and examined the role it has played in experimental work over the past decade. I have discussed some issues arising from this experimental work which pose problems for those phonological theories which sparked off heightened interest in the phonetic aspects of neutralisation. By relating these problems to my GP analysis I have been able to show that it is possible to overcome them.

In fact, it seems that neutralisation as a theoretical construct is rapidly disappearing from the phonological landscape. In Lexical Phonology, it has been replaced by Structure Preservation (which, itself, is being exposed as much less far-reaching and important than originally assumed) and in GP it has no theoretical status at all. That is not to say, though, that the word 'neutralisation' will soon be missing from phonologists' vocabulary. It is still a useful cover term for a wide range of effects, whatever their theoretical status may be.

In this thesis I have shown that final obstruent devoicing can be related to other phonological processes, in German as well as in other languages. Treating it as an instance of autosegmental licensing in the sense defined in Chapter 4 enables us to unify it with apparently disparate processes such as *r*/vowel alternations in German *Hochlautung* and spirantisation of velars in Northern Standard German as well as, say, *t*-lenition in English. More importantly, though, my investigation of FOD provides further evidence in support of the insight that licensed empty nuclei have special properties, such as limited licensing power both for government-licensing and for licensing segmental content in a preceding onset. As our stock of evidence concerning such positions grows, it becomes more and more likely that we will soon be able to uncover more general principles which lie behind these special properties. My investigation of *r*/vowel alternations and spirantisation of velars in NSG has also drawn attention to the fact that empty-headed expressions cause interesting anomalies in the behaviour of some of their elements. This may have far-reaching implications which, at present, we can only guess at.

My exploration of FOD, of course, is not intended as an exhaustive treatment of the subject, but as a first approach to it. Obviously, a great deal more light can be shed on the workings of FOD once data from other languages (such as Polish, Catalan, Dutch or Russian, for example) is also included. However, I feel that even the development of a first working hypothesis, within the confines of a single language, has raised some interesting theoretical issues, which, I hope, will be addressed in future work.

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JASA	*Journal of the Acoustical Society of America*
JL	*Journal of Linguistics*
JPh	*Journal of Phonetics*
Lg	*Language*
LI	*Linguistic Inquiry*
NLLT	*Natural Language and Linguistic Theory*

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