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Final Devoicing and the stratification of the lexicon in German[1]

0. Introduction

This paper examines German Final Devoicing in OT and shows that a full account of the data requires not only an explanation for Final Devoicing itself, but also a model of the stratification of the lexicon. The point of departure of this study is the observation that although various recently proposed analyses of German Final Devoicing in OT seem to make equally good predictions for the voicing of obstruents in the word-final position, none of them makes the right predictions for all data when ambisyllabic obstruents are also considered.

In the first part of the paper, the data for Final Devoicing in the word-final position are introduced, as well as the different optimality-theoretic analyses. In the second section, it is shown that additional data involving ambisyllabic obstruents in the native vocabulary cannot be accounted for by these analyses in a straightforward way. The third section introduces a model of the stratification of the lexicon, in which the phonological grammar of the language consists of the markedness constraints only. The faithfulness constraints can in principle appear between each markedness constraint. This implies that there can in principle exist as many lexical strata as there are markedness constraints. Finally, it is shown in the last section how an account involving two kinds of analyses for Final Devoicing plus the model for the stratification of the lexicon introduced in the preceding section can explain all the data.

1. Final Devoicing in the absolute final position

1.1 Data and pre-OT analyses

Independently of the analysis, German Final Devoicing is a classical case of phonological neutralization. Neutralization implies a reduction of the segment inventory in certain contexts. In a neutralizing position only a subset of the segments of a language may appear. In German, most obstruents are voiceless in the syllable coda, which is the standard position for neutralization. In the absolute final position, as shown in the examples in (1), all obstruents are voiceless.

(1) Final Devoicing in the absolute final position

a. loben	[lo:.bn]	‘to praise’	Lob	[lo:p]	‘praise, N.’
b. Hände	[h´nd\]	‘hands’	Hand	[hant]	‘hand’
c. kluge	[klu:g\]	‘clever, inflected’	klug	[klu:k]	‘clever, uninfl.’
d. brave	[bËå:v\]	‘good, inflected’	brav	[bËå:f]	‘good, uninfl.’

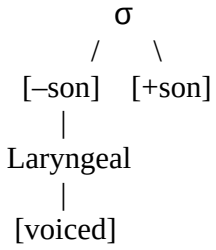
[1] I would like to thank Junko Ito and Armin Mester, who have inspired this work. Also many thanks to Kirsten Brock, Fritz Hamm, Markus Hiller, Michael Jessen, Curt Rice, Ruben van de Vijver and Ede Zimmermann, two anonymous reviewers as well as to the audiences in Potsdam and at HILP 4 in Leiden for helpful comments.

e. niesen [ni:zn] ‘to sneeze’ nies [ni:s] ‘sneeze, imp.’
f. Orange [oËãž\] ‘orange, N.’ orange [oËãʃ] ‘orange, adj.’

Two approaches to Final Devoicing have been proposed in the literature. First we have what can be called the neutralizing coda-based approach, which has been defended by Brockhaus (1995), Hall (1992), Rubach (1989), Vennemann (1972) and Wiese (1996) a. o. In this approach, it is the fact that the obstruents are in the coda which is responsible for their neutralization.

Second, there is the onset-based approach of Lombardi (1991, 1995), who formulates Final Devoicing as a filter restricting the occurrence of voiced obstruents to the syllable onset. According to Lombardi’s filter in (2), obstruents are only allowed to be voiced before tautosyllabic sonorants, which, for German, amounts to restricting the occurrence of voiced obstruents to the onset position. In this approach, then, it is the fact that the obstruents are in the onset that explains the possibility of their being voiced.

(2) Lombardi’s filter (1991, 1995)



1.2 The positional onset-based approach to Final Devoicing in OT

Turning now to the optimality-theoretic analysis of these accounts, it has been observed that numerous languages display certain contrasts only in their syllable onsets, while neutralizing them in the coda (see Beckman 1997, 1998, Harris 1997, Lombardi 1991, 1995, Padgett 1995, Steriade 1997 and Trubetzkoy 1939).[2]

In the framework of OT, Beckman proposes positional faithfulness, which decomposes a given faithfulness constraint into multiple ones according to the position of the segment in the syllable. In the case of Final Devoicing, faithfulness of [voice] in an onset obstruent makes more specific requirements than general faithfulness of [voice]. Compare the two constraints in (3) and (4). *VDOBSTR, a markedness constraint formulated in (5), is ranked between these two constraints in Tableaux 1 and 2, which show an adaptation of Beckman’s approach for the words *blind* and *blinde*. The result is that a voiced obstruent is only possible in a syllable onset, but nowhere else. In the syllable coda, an obstruent surfaces as voiceless.

(3) Faithfulness constraint (Beckman 1998:38)
IDENT(voice)
For all segments *x*, *y*, where *x* Input and *y* Output, if *xRy*, then *y* is [voice] iff *x* is [voice].

[2] According to Steriade (1997), the final position or the position preceding a consonant correlates with the absence of the relevant phonetic cues, in our case, Voice Onset Timing on a following sonorant. In her acoustic account, only a following vowel provides the context in which laryngeal contrasts can be perceived. Steriade denies that syllable structure plays a role. The fact that a final position generally coincides with a coda and a prevocalic position with an onset is just epiphenomenal.

"Correspondent segments must agree in voicing."

(4) Positional faithfulness constraint (Beckman 1998:38)
IDENT(voice)$_{Onset}$
For all segments *x, y*, where *x* Input and *y* Output and *y* is syllabified in onset position, if *xRy*, then *y* is [voice] iff *x* is [voice].
"Onset segments and their input correspondents must agree in voicing."

(5) *VDOBSTR: Obstruents are voiceless.

NOCODA has been added for the sake of clarity. NOCODA (Prince & Smolensky 1993) forbids codas. This constraint is low ranking in German.

(6) NOCODA: Syllables have no coda.

/blˆnd/ 'blind'	IDENT(voice)$_{Onset}$	* VDOBSTR	IDENT(voice)	NOCODA
☞ .blˆnt.		*	*	**
.blˆnd.		**!		**
.plˆnt.	*!		**	**

Tableau 1: *blind* in the positional faithfulness approach

/blˆind+\/ 'blind, inflec.'	IDENT(voice)$_{Onset}$	* VDOBSTR	IDENT(voice)	NOCODA
☞ .blˆn.d\.		**		*
.blˆn.t\	*!	*	*	*
.plˆn.d\	*!	*	*	*
.plˆn.t\	*!*		**	*

Tableau 2: *blinde* in the positional faithfulness approach

1.3 The neutralizing coda-based approach to Final Devoicing in OT

Similarly, the coda-based approach can be expressed with two markedness and one faithfulness constraints interacting in the same way as the two faithfulness and one markedness constraints of the preceding subsection. One constraint is a special case of the other, in the sense that the violations of the specific constraints form a subset of the violations of the general case (see Kager 1999 for an approach to nasal vowels on those terms). The positional markedness constraint *VDOBSTR$_{(CODA)}$ in (7) (henceforth abbreviated as FD for Final Devoicing) posits that obstruents in the syllable coda are voiceless. The other constraints are identical to the ones above.

(7) *VDOBSTR$_{(CODA)}$(FD):Obstruents in the syllable coda are voiceless.

/blˆnd/	FD	IDENT(voice)	*VDOBSTR	NOCODA
☞ .blˆnt.		*	*	**
.blˆnd.	*!		**	**

Tableau 3: *blind* in the neutralization approach

/blˆnd+\/	FD	IDENT(voice)	*VDOBSTR	NOCODA
☞ .blˆn.d\.			**	*
.blˆn.te.		*!	*	*

Tableau 4: *blind*\in the neutralization approach

Alternatively, Ito & Mester's (1998b) approach, which uses the local conjunction of constraints (Smolensky 1995), can be shown to make the same predictions for *blind* and *blinde*. The conjoined constraint in (8) is violated if both NOCODA and *VDOBSTR are violated. The kind of local conjunction of constraints needed for Final Devoicing prohibits accumulated markedness effects: simultaneous violation of two markedness constraints in a single domain is worse than violation of each of them in two different domains. In the case at hand, it is worse to violate both NOCODA and *VDOBSTR in a single segment - necessarily the coda - than to violate each of these constraints in two different segments - like the onset and the coda of a syllable.

A possible drawback is the fact that the domain of the conjoined constraint has to be specified in the constraint itself, which leads to a certain amount of redundancy. The local domain of the conjoined constraint is the segment (expressed by δ in (8)).

(8) NOCODA $\&_{\delta}$*VDOBSTR: local conjunction of NOCODA and *VDOBSTR.

/blˆnd/	NOCODA $\&_{\delta}$*VDOBSTR	IDENT(voice)	*VDOBSTR	NOCODA
☞ .blˆnt.		*	*	**
.blˆnd.	*!		**	**

Tableau 5: *blind* in the local conjunction of constraints approach.

/blˆnd+\/	NOCODA $\&_{\delta}$*VDOBSTR	IDENT(voice)	*VDOBSTR	NOCODA
☞ .blˆn.d\.			**	*
.blˆn.t\		*!	*	*

Tableau 6: *blinde* in the local conjunction of constraints approach

One of the major problems of the constraint conjunction approach is that there is no apparent limit to the possible conjunctions. If two constraints can be conjoined, so can three, four and so on. Constraints can also be conjoined with themselves. In contrast, parametrizing constraints for prosodic positions is much more restricted because the number of prosodic positions is limited. For this reason, the constraint conjunction will not be pursued here.

The coda and the onset approaches are equally adequate to explain Final Devoicing in the word-final position.[3] Both contain the same amount of complexity in the formulation of the required constraints, since they use one constraint of one kind, either faithfulness or markedness, sandwiched between two constraints of the other kind. The low-ranking NOCODA doesn't play any role in the words examined here. Up to this point, then it does not matter which analysis is chosen.

[3] Words like *Redner* 'speaker' or *Adler* 'eagle' have two syllabifications and consequently two pronunciations, depending on the syllabification of the medial obstruent: it may be in the coda of the first syllable [a:t.lá] or in the onset of the second syllable [a:.dlá] (see Vennemann 1972). These forms do not bear on the present issue.

2. Final Devoicing in ambisyllabic obstruents

The conclusion of section 1 is that the behavior of the obstruents in the word-final position does not allow us to choose between the two approaches. It might be the case that other syllable positions can help to make the decision. Interesting cases are those in which an obstruent is both coda and onset at the same time, the so-called ambisyllabic position. If these obstruents are always voiceless, this would speak in favor of the coda approach. But if the ambisyllabic obstruents can be voiced, the positional faithfulness approach should be preferred. However, as we will see in a moment, the data are not so simple, and unfortunately do not really bear on the decision as to which approach is the best. At the end, both approaches will be necessary.

Before going on with the review of the obstruents' behavior with respect to Final Devoicing, it must be shown that ambisyllabic obstruents are needed in German independently of the Final Devoicing cases.

Stressed syllables in German are bimoraic (Féry 1997), or, according to some frameworks, require two positions on the skeletal tier (Hall 1992, Vennemann 1994 and Wiese 1996 a. o.). The strongest argument for the bimoraicity or bipositionality of stressed syllables comes from the fact that lax vowels are not allowed in unequivocally open syllables, as shown in (10a and b), but require a closing consonant, ambisyllabic or not, as illustrated by the data in (10c).

(10) Lax vowels

a. Not allowed in word-final open syllables

Ótto	[øṭo]	*[øṭø]	name
Káffee	[kaf̣e]/[kaf̣\]	*[kaf̣´]	'coffee'

b. Not allowed in hiatus position

Día	[di:.å]	*[dˆ.å]	'slide'
Ruín	[Ëu.i:n]	*[Ë¨.i:n]	'ruine'

c. Allowed in closed syllables

Müll	[mÁl]		'garbage'
Birne	[bˆËn\]		'pear'
Robbe	[Ëøḅ\]		'seal'

Turning now to Final Devoicing, two cases must be distinguished. The truly core native German vocabulary allows only voiceless ambisyllabic obstruents, as illustrated by the words in (11). These words seem to speak in favor of the coda approach, because, if Final Devoicing results from onset faithfulness, it is not clear why ambisyllabic obstruents should always be voiceless. Since they are onsets as well as codas, positional faithfulness to [voice] should lead to voiced obstruents in this position. In contrast, if Final Devoicing is neutralization in the coda, then voiced ambisyllabic obstruents are always voiceless as a result of their being in the coda of a syllable, and, as shown above, obstruents are obligatorily neutralized in this position. The difference between the two approaches is shown in Tableaux 7 and 8 with the hypothetical input */g\.ʃnˆdn/ for *geschnitten* 'cut, part. of *schneiden*' with a voiced ambisyllabic obstruent. Tableau 7 in the coda approach accounts for the non-occurrence of such obstruents, whereas Tableau 8 in the positional faithfulness approach makes the wrong predictions.

(11) Ambisyllabic obstruents

offen	[øf̣n]	'open'	Sippe	[zˆp̣\]	'family, clan'

Masse	[maṣ\]	‘mass’	Mitte	[mˆṭ\]	‘middle’
lache	[laχ\]	‘laugh, 1st pers sg.’	Backe	[baḳ\]	‘cheek’

/g\.ʃnˆdn/ *geschnitten* ‘cut’	FD	IDENT(voice)	*VDOBSTR	NOCODA
☞ g\.ʃnˆṭn		*		*
g\.ʃnˆḍn	*!		*	*

Tableau 7: *geschnitten* (with input *geschnidden*) in the coda neutralizing approach

/g\.ʃnˆdn/ *geschnitten* ‘cut’	IDENT(voice)$_{Onset}$	*VDOBSTR	IDENT(voice)	NOCODA
wrong winner: g\.ʃnˆḍn		*		*
g\.ʃnˆṭn	*!		*	*

Tableau 8: *geschnitten* (with input *geschnidden*) in the positional faithfulness approach

However, if a slightly enlarged lexicon is taken into consideration, a certain number of words with voiced ambisyllabic obstruents, mostly stops, emerge. The lists in (12) and (13) show words with voiced ambisyllabic fricatives and with voiced ambisyllabic stops respectively. (12) is adapted from Jessen.[4] It is a nearly complete list for the fricatives. The list for the stops in (13), which is also adapted from Jessen, is far from being complete.

(12) Lax vowel + voiced fricative
a. [z]: *Dussel* [d¨zl] or [d¨sl] ‘idiot’, *Schussel* [ʃ¨zl] or [ʃ¨sl] ‘scatterbrain’, *Baiser, Blizzard, Faiseur, Liaison, Maisonette, Puzzle, Saison, Slezak*
b. [v]: *Bonaventura, Cheviot, clever, Covercoat, Evergreen, evviva, Jawlensky, Lewa, Rêverie, Livingstonefälle, Paulownia, Przywara, ravvivando, Sowjet, Struwwelpeter, Trevizent, Wlassowa, Zarewna*
c. [ž]: *Wuschel* [v¨žl] or [v¨ʃl] ‘mop of frizzy hair’

(13) Lax vowel + voiced stop (Jessen 1997:143)
Bagger ‘excavator’, *Egge* ‘harrow’, *Flagge* ‘flag’, *Kogge* ‘cog’, *krabbeln* ‘crawl’, *Roggen* ‘rye’, *Schmuggel* ‘smuggling’, *Ebbe* ‘low tide’, *knabbern* ‘nibble’, *Paddel* ‘paddle’, *Widder* ‘ram’, *Robbe* ‘seal’, *Kladde* ‘notebook’, *Krabbe* ‘crab’, *schrubben* ‘scrub’, *flügge* ‘fledged’, *Dogge* ‘Great Dane’, *dribbeln* ‘dribble’, *Troddel* ‘tassel’, *Quaddel* ‘rash’, *Modder* ‘mud’, *meschugge* ‘crazy’

Most words in (12) are unmistakenly foreign, but not so much the words in (13). These are loans from Dutch or Yiddish (*Paddel, Dogge* and *dribbeln* from English) or historically derived from the Low German dialect spoken in Northern Germany (see Pfeifer et al. 1993, Wurzel 1980:980 and Kloeke 1982:34 a. o.).[5] The words in (12) which are not foreign, like *Dussel* and *Wuschel* have the same status as the words in (13) and no difference will be made between them in the following, even if there are many more ambisyllabic voiced stops than fricatives. They will be analyzed below as nearly native.

[4] Jessen (1997) is primarily concerned with the phonetic realization and the featural representation of the German obstruents.
[5] An anonymous reviewer asks why the words from Dutch and Yiddish are not unmistakenly foreign. The reason is that they are perceived by many speakers as nearly native because of their trochaicity and their segmental make-up. Another anonymous reviewer denies the existence of a separate group of words altogether and would prefer to analyze them as native. However, the proposal of treating them as nearly native agrees with the intuitions of most phonologists working on German, as well as many non-linguist native speakers.

Tableaux 9 and 10 show that it is now the positional faithfulness approach which makes the right prediction.

/ Ëøb\/ *Robbe*	NoCoda &$_{\delta}$ *VdObstr	Ident(voice)	*VdObstr	NoCoda
wrong winner: Ëøp\		*		*
Ëøb̥\	*!		*	*

Tableau 9: *Robbe* in the local conjunction of constraints approach

/Ëøb\/ *Robbe*	Ident(voice)$_{Onset}$	*VdObstr	Ident(voice)	NoCoda
☞ Ëøb̥\		*		*
Ëøp\	*!		*	*

Tableau 10: *Robbe* in the positional faithfulness approach

We are now confronted with the problem that native and nearly native words seem to require different analyses depending on the degree of their nativization. In terms of the optimality-theoretic approaches that have been discussed above, it has been shown that the words in (11) require an approach based on coda neutralization, whereas the words in (12) and (13) speak in favor of an onset-based positional faithfulness approach. However, positing two different analyses for two sets of data from the same language and from the same, or nearly same, level of the lexicon - the native lexicon - is highly undesirable. It will be shown in section 5 that all data can be accounted for with one analysis. Since this analysis depends heavily on a theory of the stratification of the lexicon, this theory must first be introduced.

3. Stratification of the lexicon

3.1 The division of the lexicon into native and non-native vocabularies

Since Wurzel's work on the phonology of German in the seventies and early eighties, the German vocabulary has usually been considered to be divided into two categories of words, the native and the non-native ones, as shown in (14). This binary distinction aimed at replacing the traditional etymological division of the lexicon into *Erbwörter* 'inherited words', *Lehnwörter* 'loanwords' and *Fremdwörter* 'foreign words'. It is strictly synchronic and based exclusively on the phonology. Native words are described by a certain set of grammatical regularities of German and non-native words by another.

(14) Phonological and synchronic binary division of the lexicon

a. Native words: *Hahn* 'cock', *Krug* 'jug', *Kirsche* 'cherry', *Gold* 'gold', …

b. Non-native words: *Diner* 'dinner', *Chemie* 'chemistry', *Präsident* 'president', *Rarität* 'rarity', *kapitalistisch* 'capitalistic', *tolerierbar* 'tolerable', *marschieren* 'to march',…

Some problems arise with the binary hypothesis, the most serious one being related to the definition of the non-native words as a single phonological class. The difficulty comes from the fact that a twofold division of the lexicon is not sufficient to account for all data accurately, especially in the framework of traditional generative phonology, which considers phonological rules as obligatory. A definition of the native vocabulary is relatively simple and straightforward, but this is not true of the non-native words. In this framework, if a rule applies, then it applies to the whole class of words. To see the problem more clearly, consider the word-initial realization of voiceless [s]. This segment is not possible in the native words,

as shown in (15a). The native words begin with voiced [z] or with alveopalatal [ʃ], but never with voiceless [s]. In one part of the vocabulary, called here Class 1, [s] can appear before [k], like in *Skelett* and *Skat*, but in no other environment.[6] In a second set of words, called Class 2, [s] can appear before consonants, like in *Steak* and *Slalom*, but not before vowels, as illustrated by *Salto* and *Sowjet*. In a further class of words, Class 3, [s] can appear everywhere, including before vowels, as shown by the words *City*, *Single* and *Surf*. It is not clear how a twofold division of the lexicon can account for such data.

(15) No [s] word-initially
a. Always fulfilled in the native words: *Sense* [z´nz\], *Sprache* [ʃp≈å:x\], *Schule* [ʃu:l\]
b. Not fulfilled in the non-native words:
- Class 1: [s] appears only before [k]: *Skelett* [sk\l´t], *Skat* [skå:t] (but *Spedition* [ʃpeditsio:n], *stornieren* [ʃtøËni:Ën])
- Class 2: Before all consonants: *Steak* [ste:k], *Slalom* [slå:løm] (but not before vowels *Salto* [zalto], *Sowjet* [zovj´t])
- Class 3: also before vowels: *City* [sˆti], *Single* [sˆ˜l], *Surf* [sœËf]

The existence of these three non-native classes is based on independent evidence, like stress behavior (final stress in *Spedition*, *Skelett, Sowjet*), phonotactics as illustrated in (15), segmental make-up (final full vowel in *Salto* and *City*), morphology (non-native stressed suffixes in *stornieren*) and even orthography (*City, Surf*).

Some of the properties of non-native words are more part of the phonology of German than others in the sense that the group of words displaying them is quite large (final stress, suffixation with nonnative suffixes like *-ieren*). *Spedition* and *stornieren* differ from *Steak* for instance because of the pronunciation of <st> and because of the orthography, which is adapted to German in the first cases but not in *Steak*. *Salto* and *Slalom* are even more peripheral because of their phonotactics: *sl* is not a frequent consonant cluster and nouns ending in *-o* are marginal. As to the class 3 words, they are new loans, as attested by the various pronunciations of these words (see also below for additional arguments for classifying non-native words in different classes)

A second problem with a twofold division of the lexicon comes from the fact that, ideally, the segments' inventory of a language forms a closed class. However, this is only true of the native words. As soon as an enlarged lexicon is taken into consideration, things get more complicated. It is shown in (16) that the bilabial approximant [w] is excluded in most parts of the vocabulary. The non-native words *Watt* and *Whiskey* are pronounced [vat] and [vˆski] in German. But in *Walkman* or *Washington*, also non-native words, the bilabial approximant can be realized.

The status of the nasal vowels is also unclear. In a large part of the non-native vocabulary, like in *Lampe, Champignon, blond*, etc., these segments are replaced by a sequence of an oral vowel plus a nasal consonant. However, other words, like *Renaissance* and *Ensemble*, are often realized with a nasal vowel. In these cases, a twofold division of the vocabulary is problematic, too.

(16) Restrictions against certain segments
a. No bilabial approximant [w]: *Watt* [vat], *Quiz* [kvis] (but *Walkman* [wøkm´n])
b. No nasal vowel in some non-native words: *Lampe* [lamp\], *Champignon* [ʃampiµo˜], *blond* [blønt], *rund* [Ë¨nt] (but *Renaissance* [Ë\n´sãs], *Ensemble* [ãsãb\l], and also some pronunciations of *Chance* [ʃa˜z\/ʃanz\/ʃãs], *Ballon* [balø˜/balo:n/balõ], …)

[6] See Hall (1992), who analyzes this distribution as a case of dissimilation.

In the following, a different, more complex model of the stratification of the lexicon is proposed, inspired by previous optimality-theoretic proposals, like the ones of Davidson & Noyer (1997), Ito & Mester (1995, 1998a), and Yip (1993). In these proposals, as well as in other, non-optimality-theoretic ones like Kiparsky (1968), Paradis & Lacharité (1997) and Silverman (1992), the different classes of words do not just coexist, but have a hierarchically organized structure. Before the model can be presented, it is necessary to take a look at some pre-theoretical properties of the lexicon which will help to motivate the model. For expository reasons, the next two subsections are called 'the native lexicon' and 'the non-native lexicon'. However, this subdivision is not an essential component of the model proposed here. Rather than a twofold division of the vocabulary, it is assumed that the lexicon contains a large number of hierarchically organized strata, some of which obey the German phonological restrictions more strictly than others. The part of the lexicon obeying these restrictions most closely is called the native words. In the peripheral parts of the lexicon, called the non-native words, the restrictions are gradually relaxed.

3.2 The native lexicon

First we will examine that part of the lexicon which meets the requirements of the strictest phonology of German. Some examples were presented in (14) and additional examples are listed in (17). (17a) gives a list of words of Germanic origin, like *Hund, Knopf* and *Arbeit*. Many words of French or English origin also belong to the native part of the lexicon on the basis of their phonology. Some words were borrowed from French in the Middle Ages (12th or 13th century), like *Reim, fein, Tanz, rund* and *Rosine* (see Volland 1986:11) and have been completely adapted to the German phonology. Examples of words borrowed from English which belong to the core vocabulary are *Flipper, Bar* and *Quiz*.

(17) Native lexicon

a. Words with a Germanic origin (Wurzel 1980): *Hund* 'dog', *Knopf* 'button', *Arbeit* 'work', *Zunge* 'tongue', *lieb* 'kind', *Hornisse* 'hornet', *Wachholder* 'juniper', *Freiheit* 'freedom', *Arbeitslosigkeit* 'unemployment'…

b. Words with a French origin (Volland 1986:11): *Reim* 'rhyme', *fein* 'fine', *Tanz* 'dance', *rund* 'round', *Rosine* 'raisin', …

c. Words with an English origin (Galinsky 1980:253): *Flipper, Bar, Tip, Quiz*, …

Within the framework of this article, it is neither possible nor necessary to review the entire phonology of German. Instead a few important segmental properties will be listed.

It is shown in (18) that some segments belonging to the enlarged German inventory are absent from the native vocabulary, like for instance the labial approximant [w], the palatal nasal [µ], the postalveolar fricative [ž] and the nasal vowels [õ, ã,…]. Other segments, like dental fricatives and pharyngeals are excluded from the entire lexicon.

(18) Phonemic restrictions of the native lexicon

a. No labial approximant [w]	*[kwiz] *Quiz* (E)	but [kvis]
b. No palatal nasal [µ]	*[baµ´Ë] *bannière* (F)	but *Banner* [baná]
c. No voiced alveopalatal fricative [ž]	*[žibõ] *gibbon* (F)	but [gˆbøn]
d. No nasal vowel [õ, ã, …]	*[blõd] *blond* (F)	but [blønt]
e. No dental fricative [†]	*[bar†\lona] *Barcelona* (SP)	but [baËts\lona]
f. No pharyngeal [Ó], [¿]	*[møÓam´t] *Mohamed* (Arab.)	but [h] or [x]

(19) lists some phonotactic restrictions which hold without exception in the native lexicon, like for instance the two kinds of Final Devoicing exemplified above, called here Final Devoicing I (19a) and Final Devoicing II (19b). Final Devoicing I says that obstruents are voiceless word-finally and Final Devoicing II that they are voiceless syllable-finally. (19c) posits that stops are aspirated before stressed vowels. Further restrictions are the following: a glottal stop is realized before a syllable-initial stressed vowel (19d), there is no lax vowel in open syllables (19e), no short tense vowel (19f) there is no final unstressed [e] (19g), no unstressed rounded front vowel (19h), no voiceless [s] and no palatal fricative [ç] are realized word-initially (19i and j), no sequence (19k), and finally, all obstruent sequences are voiceless (19l).

(19) Phonotactic restrictions of the native lexicon

a. Final Devoicing I: Obstruents are voiceless word-finally	*Rad* 'wheel', *los* 'off, free' [t, s]
b. Final Devoicing II: Obstruents are voiceless syllable-finally	*Mitte* 'middle', *Nüsse* 'nuts' [t, s]
c. Aspiration of the stops: Stops are aspirated foot-initially	*T¨ür* [tˈy:Ë] 'door', *bekánnt* [b\kˈant] 'known'
d. Glottal stop: [÷] is realized before stressed vowel	*Be÷amte* [b\÷ámt\] 'civil servant', *Chaot* [ka÷ó:t] 'chaotic person'
e. No lax vowel in open syllables	but only tense ones
f. No short tense vowel	but only lax ones
g. No final unstressed [e]	but only [\]
h. No unstressed rounded front vowel	only stressed ones
i. No [s] word-initially	*sieben* 'seven' [z]
j. No [ç] word-initially	but only [k] or [ʃ]
k. No [˜g]	*Zunge* 'tongue', *lang* 'long' [˜]
l. All obstruent clusters are voiceless	*Ast* 'branch'[st], *Katze* 'cat' [ts]

3.3 The non-native lexicon

As far as the non-native words are concerned, we see that some of the properties in (18) and (19) are practically never violated by the non-native words. Some interesting restrictions are listed in (20).[7] Together with phonetic or allophonic characteristics in the realization of some sounds, these properties characterize the German accent. Some native speakers of German have great difficulty suppressing them in the process of learning a foreign language.

(20) Exceptionless phonotactic restrictions (lead to German accent)
- a. Final Devoicing I: Obstruents are voiceless word-finally.
- b. Aspiration of the stops: Stops are aspirated foot-initially.
- c. Glottal stop is realized before syllable-initial stressed vowels.

However, most of the properties in (18) and (19) can be violated in the non-native lexicon. Wurzel (1980) mentions the occurrence of the palatal nasal in (21b), of the nasal vowels in

[7] The uninteresting ones are the prohibitions against clicks, pharyngeals, etc.

(21d) and also of the short tense vowels in (22b). Kloeke (1982) lists other properties of the non-native words, like the presence of a voiced postalveolar fricative in (21c) and a voiceless palatal fricative word-initially in (22f). Further properties which can be violated by the non-native words are also listed in (21) and (22).

(21) Violated phonemic restrictions

a. No labial approximant [w]	*Walkman*
b. No palatal nasal [µ]	*Bretagne, Champagner*
c. No postalveolar fricative [ž]	*Gelee, Garage*
d. No nasal vowels [õ, ã, …]	*Renaissance*

(22) Violated phonotactic restrictions

a. Final Devoicing II	*Robbe* 'seal', *Puzzle, Dussel* 'idiot'
b. No short tense vowel	*Ökonomie* 'economy'
c. No final [e]	*Chile, Kaffee*
d. No unstressed rounded front vowel	*möblíeren* 'to furnish'
e. No [s] word-initially	*City, Steak, Sevilla, Software*
f. No [ç] word-initially	*Chemie, China*
g. No sequence nasal + voiced dorsal stop [˜g]	*Ungarn, Mango*
h. No voiced obstruent clusters	*Budget* [bydže:]

The non-native words have some properties which have been mentioned in the literature for other languages, but which are true for German, as well. These properties are summed up in (23).

(23) Properties of the non-native lexicon

a. Some violations are worse than others in being more non-native.
b. Loanwords on their way to nativization take over some properties of the borrowing language more quickly than others.
c. Some foreign sounds are adopted more easily than others.
d. The number of levels is unclear.
e. The position which a non-native word occupies in a hierarchy is not always clear-cut.

First, non-native words violate the constraints characterizing the native lexicon in various ways. The individual words do not violate all constraints at once, but typically involve only one or two violations, in other words, just a small fraction of the total number. Some violations are felt to be worse than others, because they are perceived as more non-native. Crucial for the non-nativeness of a word is thus not the number of violations that it contains, but the relative weight of the violated constraints (23a).

The second important observation which has already been made for other languages (by Fries & Pike 1949 for Mazateco, Holden 1976 for Russian and most clearly by Ito & Mester 1998a for Japanese) is that some properties are fulfilled earlier by non-native words on their way to nativization than others. Typically, the most serious violations are corrected first (23b).

The third property is that some foreign phonemes and sounds are taken over more easily than others, depending on the sounds and on the language. The non-native sounds also form a hierarchy (23c).

But, and this is the fourth property in (23d), the number of lexical levels or strata needed by the non-native lexicon is unclear.

Finally, the exact position which a non-native word occupies in a hierarchy is not always well-defined. A word like *City* [sˆti], for instance, is pronounced as [tsˆti] by others. It is thus not even always clear whether a word is native or not (23e).[8]

These properties must be accounted for by a model of the lexicon. A twofold division of the lexicon cannot explain them, since, in such a model, the non-native vocabulary is considered as an entity with immutable characteristics of equal value. In contrast, a model of the lexicon based on the principles of OT is able to explain all these properties, as shown in the next section.

3.4 A model of the lexicon

In OT, a grammar of a language consists of a strictly linear ranking of the universal constraints. Consider first the markedness constraints regulating the kind of phonemic and phonotactic restrictions which were exemplified in (18) and (19) and which were shown to be crucial for distinguishing between different levels of the lexicon. Ideally, these are of course also strictly linearly ordered. In (24), M_1 is the highest constraint, then M_2, M_3, etc. As an example, we can think of M_1 as the constraint militating against clicks, M_2 as the one against pharyngeals, M_3 as the one requiring a glottal stop, etc. (No attempt will be made here at describing the actual ordering of the constraints.)

(24) Linear ordering of the markedness constraints

$M_1 >> M_2 >> M_3 >> M_4 >> M_5 >> M_6 >> M_7 >> M_8 >> \ldots >> M_n$

Concentrating on the behavior of the lexical words with respect to phonemic and phonotactic restrictions, the native words fulfill all constraints up to a certain place in the hierarchy. This means that all high-ranking constraints are fulfilled by the words belonging to the core lexicon. These words violate low-ranking constraints, which can be claimed to be outside the phonology of German, but which are nevertheless present in all grammars, since the optimality-theoretic constraints are universal. Examples of such constraints which are systematically violated in German are given in (25). These constraints can be high-ranking in other languages (the ones in (25) are high-ranking in Hawaiian).[9]

(25) Examples of constraints systematically violated in German

a. *[f]: No Labial Fricative
b. *[t]: No Alveolar Stop

(26) illustrates the native grammar schematically. The markedness constraints active in German are fulfilled by the native words, some by default. F stands for the place in the hierarchy from which on the lower constraints are no longer satisfied.

[8] An anonymous reviewer asks if the fact that some people say [tsiti] and others [siti] might be not simply be an indication that these people differ in the underlying form they postulate. At some point in their life, speakers of German will certainly have heard both pronunciations, thus allow for both inputs, and will have to choose the output they prefer. They will do that in agreement with their internalized grammar.

[9] Though a low-ranking constraint like NOCODA is active in German and triggers the effect called *Emergence of the Unmarked* in McCarthy & Prince (1995), as attested by the fact that a word like *Judo* is always syllabified as *Ju.do* and never as *Jud.o*, for instance, no such effect can be observed for the constraints (25a and b). Thus [f] or [t] are never avoided which means that they are not subject to the *Emergence of the Unmarked.* I am not aware that the limits of *Emergence of the Unmarked* have been explored, yet.

(26) Grammar for the native words

$M_1 >> M_2 >> M_3 >> \ldots >> M_i >> M_j >> M_k >> M_l >> F >> M_m$

|

Faithfulness constraints
for the native words

Up to a certain point, it does not matter which input is chosen for the native words, since the non-optimal outputs are eliminated by the markedness constraints. Assume that the German word *blond* 'blond' takes the French pronunciation /blõd/ as input. Tableau 11 shows that the faithful candidate [blõd] has no chance of winning, since this candidate violates two high-ranking markedness constraints, FD and NONASALVOWEL, not to speak of the syllable structure. The winner is the unfaithful candidate fulfilling the markedness constraints. Notice that another input could be chosen and the same result would have been obtained. This can be seen in Tableau 11, which illustrates the Richness of the Base, also called Freedom of the Input.[10] The actual violations of Faith in this tableau depend on which form is taken as the correspondent input. What is important to note is that the Faith violations are irrelevant - the first two constraints have already determined the optimal candidate.

/blõd/, /blønt/, /blõt/, /blønd/	FD	NONASALVOWEL	Faith (VDOBSTR,NASALVOWEL)
☞ a. [blønt]			
b. [blõt]		*!	
c. [blønd]	*!		
d. [blõd]	*!	*	

Tableau 11: Richness of the base

In principle, the model shown in (26) also applies to the non-native words. Practically, however, it is a little bit more complicated because the phonology of the non-native words is more liberal, which implies that the markedness constraints do not play such an important role. In contrast, the faithfulness constraints gain more weight in the evaluation of the non-native words, since the non-native words are more faithful to their input - which then takes the form they have or had in their original language. In terms of the constraint ranking, faithfulness to the input can be effective at different places for different words. At the position where F stands, faithfulness is more important than markedness, and from this point on the markedness constraints are systematically violated. This is illustrated in (27). If F is located high in the hierarchy, the markedness constraints are not very effective and the output resembles the input, even if it violates many markedness constraints. (27a) is such a case. An unassimilated word like *rave*, which keeps its English pronunciation, could be an example, since it violates Final Devoicing. A word which would obey a hierarchy like (27b) would sound a little bit less foreign than a word under (27a). In (27c) it is shown that F can be low in the hierarchy, though not as low as for the native words. It is important to notice that the property of being more or less faithful to inputs is a property of the individual words or classes of words. The faithfulness constraints appear all over in the constraint ranking between the markedness constraints, as shown in (28), which illustrates the general model, and the individual words, groups of words or morphological classes rank themselves in the hierarchy with respect to the faithfulness constraints.

[10] Richness of the Base is to be taken with a grain of salt. For OT to be workable, the faithfulness constraints require that a lot of information be already present in the input(s) of some output form. Only allophonic variants or free alternations and the like allow the proliferation of several input forms. In a certain interpretation of Richness of the Base, all kinds of inputs are admitted, but most of them do not correspond to an output.

(27) Grammar for non-native words

a. M_1 >> M_2 >> M_3 >> F >> … >> M_i >> M_j >> M_k >> M_l >> … >> M_n

b. M_1 >> M_2 >> M_3 >> M_4 >> F >> … >> M_i >> M_j >> M_k >> M_l >> … >> M_n

c. M_1 >> M_2 >> M_3 >> … >> M_i >> M_j >> F >> M_k >> M_l >> … >> M_n

(28) General model

M_1 >> F >> M_2 >> F >> M_3 >> F >> … >> F >> M_i >> F >> M_j >> F >> M_k >> …

The model in (28) is extremely simplified. The effect of F is obtained by the combination of many different faithfulness constraints standing at different places in the hierarchy, as shown in Tableau 12 for the realization of [s]. A word like *Skelett*, which violates a relatively low-ranking constraint ($*_{Word}$[sk), is less foreign than *City* or *Surf*, which violate a higher-ranking constraint ($*_{Word}$[sV). This tableau illustrates how words in various stages of nativization fulfill the markedness constraints differently. The native words *Ski* and *sieben* fulfill all relevant markedness constraints. These words are sensitive to the Faithfulness constraint 5, which is the lowest faithfulness constraint for [s]. *Salto* is behaving like *sieben* w.r.t. [s]. Thus, if it is less nativized than *sieben* for other features – like the final [o] – this is not visible here. However, it is assumed that it fulfills a faithfulness constraint higher in the hierarchy exactly for these reasons: it is less nativized than *sieben*. *Skandal*, *Steak* and *City* are more faithful to their input and violate higher-ranking constraints. However, *Steak* is pronounced with [ʃ] far more often than *Skandal* which is always realized with [s] in the standard dialect. This is due to the fact the sequence [sk] is more acceptable than the sequence [st]. In the tableau, this difference is accounted for by the fact that *Skandal* fulfills a lower-ranking constraint for [s] than *Steak*. And finally, *City* fulfills a very high faithfulness constraint for [s]. The same word can be more faithful to the native pronunciation of German for other properties – like the quality of the vowel or the realization of <t> as a coronal stop, and not as a flap as in English. The markedness constraints responsible for the latter properties are ranked higher than the ones responsible for the pronunciation of <s> as [ʃ] before consonants. Interestingly, this kind of properties give evidence for the ranking of non-interacting markedness constraints.

Tableau 12 here

Returning now to the properties of the non-native vocabulary which were listed in (23), we can see that they are taken account of and explained by the model.

The first property (23a) was that non-native words violate in various ways the constraints characterizing the native lexicon. Some violations are worse than others in the sense that they are less native. This property of the non-native vocabulary is accounted for by the model. Words violating high-ranking constraints sound more foreign - more non-native - than those which violate low-ranking constraints. This is because high-ranking constraints are a more inherent part of the grammar of a language than low-ranking ones.

The second property (23b) which is explained by the model is that loanwords on their way to nativization adapt themselves to the new language more quickly with respect to some properties than to others. Consider a French word taken over in German, as for instance the word *Landes*, which is the name of a region (29). This word violates two constraints, first the high-ranking FD and second the constraint against nasal vowels, which is not so high-ranking. These two constraints must be satisfied if the word is nativized. But since FD ranks higher than NONASVOW, Final Devoicing will be satisfied before NONASVOW can be. There is no way that the reverse ordering could apply. A partial nativization like the one in (29b) is expected, but the reverse ordering of the nativization, like in (29c), is impossible. A similar point has been made by Ito & Mester (1998b) for Japanese with the word *Citybank.*

(29) *Landes* ‘geographic name’ (region in France)
a. FD >> … >> NONASVOW
b. [lãd] –> [lãt] Final Devoicing before oralization of the nasal vowel: Expected nativization
c. [lãd] –> *[land] Oralization before Final Devoicing: Not a possible nativization

As a correlate, it should be mentioned that, if words move at all, then in the direction of nativization, which means that words can evolve in the direction of fulfillment of the grammar. Single words become more native because they satisfy the grammar more by satisfying more constraints.

The third property (23c) that a model of the stratification of the lexicon should account for is that some foreign sounds are adopted more easily than others. The postalveolar fricative [Ω] and the English sound [®] - the retroflex r - are taken over into German without any problem. In contrast, the English interdental fricatives [†] and [∂] have not been taken over and it is not very probable that pharyngeals, for instance, will ever become German phonemes. The model proposed here accounts for this property, as well. All sounds, whether they belong to the native inventory or not, are ordered in a hierarchy. This is illustrated in (30). The constraints prohibiting interdental fricatives [†] and [∂], as well as pharyngeals are high in the hierarchy and as a consequence, these sounds cannot be easily integrated into the German segmental inventory. But the constraints against [ž] and [®] are lower ranked and are violated in actual words.

(30) Non-native sounds
NOPHARYNGEAL >> NO [∂ /†] >> … >> NO [®] >> … >> NO [ž] >> …

A further property was that the number of levels is unclear. In the present model, the stratification of the lexicon is a direct consequence of the markedness constraints. In principle, there are as many levels as markedness constraints, since the effectiveness of the constraint hierarchy can be blocked by faithfulness constraints at each markedness constraint.

And finally, the exact position which a non-native word occupies in a hierarchy is not always well-defined. This property is explained by the fact that the position of F is not given once and for all, but is variable for many words. In addition to diachronic variation, individual differences are also expected.

4. Final Devoicing in this model

We are now in a position to return to the problem which arose from the consideration of ambisyllabic obstruents, namely the different violations of Final Devoicing by different kinds of native words. It is shown in this last section that the model just discussed accounts for the data nicely.

An interesting fact about these data is that two classes of native words must be distinguished. First the core native ones, like *Mitte, Nüsse* and *geschnitten*, which do not tolerate ambisyllabic voiced segments, and second the slightly more peripheral words, like *Robbe*, *Roggen* and *Dussel*, which do. These words show that not only non-native words but also the native ones must be subdivided into several subclasses of words, depending on their behavior with respect to faithfulness constraints,. For the cases at hand, a positional markedness constraint (FD, short for *VDOBSTR$_{(CODA)}$) is needed along with a general one (*VDOBSTR). There is no way of escaping the fact that the faithfulness constraint IDENT(voice) is also subdivided into two, a positional and a general one, IDENT(voice)$_{ONSET}$1 and IDENT(voice). In the analysis proposed here, the same faithfulness constraint can appear

several times in the constraint hierarchy. This is what happens with IDENT(voice)$_{ONSET}$. Tableau 13 illustrates the analysis for the words *Bund* and *geschnitten*.

As shown in section 2, FD, ID(voice) and *VDOBSTR are sufficient to explain the core native words - but not the nearly native ones illustrated in Tableau 14. The lack of voiced ambisyllabic obstruents in a word like *geschnitten* in this part of the lexicon is accounted for only by an approach making use of FD. Positional faithfulness is not able to account for these words. Notice that a solution to the effect that there is no input with ambisyllabic voiced obstruent is not satisfactory, both because of Richness of the Base and on the face of alternations like *schneiden/geschnitten.*

In Tableau 13, IDENT(voice)$_{ONSET}$1 is invisible. The difference between the voicing of *b* in *Bund* and the voicelessness of *t* in *geschnitten* is explained by the place of IDENT(voice)$_{ONSET}$2, which is ranked below FD, and to which these words are sensitive. Since *t* in *geschnitten* is not only the onset of the final syllable but also the coda of the preceding syllable, it is subject to FD before it is to IDENT(voice)$_{ONSET}$2, and it is thus voiceless. [b] in *Bund* is just an onset, and can retain its voicing.

For the words illustrated in Tableau 14, positional faithfulness, thus ID(voice)$_{ONSET}$, is needed. FD cannot explain why voiced ambisyllabic obstruents are now possible. A solution to the effect that FD is parametrized for different classes of words does not work, since then we would predict that all input voiced obstruents belonging to the same class as *Puzzle* and *Robbe* are realized as voiced, also in the absolute final position. But, as was shown above, Final Devoicing has an effect till relatively late in the lexicon, also in words which are clearly non-native.

The rather inelegant model proposed in this paper appears to be unavoidable in the present state of the optimality-theoretic analysis.

	ID(voice)$_{ONSET}$ 1	FD	ID(voice)$_{ONSET}$2	ID(voice)	*VDOBSTR
/g\ʃnˆdn/ *geschnitten* 'cut'					
☞ g\ʃnˆt̩n			*		*
g\ʃnˆd̩n		*!			
/b¨nd/ Bund 'federation'					
b¨nt					*
☞ b¨nd		*!			
p¨nt			*!		**

Tableau 13: Core native words

	ID(voice)$_{ONSET}$ 1	FD	ID(voice)$_{ONSET}$ 2	ID(voice)	*VDOBSTR
/p¨zl/ *Puzzle*					
☞ p¨zl		*			
p¨sl	*!		*		*
/Ëøb\/ *Robbe* 'seal'					
☞ Ëøb\		*			
Ëøp\	*!		*		*
/kl¨b/ *Klub* 'club'					
☞ kl¨p					*
kl¨b		*!			

Tableau 14: Non-core native words

5. Conclusion

This paper has proposed a model of the stratification of the lexicon which accounts for Final Devoicing data which at first sight seemed hopelessly contradictory. Both approaches to Final Devoicing which have been proposed in the literature, the neutralizing coda approach and the positional onset one, are needed for a full account of the data. A crucial aspect of the analysis is that faithfulness constraints can appear at different places in the hierarchy, whereas markedness constraints appear just once. Thus, the markedness constraints constitute the 'real' grammar of the language and non-native words fulfill the grammar in many different ways, some more, some less.

In the paper, only a few interactions between markedness constraints have been discussed. The constraint against pharyngeals has nothing to do with the constraint against voiced obstruents, for instance. The proposed constraint hierarchy only reflects the different degrees of assimilation of the sounds into the grammar of German. The fact that the hierarchy can provide a ranking for unrelated constraints is a welcome result since it confirms the idea of a total linear ordering of all constraints. Constraints which cannot interact are also ranked, but on a different basis.

References

Beckman, Jill N. (1997a) Positional Faithfulness, Positional Neutralisation and Shona Vowel Harmony. Phonology 14.1. 1-46.

Beckman, Jill N. (1998) Positional Faithfulness. Doctoral Dissertation. University of Massachusetts, Amherst [ROA 234].

Brockhaus, Wiebke (1995) Final Obstruent Devoicing in the Phonology of German. Tübingen. Niemeyer.

Davidson, Lisa & Rolf Noyer (1997) Loan Phonology in Huave: Nativization and the Ranking of Faithfulness Constraints. In: Agbayani, Brian & Sze-Wing Tang (eds.) The Proceedings of the Fifteenth West Coast Conference on Formal Linguistics. Stanford: CSLI Publications. 65-79.

Féry, Caroline (1997) The Mora as a Measure of Weight and a Syllabic Constituent. In: Bertinetto, P.M., L. Gaeta, G. Jetchev & D. Michaels (eds.). Certanem Phonologicum III. Papers from the Third Cortona Phonology Meeting. Torino. Rosenberg & Sellier. 91-110.

Filipec, Josef (1966) Probleme des Sprachzentrums und der Sprachperipherie im Wortvorratssystem. Travaux Linguistiques de Prague 2. 257-275.

Fries, Charles C. & Kenneth L. Pike (1949) Coexistent Phonemic Systems. Language 25. 29-50.

Galinsky, Hans (1980) American Neologisms in German. American Speech 55. 243-263.

Hall, T.A. (1992) Syllable Structure and Syllable-Related Processes in German. Tübingen. Niemeyer (= Linguistische Arbeiten 276).

Harris, John (1997) Licensing Inheritance: an integrated theory of neutralization. Phonology 14.3. 315-370.

Haugen, Einar (1950) The Analysis of Linguistic Borrowing. Language 26. 210-231.

Hock, Hans Heinrich (1986) Principles of Historical Linguistics. Berlin/New York. Mouton de Gruyter.

Holden, Kyril (1976) Assimilation Rates of Borrowings and Phonological Productivity. Language 52. 131-147.

Ito, Junko & Armin Mester (1995). Japanese Phonology. In: Goldsmith, John (ed.) Handbook of Phonological Theory. Oxford. Blackwell. 817-338.

Ito, Junko & Armin Mester (1998a) The Phonological Lexicon. To appear as Chapter 3 of: Tsujimura, Natsuko (ed.) A Handbook of Japanese Linguistics. Oxford. Blackwell.

Ito Junko & Armin Mester (1998b) Markedness and Word Structure: OCP Effects in Japanese. Ms. University of California at Santa Cruz.

Jessen, Michael (1997) Phonetics and Phonology of the tense and lax obstruents in German. Arbeitspapiere des Instituts für Maschinelle Sprachverarbeitung-Phonetik. Universität Stuttgart.

Kiparsky, Paul (1968) How abstract is phonology? Ms. MIT.

Kloeke, W.U.S. van Lessen (1982) Deutsche Phonologie und Morphologie: Merkmale und Markiertheit. Tübingen. Niemeyer.

Lombardi, Linda (1991) Laryngeal Features and Laryngeal Neutralization. Doctoral Dissertation. University of Massachusetts, Amherst.

Lombardi, Linda (1995) Laryngeal Features and Privativity. The Linguistic Review 12.1. 35-59.

McCarthy, John J. & Alan S. Prince (1994) The Emergence of the Unmarked: Optimality in Prosodic Morphology. In Mercè Gonzalez (ed.) Proceedings of the North East Linguistic Society 24. Amherst, MA: Graduate Linguistic Student Association. 333-379.

Nessly, Larry (1971) Anglicization in English Phonology. In: Papers from the Seventh Regional Meeting. Chicago Linguistic Society. 499-510.

Padgett, Jaye (1995) Partial Class Behaviour and Nasal Place Assimilation. In: Proceedings of the Arizona Phonology Conference. Workshop on Features in Optimality Theory. Coyote Working Papers. University of Arizona, Tucson.

Paradis, Carole & Darlene Lacharité (1997) Preservation and Minimality in Loanword Adaptation. Journal of Linguistics 33. 379-430.

Pfeifer, Wolfgang et al. (1993) Etymologisches Wörterbuch der deutschen Sprache. Berlin. Akademie Verlag.

Polenz, Peter von (1967) Fremdwort und Lehnwort, Sprachwissenschaftlich Betrachtet. Muttersprache 77. 65-80.

Prince, Alan & Paul Smolensky (1993) Optimality Theory: Constraint Interaction in Generative Grammar. Ms. Univ. of Colorado, Boulder.

Rubach, J. (1989) Final Devoicing and Cyclic Syllabification in German. Linguistic Inquiry 21.1. 79-94.

Silverman, Daniel (1992) Multiple Scansions in Loanword Phonology: Evidence from Cantonese. Phonology 9. 289-328.

Smolensky, Paul (1995) On the Internal Structure of the Constraint Component Con of UG. Handout of a talk given at the University of Arizona.

Steriade, Donca (1997) Phonetics in Phonology: The Case of Laryngeal Neutralization. Ms, University of California, Los Angeles.

Trubetzkoy, Nikolai Sergejewitsch (1939) Grundzüge der Phonologie. Prag (=TCLP 7) (republished 1958 by Vandenhoeck & Ruprecht, Göttingen).

Vachek, Josef (1966) On the Integration of the Peripheral Elements into the System of Language. Travaux Linguistiques de Prague 2. 23-37

Volland, Brigitte (1986) Französische Entlehnungen im Deutschen. Tübingen: Niemeyer (= Linguistische Arbeiten 163).

Vennemann, Theo (1972) On the Theory of Syllabic Phonology. Linguistische Berichte 18. 1-18.

Vennemann, Theo (1994) Universelle Nuklearphonologie mit epiphänomenaler Silbenstruktur. In: Ramers, Vater & Wode (eds.) Universale phonologische Strukturen und Prozesse. (= Linguistische Arbeiten 310) Tübingen. Niemeyer. 7-54.

Werner, Reinhold (1981) Systemlinguistische Aspekte der Integration Entlehnter Lexikalischer Einheiten. In W. Meid, K. Heller (eds.) Sprachkontakt. Innsbrucker Beiträge zur Sprachwissenschaft 34. 219-235.

Wiese, Richard (1996) The Phonology of German. Oxford. Clarendon Press.

Wurzel, Wolfgang Ullrich (1980): Phonologie. In Heidolph, K. E., W. Flämig, W. Motsch et al. (eds.) Grundzüge einer deutschen Grammatik. Berlin: Akademie Verlag.

Yip, Moira (1993) Cantonese Loanword Phonology and Optimality Theory. Journal of East Asian Linguistics 2.

	Faith [s] 1	*$_{Word}$[sV	Faith [s] 2	*$_{Word}$[sC	Faith [s] 3	*$_{Word}$[sk	Faith [s
sieben [s]		*!					
sieben [z]							
Ski [s]							
Ski [ʃ]							
Salto [s]		*!					
Salto [z]							*
Skandal [s]						*	
Skandal [ʃ]					*!		
Steak [s]				*			
Steak [ʃ]			*!				
City [s]		*					
City [z]	*!						

Tableau 12: Word-initial [s]