Loanword Nativization in German*

T.A. Hall und Silke Hamann

Abstract

The present article examines the changes that affect stressed vowels in the nativization of loanwords into Standard German, e.g. laxing of vowels like [i] to [ɪ] in *F[ɪ]rma* (< Italian *F[i]rma*). An Optimality-Theoretic treatment (Prince & Smolensky 1993) of the loanword data is proposed in which the nativization process is accounted for by ranking two MARKEDNESS constraints ahead of two FAITH constraints. A significant finding is that these four constraints as well as the ranking MARKEDNESS ≫ FAITH are independently required for the native lexicon of German. Thus, we conclude that our treatment is inherently superior to any rule-based analysis because a rule-based treatment would be forced to posit specific rules to account for the loanword data which have no independent motivation.

---

1. Introduction

A number of linguists have shown that in a rule-based model the nativization of loanwords requires rules that are otherwise unmotivated in the borrowing language, e.g. Silverman (1992), Yip (1993). For example, when the English word *game* [geɪm] is borrowed into Cantonese, the word surfaces as [kɛm] (see Silverman 1992:297). In this example one would require a rule converting /g/ into [k] and another one which turns /eɪ/ into [ɛ], but the problem is that Cantonese does not have these phonological rules in its system because it has neither /g/ nor /eɪ/. In many languages the nativization of loanwords is captured in terms of prosodic requirements that do not require rules. For example, in a language like Hawaiian with neither complex onsets nor closed syllables, an English word like *school* [skuːl] surfaces as [kola] (Gussenhoven & Jacobs 1998: 43), but Hawaiian phonology has no phonological rules deleting word-edge consonants.

---

* We would like to thank Ingo Plag, Marzena Rochoń and three anonymous reviewers for their comments on earlier versions of this article.

Zeitschrift für Sprachwissenschaft 22.1 (2003), 56–85

ISSN 0721-9067

On the basis of examples such as these several linguists have argued that constraint-based approaches, in particular Optimality Theory (henceforth OT; Prince & Smolensky 1993), are better suited to capturing the nativization of loanwords (e.g. Yip 1993, Jacobs & Gussenhoven 2000, Golston & Yang 2001). In OT one would require for the native vocabulary of Hawaiian MARKEDNESS constraints ensuring that all syllables are of the form CV, namely ONSET and NOCODA, and the ranking of these two constraints ahead of FAITH constraints which prevent the deletion or insertion of segments and the change of features. Significantly, the ranking of MARKEDNESS (i.e. ONSET and NOCODA) over FAITH in the native lexicon of Hawaiian also captures the nativization of loanwords like [skuːl] to [kola].

We will argue below that certain vocalic changes that can be observed in the nativization process of loanwords in German (henceforth MSG; Krech et al. 1982, Drosdowski et al. 1990) can most insightfully be captured in an OT approach. We reach this conclusion because the modifications involved cannot be expressed with phonological rules but they do follow given two MARKEDNESS constraints and two FAITH constraints which are independently required in the native lexicon. As in Hawaiian, we argue that the vocalic changes in loanwords require the general ranking of MARKEDNESS over FAITH.

The vocalic changes we investigate below involve alterations in tenseness or in length in ancient, as well as more recent loanwords. For example, in Italian, as in number of other languages, stressed (short) tense vowels (e.g. [i o]) surface consistently in MSG as the corresponding lax sounds (i.e. [ɪ ɔ]) in words like the following:[1]

(1)	*Italian*		*MSG*	*change*
	firma	>	Firma	i → ɪ
	conto	>	Konto	o → ɔ

Since the stressed vowel in the MSG examples in (1) is followed by a syllable-final consonant, the data in (1) suggest a rule as in (2):

(2) Short (tense) vowels become lax in a closed syllable

One argument against a rule like the one in (2) is that there are no alternations in MSG which independently require it. Another problem with (2) can be gleaned from examples like the one in (3):

---

[1] Our source for the data in (1) and below is Kluge (1999). See Lichem (1970) for discussion on the phonetics of Italian vowels and section 4.1 below on the comparison of these sounds to the relevant German vowels.

(3)

Latin		*MSG*	*change*
mūsica	>	Musik	i → iː

In (3) we can observe that short tense vowels regularly lengthen in closed syllables if those closed syllables are word-final.

The following questions can be posed with respect to the data in (1) and (3):

(4)
  a. Why is laxing restricted to the stressed vowels in a word-internal closed syllable, as in (1)?
  b. Why do short tense vowels lengthen word-finally, as in (3), but not word-internally, as in (1)?

The purpose of this paper is to answer the questions in (4a) and (4b).

We argue that the vocalic changes in (1) and (3) can most insightfully be understood as the consequence of the interaction of two MARKEDNESS constraints and two FAITH constraints and the general ranking MARKEDNESS over FAITH. The first of the MARKEDNESS constraints (which we call TENSE = LONG) guarantees that stressed tense vowels are long and that stressed lax vowels are short; it is the high ranked status of TENSE = LONG that accounts for the lengthening of the short tense vowel in (3). The second MARKEDNESS constraint is required to capture the distribution of superheavy syllables, i.e. syllables consisting of a long vowel or diphthong + consonant(s) (e.g. *viel* 'much'), or a short vowel + two or more consonants (e.g. *kalt* 'cold'). In general, superheavy syllables are restricted to surfacing only at the right edge of a phonological word (henceforth pword; see Hall 2002a, b). We capture this fact directly with a constraint we call ALIGN-3μ. With respect to the nativization of loanwords, this constraint is important because it helps explain why the stressed vowels in (1) do not lengthen as in (3).

This article is organized as follows. In 2 we discuss the connection between length and tenseness in the MSG vowel system and posit a MARKEDNESS constraint and two FAITH constraints which capture the German facts. In § 3 we discuss the relationship between morphological structure and the pword in MSG, as well as the distribution of superheavy syllables. We show in that section that in the native lexicon the latter syllables occur almost exclusively in pword-final position and that this is captured directly with the constraint ALIGN-3μ referred to above. It will also be shown in § 3 that the native lexicon requires the general ranking of MARKEDNESS (i.e. TENSE = LONG and ALIGN-3μ) over FAITH to account for certain systematic gaps. In § 4 we discuss the nativization of both ancient and recent loanword into the sound system of German, as in (1) and (3). In § 5 we present an analysis of the loanwords data in terms of the same ranking of MARKEDNESS over FAITH that is necessary for the native vocabulary. § 6 concludes.

2. Vowel length and tenseness

Since the nativization of loanwords discussed below involves the change of vowel tenseness and/or length we provide here a brief OT analysis of how the contrast between (stressed) vowels like [iː yː uː oː] vs. [ɪ ʏ ʊ ɔ] in the native vocabulary of MSG is expressed. We show below that the connection between length and tenseness requires one MARKEDNESS constraint and two FAITH constraints.

A number of previous studies have observed a connection between vowel length and tenseness in MSG (and in other languages), the generalization being that stressed tense vowels like [i y u o] are long (= [iː yː uː oː] in a narrow transcription) and lax vowels like [ɪ ʏ ʊ ɔ] short (see Becker 1998 for discussion and references for MSG). Some relevant data from MSG containing the vowels [iː yː oː] and [ɪ ʏ ɔ] are provided in (5a) and (5b) respectively:

(5) a. Stressed, long, tense vowels:

viel	[fiːl]	'much'
kühn	[kyːn]	'bold'
Hohl	[hoːl]	'hollow'

b. Stressed, short, lax vowels:

Tisch	[tɪʃ]	'table'
dünn	[dʏn]	'thin'
Groll	[gʀɔl]	'grudge'

We discuss only stressed vowels here because the loanwords we analyze in § 4 only show changes in metrically prominent syllables.

In derivational analyses the connection between length and tenseness is usually established with default rules specifying that underlying short and long vowels receive features such as [− tense] and [+ tense] respectively (see, for example, Hall 1992:28 and Wiese 1996:155, who both employ [ATR]). In the present treatment we capture the relationship between length and tenseness with three constraints, the first of which is the MARKEDNESS constraint in (6), which refers to the output representation only (see also Green 2001, who proposes a similar constraint on the basis of English data).[2] We capture the contrast between long vs. short in terms of moraic structure, i.e. long vowels are bimoraic and short vowels monomoraic.

---

[2] Natural classes in German phonotactics crucially refer to the two classes defined as [+ tense] and [− tense] (as well as short vs. long). See Wiese (1996) and Hall (1999 b) for discussion on German and also McMahon (2001), who shows that both [± tense] and length are necessary in Modern English. See Ladefoged & Maddieson (1996:302–306) for discussion on the phonetic correlates of tenseness in German.

(6) TENSE = LONG:
a. Stressed tense vowels are long
b. Stressed lax vowels are short

As stated in (6), all of the vowels in the examples in (5) satisfy TENSE = LONG. TENSE = LONG is violated in the case of the long lax vowel [ɛː], e. g. [mɛːtçən] 'girl' (see note 6 below).[3]

The two FAITH constraints in (7) ensure that input and output vowels agree with respect to tenseness and length (= moraic structure) respectively:

(7) a. IDENTTENSE: The value of [tense] in the input is identical with the value for [tense] in the output
b. IDENTLONG: The moraic structure of input and output vowels is identical

IDENTTENSE is satisfied when an underlying tense vowel surfaces as tense, or an underlying lax vowel as lax, but is violated if the feature [tense] changes (e. g. /i/ → [ɪ]). The constraint IDENTLONG has a similar function with respect to the number of moras for input and output vowels.[4] Thus, if a long vowel surfaces as short (e. g. /iː/ → [i]) or if a short vowel surfaces as long, then IDENTLONG is not satisfied.

A long-standing debate concerns the underlying representations of the vowels in words like the ones in (5). Some linguists have argued that the contrast between pairs like /iː yː oː/ vs. /ɪ ʏ ɔ/ involves only one of length and tenseness is redundant (e.g. Hall 1992, Wiese 1996, Féry 1997), whereas others have argued that tenseness is primary and length is predictable (e.g. Kloecke 1982). In our treatment the choice of which feature(s) distinguish the vowels in words like the ones in (5) is moot, since the language-specific ranking in (8) will always produce the correct surface vowels.

(8) Ranking for MSG:
TENSE = LONG, IDENTTENSE ≫ IDENTLONG

---

[3] The constraint TENSE = LONG makes reference to stressed vowels because unstressed vowels do not obey the same generalizations. For example, tense vowels are *short* when unstressed, e.g. the [i] in *Zitrone* 'lemon' (see Drosdowski et al. 1990). We ignore short tense vowels below because our analysis of the loanwords in §4 only pertains to stressed vowels, as in (5), which are always long when tense (= 5a). For treatments of the distribution of MSG short tense vowels see Ramers (1988), Hall (1992), Becker (1996), and Wiese (1996).

[4] The constraint IDENTLONG is sometimes referred to as FAITHMORA (see, for example, Gussenhoven 2000).

We argue below in §3 for the ranking Tense = Long ≫ IdentTense and conclude in that section that the language-specific ranking Tense = Long ≫ IdentTense ≫ IdentLong can be generalized to the ranking of one Markedness constraint (i.e. Tense = Long) over two Faith constraints (i. e. IdentTense, IdentLong).

Consider now the evaluation of *kühn* and *dünn* – representative of (5 a) and (5 b) – in tableaus (9) and (10). Here we assume that the underlying vowels are distinguished by tenseness, although we show below that other underlying forms are possible as well. We also assume that the moraic structure of the vowels is present in the underlying representation.

(9) Evaluation of *kühn* with an underlying /y/ (short and tense):

	/kyn/	Tense = Long	IdentTense	IdentLong
a.	→ .ky:n.			*
b.	.kyn.	*!		
c.	.kʏ:n.	*!	*	*
d.	.kʏn.		*!	

(10) Evaluation of *dünn* with an underlying /ʏ/ (short and lax):

	/dʏn/	Tense = Long	IdentTense	IdentLong
a.	.dy:n.		*!	*
b.	.dyn.	*!	*	
c.	.dʏ:n.	*!		*
d.	→ .dʏn.			

In the first tableau we can observe that (9 a) is more harmonic than (9 b – d) due to the ranking Tense = Long ≫ IdentLong and IdentTense ≫ IdentLong. In tableau (10) candidate (10d) is obviously the optimal one because (10 a, b, c) each violate at least two of the three constraints.

It should be noted here that the correct output forms in (9) and (10) would be selected even if other assumptions were to be made concerning the underlying vowels. Four possibilities for the contrast in (9) and (10) are: (i) /y/ and /ʏ/, (ii) /y:/ and /ʏ/, (iii) /y:/ and /ʏ:/, or (iv) /y/ and /ʏ:/. That the inputs in (i) result in the correct output forms being selected was demonstrated in (9) and (10).

Although we do not provide tableaus here, options (ii)–(iv) also obtain the correct phonetic representations given the ranking in (8).[5,6]

To summarize, the three constraints Tense = Long, IdentTense and Ident-Long are required in an OT treatment to capture connections between tenseness and length of stressed vowels. Given the language-specific ranking in (8) we need not to commit ourselves to the underlying forms in (9) and (10), since the other possibilities mentioned above give us the right result. Significantly, we show in § 5 below that the same ranking in (8) (supplemented with an additional Markedness constraint we posit in § 3) accounts for the vowel laxing and lengthening processes we see in the nativization of loanwords.

3. The pword and the distribution of superheavy syllables

We begin this section in § 3.1 with a discussion of the connection between morphological structure and pwords in MSG. In § 3.2 we turn to the distinction between 'heavy' vs. 'superheavy' syllables and in § 3.3 we present data from the native vocabulary of MSG illustrating the distribution of superheavy syllables within grammatical words. In contrast to heavy syllables, superheavy syllables do not have a free distribution in the sense that they are restricted to surfacing only at the right edge of a pword. The distribution of superheavy syllables has not been discussed in the literature on MSG phonology (although see Hall 2001, 2002 a, b, upon which the following treatment is based).

---

[5] This discussion here demonstrates that underlying representations are not as important in OT as in traditional rule-based systems. This follows from the principle known as Richness of the Base, according to which no constraints hold at the level of underlying forms (Prince & Smolensky 1993:191 ff.). In § 5 below we discuss this issue with respect to loanwords.

Note that the four underlying pairs in (i)–(iv) do not presuppose underspecification. Were one to allow for underlying forms which are underspecified (e.g. for moraic structure or for tenseness) then there are clearly more than four possibilities. At any rate the constraints in (8) would select the correct output forms even if underspecification is assumed.

Although Richness of the Base implies that any underlying representation should be possible, we hold that MSG vowels like [yː] and [ʏ] should be distinguished in terms of vowel quality (i.e. tenseness), as in (i)–(iv) above. We therefore reject a possible analysis in which this and similar vowel pairs are distinguished only in terms of length (e.g. /yː/ vs. /y/) because the rankings in (8) would not always select the correct output forms. Since (8) derives independent support (see (22) and § 5 below), we operate under the assumption that German vowels are distinguished underlyingly in terms of quality (and length).

[6] Recall that /ɛː/ violates the constraint Tense = Long. We account for the fact that /ɛː/ surfaces as [ɛː] and not as [ɛ] or [eː] by ranking two specific Faith constraints over Tense = Long. The former two constraints ensure that the moraic structure of /ɛː/ and the value of [tense] of /ɛː/ are identical with the moraic structure and the value of tenseness of the output vowel.

3.1 Introduction

A number of linguists have argued that the pword plays a central role in German phonology and prosodic morphology, e.g. Booij (1985), Yu (1992), Iverson & Salmons (1992), Wiese (1996), Hall (1998, 1999b) and Raffelsiefen (2000).[7] Although none of these authors agrees completely on how morphologically complex grammatical words should be parsed into pwords, there is a general consensus that the morphological configurations in the first column in (11) have the pword structure as indicated in the sample words in the second column. In (11) and below the pword is abbreviated as 'ω'. We ignore prefixation in the present study.[8]

(11)	a. stem	(.liːp.)$_\omega$	'love (imp. sg.)'
	b. stem + suffix containing no vowel	(.liːp-t.)$_\omega$	'love (3p. sg. ind. pres.)'
	c. stem + vowel-initial suffix	(.liː.b-ə.)$_\omega$	'love (1p. sg. ind. pres.)'
	d. stem + consonant-initial suffix	(.liːp.)$_\omega$-lɪç.	'dearly'

'or purposes of this article (11a–d) can be thought of as an algorithm which arses the morphological configurations in the first column with the correponding upwords in the second one. For an account of the constraints ecessary to predict the prosodic structure in the second column in (11) see Hall 2002a, b).

Consider first (11a). The category 'stem' subsumes monomorphemic words belonging to a major lexical category, e.g. nouns, verbs, and adjectives. By contrast, function words (e.g. pronouns, conjunctions) typically do not form their own pwords (see Selkirk 1995 for English and Hall 1999b for German). The category 'stem' (= lexical word) is also intended to subsume each part of a

---

[7] For studies of the pword in languages other than German see Dixon (1977a, b) for Yidiny, Cohn (1989) for Indonesian, Kang (1991) for Korean, Hannahs (1995a, b) for French, Peperkamp (1997) for Italian and Nespor & Vogel (1986) for several languages. A more in depth survey of the literature, and of the (cross-linguistic) arguments for pwords is presented in Hall (1999a). A central claim made by all of the authors cited above is that the pword is not coterminous with the grammatical word; thus, it is considered to be uncontroversial that a single grammatical word can consist of two or more pwords (e.g. a compound word). Most, but not all, of the linguists cited above also believe that a single pword can consist of two or more grammatical words (e.g. a host + enclitic).

[8] On the prosodic structure of prefixed forms see Wiese (1996), Hall (1999b) and Raffelsiefen (2000).

typical compound word, e.g. *Tischbein* 'table leg' is parsed (Tisch)$_\omega$(bein)$_\omega$ because *Tisch* and *Bein* are both stems.[9]

A comparison of the parsings in (11c) and (11d) reveals that the suffix in the former configuration belongs to the same pword of the stem, whereas the suffix in the latter context does not. Following earlier writers (e.g. Dixon 1977a, b), we refer to suffixes like *-e* in (11c) as 'cohering' and to ones like *-lich* in (11d) as 'noncohering'.[10] In (11c) and (11d) we see that the phonological shape of the suffix determines its status as cohering or noncohering: Vowel-initial suffixes are cohering and consonant-initial ones are noncohering.

3.2 Heavy vs. superheavy syllables

Examples of monosyllabic German words with heavy syllables have been presented in (12). In (12) and below 'V' represents a short vowel or syllabic sonorant consonant, 'Vː' either a long vowel or a diphthong, C is a consonant and X is a variable ranging over a consonant or the second mora of a vowel.

(12) Heavy syllables (final VX):

naß	[nas]	'wet'
See	[zeː]	'lake'
Tau	[taʊ]	'rope'

In contrast to the heavy syllables in (12), light syllables end in a short vowel.

In (13) we have provided examples of monosyllabic German words ending in a superheavy syllable:

(13) Superheavy syllables (final VXC):

a. short vowel + two consonants

kalt	[kalt]	'cold'
Kalb	[kalp]	'calf'
Amt	[ʔamt]	'office'

---

[9] This brings up the status of bound roots that do not belong to lexical categories, e.g. the syllable [mɛːt] in *Mädchen* [mɛːt.çən] 'girl'; cf. Early New High German *Mägd-chen* 'maiden' (dim.). In Hall (2002b) it is argued that the pword structure in such words is underlying because it does not fall out from the algorithm in (11).

[10] Whether or not noncohering suffixes like *-lich* in (11d) are parsed as independent pwords in German is controversial (see Wiese 1996, Hall 1998, 1999b and Raffelsiefen 2000 for discussion). We represent suffixes of the form *-CV(C)* henceforth as pwordless syllables situated outside of the pword of the stem. The question of which prosodic constituent the noncohering suffix is linked to (e.g. a recursive pword) is peripheral to the present study and will therefore be ignored. Other languages in which noncohering affixes like *-lich* have been proposed include Yidiny (Dixon 1977a, b) and Turkish (Kabak & Vogel 2001).

b. long vowel + one consonant

viel	[fiːl]	‘many’
Lob	[loːp]	‘praise’
zahm	[t͡saːm]	‘tame’

c. diphthong + one consonant

Bein	[baɪn]	‘leg’
Baum	[baʊm]	‘tree’
euch	[ʔɔɪç]	‘you (2p. pl. acc.)’

Superheavy syllables can exceed the VXC structure in (13). Some representative examples can be seen in (14):

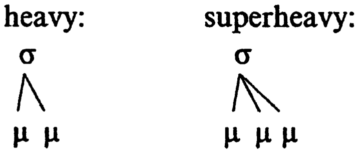
(14) Superheavy syllables (final VXCC):

Haupt	[haʊpt]	‘chief’
Krebs	[kʀeːps]	‘crab’
Herbst	[hɛɐpst]	‘autumn’
Obst	[ʔoːpst]	‘fruit’

A number of writers (e.g. Moulton 1956, Halle & Vergnaud 1980, Hall 1992, Wiese 1996) have observed that the final C in syllables like the ones in (14) is always a coronal obstruent, i.e. [t s ʃ]. The coronality restriction is not important for the present study and will therefore be ignored. For discussion see Hall (2002a).

Our analysis requires that heavy syllables are represented structurally in such a way that they are distinct from superheavy syllables. Since our analysis of vowel length is analyzed in terms of moras, we assume here the moraic model (as in Hayes 1989), in which the two types of syllables have the following representations:

(15)



In (15) we see bimoraic and trimoraic structures depicting heavy and superheavy syllables respectively. See, for example, Hayes (1995), who proposes that the heavy vs. superheavy distinction in various languages is captured in terms of the moraic structures in (15).[11]

---

[11] We refer the reader to Hall (2001, 2002 a, b), who adopts the moraic representations in (15) in his treatment of superheavy syllables of German and English. In this approach it is argued that the trimoraic structure in (15) is maximal and that the final coronal segments in (14) are linked directly to the syllable node.

3.3 The distribution of superheavy syllables

The words in (16) contain heavy syllables, the moraic portion of which has been underlined. These examples have been organized into one of four separate contexts: word-finally in (16a), before a compound boundary in (16b), before a suffix in (16c) and morpheme-internally in (16d).

(16) *Distribution of heavy syllables:*

a. *Word-finally:*

See	[zeː]	‘sea’
Tau	[taʊ]	‘dew’
Bett	[bɛt]	‘bed’

b. *Before a compound boundary:*

See-tang	[zeː.taŋ]	‘sea-weed’
Schuh-anzieher	[ʃuː.ʔan.t͡siː.ɐ]	‘shoe-horn’
Bein-bruch	[baɪn.bʀʊx]	‘fractured leg’

c. *Before a suffix:*

Droh-ung	[dʀoː.ʊŋ]	‘threat’
schuh-los	[ʃuː.loːs]	‘shoe-less’
Frei-heit	[fʀaɪ.haɪt]	‘free-dom’

d. *Morpheme-internally:*

Biene	[biː.nə]	‘bee’
Traube	[tʀaʊ.bə]	‘grape’
Milbe	[mɪl.bə]	‘mite’

Data like the ones in (16) illustrate that bimoraic syllables have a free distribution.

The examples in (17) contain superhavy syllables. The data have been organized into three separate contexts: before a word boundary in (17a), at the end of each part of a compound in (17b), and before a consonant-initial (i.e. noncohering) suffix in (17c):

(17) *Distribution of superheavy syllables:*

a. *Word-final position:*

Werk	[vɛɐk]	‘work’
Baum	[baʊm]	‘tree’
Buch	[buːx]	‘book’

b. *Before a compound boundary:*

Werk-statt	[vɛɐk.ʃtat]	‘workshop’
Baum-stamm	[baʊm.ʃtam]	‘tree trunk’
Buch-weizen	[buːx.vaɪ.t͡sən]	‘buckwheat’

c. *Before a CV(C) suffix:*

leb-los	[leːp.loːs]	'lifeless'
Ein-heit	[ʔaɪn.haɪt]	'unit'
lieb-lich	[liːp.lɪç]	'dearly'

The contexts in which superheavy syllables occur are summarized in (18a) and the one environment in which they are barred from appearing in (18b) with a nonce word.

(18) a. Three contexts in which superheavy syllables occur:

	context	*superheavy syllable*	
(i)	before a word boundary	Werk	(.vɛɐk.)$_\omega$
(ii)	before a compound boundary	Werk-statt	(.vɛɐk.)$_\omega$ (.ʃtat.)$_\omega$
(iii)	before suffixes of the form -CV(C)	lieb-lich	(.liːp.)$_\omega$.lɪç

b. One context in which superheavy syllables cannot occur:

context	*superheavy syllable*	
morpheme-internally	*[ʔeːndə]	*(ʔeːn.də)$_\omega$

The analysis of pwords presented in § 3.1 enables us to reduce the three contexts in (18a) to one: pword-final position. In (18ai) and (18aii) the respective stems are predicted to be pwords by (11i) and (11iii) ensures that the suffix is not a part of the pword of the stem in (18aiii).

Gaps like the one in (18b) are significant. What they show is that in a heterosyllabic (pword-internal) sequence '$(\ldots C_a.C_b\ldots)_\omega$', C_a must be preceded by a short vowel. That this is indeed the case is illustrated with the examples in (19). In the present study we do not attempt to provide an exhaustive list of all heterosyllabic consonant clusters of MSG. The data in (19) illustrate this regularity with respect to nasal + consonant and liquid + consonant sequences, which are representative of all '$(\ldots C_a.C_b\ldots)_\omega$' sequences.[12]

---

[12] This generalization does not hold for morphologically complex words. For example, in *Monde* [moːn.də] 'moons' we see the superheavy syllable [moːn] within the pword. We follow Hall (2002b), who argues that the constraint guaranteeing that superheavy syllables surface at the right edge of a pword (= 21 b below) is outranked by a PARADIGM UNIFORMITY constraint which ensures that the number of moras in a stem is constant in morphologically complex words containing the same stem. Thus, the word [moːn.də] has a pword-internal superheavy syllable because the bare stem [moːnt] does as well. Some of the recent literature on the role of paradigm uniformity in phonology includes Raffelsiefen (1995), Kenstowicz (1996), Steriade (1999), and Benua (2000). See also Kager (1999: chapter 4) for a synthesis on the recent literature on this topic.

One idiosyncratic exception to the generalization discussed above is *Erde* [ʔeːɐ.də] 'earth'. Not surprisingly, many native speakers pronounce this word with [ɛ].

(19) Only short vowels before heterosyllabic clusters:

a. nasal + consonant

Ende	[ʔɛn.də]	'end'
Imker	[ʔɪm.kɐ]	'bee keeper'
Unke	[ʔʊŋ.kə]	'toad'
Gemse	[gɛm.zə]	'chamois'
Amsel	[ʔam.zəl]	'blackbird'

b. liquid + consonant

Welpe	[vɛl.pə]	'puppy'
Milbe	[mɪl.bə]	'mite'
Felge	[fɛl.gə]	'rim'
Hülse	[hʏl.zə]	'husk'
Garten	[gaɐ.tən]	'garden'
Birke	[bɪɐ.kə]	'birch'

The vowel preceeding heterosyllabic clusters like the ones in (19) cannot be Vː (nor can it be a a VC sequence), otherwise the structure would yield a superheavy syllable within a pword, violating the generalization in (20a). From a formal point of view we assume that this generalization translates into the alignment constraint in (20b), according to which the right edge of a trimoraic syllable aligns with the right edge of a pword.

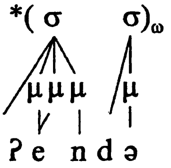
(20) a. Superheavy syllables must occur at the right edge of a phonological word

b. ALIGN-3μ: ($[\mu\mu\mu]_\sigma$, right, pword, right)

See Hall (2001, 2002a, b), who provides a more detailed analysis of the data motivating the constraint ALIGN-3μ in English and German.

We conclude this section with some comments on gaps like the one in (18b). That a nonce word like [ʔeːn.də] violates ALIGN-3μ is illustrated in (21):

(21)



To say that the nonce form [ʔeːndə] is non-occurring because it violates a constraint does not answer the question how a potential input form like /ʔeːndə/ would be pronounced in MSG. One possibility is that an input sequence like /ʔeːndə/ would not be pronounced at all, in which case ALIGN-3μ would be ranked ahead of the constraint MPARSE, which says that words have to be pronounced (see, for example, Hammond 1999 and Hall 2001, who take this approach to gaps in English phonotactics). The alternative we pursue here is that ill-formed inputs are repaired in some way in the respective output forms, meaning in this case that ALIGN-3μ is ranked ahead of some FAITH constraint. This point is illustrated in the tableau in (22) for the nonoccurring word /ʔeːndə/, where we consider four possible pronunciations. (We assume here that the first vowel is stressed). Note that the constraint ALIGN-3μ occupies the same niche as TENSE = LONG in the ranking posited above in (8) and that TENSE = LONG must dominate both IDENTTENSE and IDENTLONG:

(22)

	/ʔeːndə/	ALIGN-3μ	TENSE = LONG	IDENTTENSE	IDENTLONG
a.	(.ʔeːn.də)$_\omega$	*!			
b.	(.ʔen.də.)$_\omega$		*!		*
c.	(.ʔɛːn.də)$_\omega$	*!	*	*	
d.	→ (.ʔɛn.də.)$_\omega$			*	*

An examination of (22a) reveals that the high ranked constraint ALIGN-3μ prevents the underlying form from surfacing with the vowel [eː]. (The same onstraint rules out 22c as well). One could imagine that the /eː/ remains tense but that the vowel quantity is altered, so that it surfaces as [e]. If this is the case see 22b) then we have a clear violation of TENSE = LONG, and since TENSE = LONG outranks FAITH (i.e. either IDENTTENSE or IDENTLONG), we can conclude that (22b) is less harmonic than (22d).

What we have demonstrated above is that the ranking of the constraints as in (22) is necessary to capture gaps in MSG phonotactics. In § 5 we show that changes involving vowel quality and quantity in the nativization of loanwords is expressed the same way.

4. Loanwords

In this section we discuss loanwords which illustrate alterations in vowel tenseness or length in the nativization process in German. Restricting our treatment to the vowels in closed stressed syllables, we demonstrate that the vocalic changes described above correlate with the location of the closed syllable: either pword-internal or pword-final. In § 4.1 we present words in which certain vowel mutations (i.e. the laxing of tense vowels) occur in the pword-internal environment. In § 4.2 we turn to pword final position and show that in this position a different kind of change transpires (i.e. the lengthening of short tense vowels).

Before presenting the data we need to clarify what exactly we mean by loanword. It is useful to distinguish two types of loanwords. First, there are *historical loanwords*, i.e. words which entered into the borrowing language at an early point in time and which are used by native speakers in the present day, e.g. the MSG word *Tafel* 'table, board', which was borrowed from Latin (cf. *tabula*) into Old High German. Speakers who use such historical loanwords never hear the original forms as they were spoken in the donor language and therefore have no reason to posit an underlying representation which differs from their own output form. In this sense historical loanwords can be thought of as being fully-integrated into the (modern) borrowing language. Second, there are *on-line adaptations*, i.e. foreign words which are borrowed 'here and now' (see Peperkamp & Dupoux 2001, who employ this term).[13] We follow linguists who have shown that the input (i.e. the underlying form) in the borrowing language for on-line adaptations is the original form as spoken in the donor language, i.e. the perceptual form (see, e.g. Paradis & LaCharité 1997 and Jacobs & Gussenhoven 2000). Seen in this light we present below the phonetic (as opposed to the underlying) representation of the loanwords in the respective donor language. We discuss our assumptions concerning the input of the loanwords in MSG at greater length in § 5.

It should also be mentioned that in literate societies there are loanwords that enter the borrowing language through the orthography. Although we recognize the existence of such examples, our analysis in § 5 only holds for loanwords that are orally transmitted.

We show below that vowel changes involving tenseness or length have been active in the German language since at least the 15th century but that these adaptations continue into the present day. Thus, our analysis in § 5 below holds for the nativization of both historical loanwords (at the point when they were borrowed) as well as for on-line adaptations.

4.1 Pword-internal closed syllables

In (23) we summarize the two attested outcomes for vocalic changes in pword-internal stressed closed syllables, where [i] and [ɪ] are taken as examples of tense and lax vowels respectively:

(23) a. (…iC.CV…)$_{\omega}$ → (…ɪC.CV…)$_{\omega}$
b. (…ɪC.CV…)$_{\omega}$ → (…ɪC.CV…)$_{\omega}$

---

[13] *Unassimilated loanwords* are also attested. We make some brief remarks on examples from the latter category in § 5.3 below.

The examples in (23) show that the vowel in the closed syllable-context surfaces consistently as short and lax.[14] Note that there are no examples attested of lengthenings in the closed syllable environment, e.g. (…iC.CV…)$_\omega$ → (…iːC. CV…)$_\omega$. As we show in § 5 our analysis correctly precludes such lengthenings.

Both on-line adaptations as well as historical loanwords from a number of languages (e.g. Italian, Russian, Polish, Arabic, Mandarin) illustrate (23a), i.e. the laxing of vowels in pword-internal closed syllables. We present examples from each of these languages in turn and then show examples of (23b).

Italian has the vowels /i e ɛ ɑ ɔ o u/, i.e. tense as well as lax vowel phonemes (Lichem 1970; Macchi 1991). Lichem (1970:56–57) writes that the closest MSG sound to Italian [i] is [iː] (and not [ɪ]) and that the same generalization holds for Italian [o], which most closely resembles MSG [oː] (and not [ɔ]). Consider now the following MSG loanwords, which illustrate the development in (23a):

(24)		*Italian*	*MSG*			
	a.	firma	Firma	[fɪɐ.ma]	'company'	< 18th C
		finta	Finte	[fɪn.tə]	'feint'	< 17th C
	b.	catacomba	Katakombe	[ka.ta.kɔm.bə]	'catacomb'	< 18th C
		gondola	Gondel	[gɔn.dəl]	'gondola'	< 17th C
		conto	Konto	[kɔn.to]	'account'	< 15th C
		torso	Torso	[tɔɐ.zo]	'torso'	< 18th C

These examples illustrate that [i] is replaced by [ɪ] in (24a) and [o] by [ɔ] in (24b).[15]

---

[14] There are no clear examples to our knowledge of loanwords in which a long vowel surfaces in the donor language in the closed syllable environment, although our analysis in § 5 predicts that shortening (and laxing) should occur. This is illustrated in (i):

(i) a. (… iːC.CV …)$_\omega$ → (… ɪC.CV …)$_\omega$
b. (… iːC.CV …)$_\omega$ → (… ɪC.CV …)$_\omega$

One potential example of (ib) is Latin, in which the stressed tense vowel in words like *rēctor* (i.e. /eː/) surfaces as short and lax in MSG (i.e. [ʀɛk.tɔɐ]). Although there are numerous other examples from Latin illustrating shortening (and laxing) in the closed syllable environment it is not clear that these vocalic changes occurred in German or if they transpired in Vulgar Latin before the words were borrowed into German. To our knowledge there is only one loanword in MSG whose vowel stays long in a closed syllable in pword-internal position, namely *Börse* [bøːɐ.zə] 'stock exchange' (< Dutch *(geld)beurs*, 17th C). Interestingly, both Krech et al. (1982) and Drosdowski et al. (1990) list an optional pronunciation for this word with [œ].

The reader is referred to Reis (1974:107), who discusses shortenings like the ones in (ib), which occurred in native words in Middle High German, e.g. *klaːf.ter* > *klaf.ter*. Our analysis in § 5 correctly predicts that this shortening process should have occurred.

[15] If no other source is mentioned in the examples presented below, then they have been drawn from Kluge (1999) and Drosdowski et al. (1994).

In the examples in this section we list the century in which that word was first attested in German (according to Kluge 1999 and Schulz et al. 1913–1983).

The change in (23a) is also illustrated in the following examples from Russian and Polish. These words show that pword-internal syllables with a tense vowel are realized with its lax counterpart in MSG. The Russian words in (25) contain [o] in (25a) and [u] in (25b), which surface in MSG as [ɔ] and [ʊ] respectively (see Gabka 1987). The short, tense [u] in (26) from Old Polish (Bielfeld 1982, Rubach 1984) has similarly been replaced by a short and lax [ʊ] in MSG.

(25)		*Russian*	*MSG*			
	a.	vodka	Wodka	[vɔt.ka]	'vodka'	< 20th C
		drožki	Droschke	[dʀɔ.kə]	'cab'	< 18th C
	b.	tundra	Tundra	[tʊn.dʀa]	'tundra'	< 19th C

(26)	*Old Polish*	*MSG*			
	ogurek	Gurke	[gʊɐ.kə]	'cucumber'	< 16th C

Loanwords from two non-Indo-Eupopean languages have been provided in (27) and (28), which also show (23 a). These examples illustrate the change from [u] to [ʊ] in (27) (Kästner 1981, Pfeifer 1995) and [i] to [ɪ] in (28) (Duanmu 2000).[16]

(27)	*Arabic*	*MSG*			
	sultān	Sultan	[zʊl.tan]	'sultan'	< 16th C

(28)	*Mandarin*	*MSG*			
	gin kyo	Ginkgo	[gɪŋ.ko]	'ginkgo'	< 17th C

The final set of examples in (29) (from Italian) illustrates (23b): In the closed-syllable context lax vowels (here [ɔ] and [ɛ]) stay lax in MSG.[17]

(29)		*Italian*	*MSG*			
	a.	porto	Porto	[pɔɐ.to]	'postage'	< 17th C
		motto	Motto	[mɔ.to]	'motto'	< 18th C
	b.	tempo	Tempo	[tɛm.po]	'speed'	< 17th C
		pergola	Pergola	[pɛɐ.go.la]	'pergola'	< 17th C

---

[16] According to Drosdowski et al. (1994) Japanese is also a possible source for *Ginkgo*.

[17] Note that the second Italian example in (29 a) contains a geminate, which is heterosyllabic. Many authors analyze the post-lax vowel consonant in MSG words like [mɔ.to] as ambisyllabic (see, for example, Wiese 1988, 1996). We ignore ambisyllabicity here because it is not relevant for our analysis.

4.2 Pword-final closed syllables

In this section we present loanwords in MSG exemplifying vocalic changes in closed syllables in pword-final position. We summarize the outcomes in (30), where [i] and [ɪ] represent a tense and a lax vowel respectively.[18]

(30) a. (…iːC)$_\omega$ → (…iːC)$_\omega$
b. (…iC)$_\omega$ → (…iːC)$_\omega$
c. (…ɪC)$_\omega$ → (…ɪC)$_\omega$

In contrast to the examples discussed in §4.1, the vowels in the loanwords we present below do not show any tendency to become lax (or short), but instead, long tense vowels are stable in this environment (see 30a). What is more, short tense vowels will lengthen in pword-final position (see 30b), but not short lax vowels (see 30c).

Loanwords from a number of languages (i.e. Latin, Greek, French, Dutch, English) illustrate (30a). Consider first the Latin examples in (31).[19] (Long vowels are indicated with a macron).

31)	*Latin*	*MSG*			
	patrōnus	Patron	[pa.tʀoːn]	'patron'	< 12th C
	decānus	Dekan	[de.kaːn]	'dean'	< 15th C
	problēma	Problem	[pʀo.bleːm]	'problem'	< 16th C
	tribūtus	Tribut	[tʀi.buːt]	'tribute'	< 9th C
	cultūra	Kultur	[kʊl.tuːɐ]	'culture'	< 17th C

The MSG loanwords in (32)–(35) also illustrate that long tense vowels in final syllables surface as long, i.e. (30a).[20]

(32)	*Greek*	*MSG*			
	sýmptōma	Symptom	[zʏm.ptoːm]	'symptom'	< 18th C
	kámēlos	Kamel	[ka.meːl]	'camel'	< 13th C

---

[18] No examples are attested in which a long lax vowel occurs in the closed syllable context in (30), e.g. (… ɪːC)$_\omega$, although our analysis in §5 predicts that the vowel should shorten to (… ɪC)$_\omega$.

[19] The endings in the Latin examples in (31) (e.g. *-a*, *-us*) were either lost when the words entered the German language (e.g. MSG *patrōn(e)*; see Schulz et al. 2, 425–428) or in the process of development of MSG (e.g. *Atomus* which entered MSG in the 16th century but lost its ending only in the 19th century; see Schulz et al. 1, 59).

[20] Some of the French words in (33) and below in (38) are ultimately derived from Latin. Although length is not distinctive for French vowels, vowels are lengthened in that language before [ʁ z v ʒ] (Tranel 1987:49), the so-called 'consonants allongantes' (Schwarze & Lahiri 1998).

(33)	*French*	*MSG*			
	tour	Tour	[tuːɐ]	‘tour’	< 16th C
	figure	Figur	[fi.guːɐ]	‘figure’	< 13th C
	papier	Papier	[pa.piːɐ]	‘paper’	< 15th C

(34)	*Dutch*	*MSG*			
	piloot	Pilot	[pi.loːt]	‘pilot’	< 15th C
	juweel	Juwel	[ju.veːl]	‘jewel’	< 15th C

(35)	*English*	*MSG*			
	typhoon	Taifun	[taɪ.fuːn]	‘typhoon’	< 19th C
	steak	Steak	[ʃteːk]	‘steak’	< 20th C
	team	Team	[tiːm]	‘team’	< 20th C

The lenthening of short tense vowels in pword-final position, i.e. (30b), is illustrated with the examples in (36)–(38) from Latin, Italian, and French.[21]

(36)	*Latin*	*MSG*			
	atomus	Atom	[a.toːm]	‘atom’	< 16th C
	mūsica	Musik	[mu.ziːk]	‘music’	< 15th C

(37)	*Italian*	*MSG*			
	credito	Kredit	[kʀe.diːt]	‘credit’	< 16th C

(38)	*French*	*MSG*			
	tarif	Tarif	[ta.ʀiːf]	‘charge’	< 17th C
	profil	Profil	[pʀo.fiːl]	‘profile’	< 17th C
	reptile	Reptil	[ʀɛp.tiːl]	‘reptile’	< 19th C
	boutique	Boutique	[bu.tiːk]	‘boutique’	< 17th C

The data in (39) from French illustrate (30c): a final short lax vowel in the donor language stays lax and short in MSG:

(39)	*French*	*MSG*			
	hotel	Hotel	[ho.tɛl]	‘hotel’	< 18th C
	carrousel	Karussell	[ka.ʀu.sɛl]	‘merry-go-round’	< 17th C
	baroque	barock	[ba.ʀɔk]	‘barock’	< 18th C
	salope	salopp	[za.lɔp]	‘casual’	< 18th C

---

[21] The word *Musik* was stressed on the first syllable until the 16th or 17th century, when the stress change to the final syllable was probably caused by the French ‘musique’ (Drosdowski et al. 1994:475).

The examples presented in (31)–(35) and (40) show that V:C, where V: is tense, is stable historically in final position. The additional MSG examples in (40) show that VCC is also stable in this position:

(40) *MSG*

Tumult	[tu.mʊlt]	'tumult'	Latin *tumultus* < 16th C
Defekt	[de.fɛkt]	'defekt'	Latin *dēfectus* < 16th C
Obelisk	[ʔo.be.lɪsk]	'obelisk'	Latin *obeliscus* < 16th C
Rapport	[ʀa.pɔɐt]	'rapport'	French *rapport* < 17th C
Damast	[da.mast]	'damask'	Italian *damasco* < 14th C

The data presented in (31)–(38) and (40) illustrate the stability of V:C and VCC syllables in word-final syllables. That superheavy syllables are historically stable in pword-final position (as opposed to final position in a grammatical word) can be established with the additional data in (41). Here we see compound words whose first part is a loanword. Note that the underlined superheavy syllables in these examples surfaces as long. The pword-final V:C syllables in (41) are stable historically because there is no tendency at all to shorten and lax the vowel.

(41) *Compound words:*

Taifun + Warnung	(taɪ.fuːn)$_\omega$ (ʋaɐ.nʊŋ)$_\omega$	'typhoon warning'
Steak + Haus	(ʃteːk)$_\omega$ (haʊs)$_\omega$	'steak house'
Team + Arbeit	(tiːm)$_\omega$ (aɐ.baɪt)$_\omega$	'team work'
Musik + Unterricht	(mu.ziːk)$_\omega$ (ʊn.tɐ.ʀɪçt)$_\omega$	'music lesson'
Atom + Kraftwerk	(ʔa.toːm)$_\omega$ (kʀaft.vɛɐk)$_\omega$	'nuclear power station'

Recall from (11 a) that stems are analyzed as pwords; as noted in § 2, each part of a compound is interpreted to be a stem and hence a separate pword.

The examples in (42) consist of a nonnative stem plus a consonant-initial (i.e. noncohering) suffix. Recall from (11 d) that the stem in this context is pword-final. The important point to observe here is that the stem-final syllable is superheavy:

(42) *Words with consonant-initial suffixes:*

problem + los	(pʀo.bleːm)$_\omega$-loːs	'without problems'
profil + los	(pʀo.fiːl)$_\omega$-loːs	'without profile'
reptil + haft	(ʀɛp.tiːl)$_\omega$-haft	'reptile like'
tarif + lich	(ta.ʀiːf)$_\omega$-lɪç	'according to the tariff'
figür + lich	(fi.gyːɐ)$_\omega$-lɪç	'figurative'

To summarize, the examples in this section show that superheavy syllables are stable in pword-final position. The analysis we propose below in § 5 shows a connection between this stability and the lengthening of tense short stressed vowels in pword-final position.

5. Analysis

In (43) and (44) we summarize the vocalic changes presented in the preceding section and provide an example in the right column. Again, [i] and [ɪ] are intended to represent tense and lax vowels respectively. We concentrate below on the vocalic developments involving a new output, i.e. (43 a) and (44 c), which have been placed in a box.

(43)	a.	(…iC.CV…)$_\omega$	→	(…ɪC.CV…)$_\omega$	Italian F[i]rma > MSG F[ɪ]rma
	b.	(…ɪC.CV…)$_\omega$	→	(…ɪC.CV…)$_\omega$	Italian t[ɛ]mpo > MSG T[ɛ]mpo
(44)	a.	(…iːC)$_\omega$	→	(…iːC)$_\omega$	Dutch juw[eː]l > MSG Juw[eː]l
	b.	(…ɪC)$_\omega$	→	(…ɪC)$_\omega$	French hot[ɛ]l > MSG Hot[ɛ]l
	c.	(…iC)$_\omega$	→	(…iːC)$_\omega$	Latin at[o]mus > MSG At[oː]m

In § 5.1 we provide an OT analysis of the laxing development in (43 a) and in § 5.2 of the lengthening in (44 c).

In order to account for the vocalic changes occuring in MSG loanwords, it is necessary to distinguish between on-line adaptations, i.e. the first adaptations of loanwords, where the perceptual input of the donor language is taken as the underlying representation (see e.g. & Paradis LaCharité 1997 and Jacobs & Gussenhoven 2000), and fully-integrated historical loanwords, where the underlying form in MSG is set equal to the output of the borrowing language (recall the discussion in § 4). Contrary to Peperkamp & Dupoux (2001), we do not assume that on-line adaptations show some kind of segmental modification during the perception of the loanword. Instead, the loanword is perceived faithfully; adaptation occurs only in the production process and follows naturally from the constraint ranking of the borrowing language (cf. Jacobs & Gussenhoven 2000). Significantly, there is no separate perceptual component in loanword adaption (as assumed e.g. by Silverman 1992 and Yip 1993).

5.1 An OT analysis of vowel laxing

Let us consider the example *Firma*, which illustrates the laxing process in (43 a). We first treat the on-line adaption of this word, in which we assume that the input (i.e. the underlying representation) equals the phonetic representation in the donor language. Thus, when this item is first orally transmitted, we have the input and output representations in (45).[22]

(45) *Input:* /f i̲ r m a/ *Output:* [f ɪ r m a]

The OT analysis we posit accounts for the change in (45) that transpires when loanwords like these are nativized, i.e. the underlined vowel is laxed. This modification is captured formally with the language-specific ranking for MSG we posited above in (22) (modified from 8) and which we repeat below in (46 a) for convenience:

(46) a. specific: ALIGN-3μ, TENSE = LONG ≫ IDENTTENSE ≫ IDENTLONG
b. general: MARKEDNESS ≫ FAITH

Ths specific ranking in (46 a) generalizes to the ranking in (46 b): Two MARKEDNESS constraints (i.e. TENSE = LONG and ALIGN-3μ) outrank the FAITH constraints IDENTTENSE and IDENTLONG.

What the rankings in (46 a) mean is that faithful outputs (e.g. the incorrect iʀma] from /fiʀma/) are sacrificed for phonotactic well-formedness, or put ifferently, vowel laxing must occur to make the outputs conform to phonotacic generalizations. We provide tableaus illustrating this below. See also Davidson & Noyer (1997), who show that the nativization of Spanish loanwords into the language isolate Huave involves the ranking of FAITH below MARKEDNESS. Robinson (2001:146–147) similarly makes this observation for a different set of loanword phenomena in MSG.

Given the ranking in (46 a) the laxing of the stressed vowel in (43 a) can be accounted for. This is illustrated in the evaluation of the word *Firma* in (47):

(47)

	/f i ʀ m a/	ALIGN-3μ	TENSE = LONG	IDENTTENSE	IDENTLONG
a.	(.fiː ʀ. m a)$_\omega$	*!			*
b.	(.f i ʀ. m a)$_\omega$		*!		
c.	(.fɪː ʀ. m a)$_\omega$	*!	*	*	*
d.→	(.f ɪ ʀ. m a.)$_\omega$			*	

A comparison of the fully faithful candidate in (47 b) with candidate (47 d) reveals that the latter form is more harmonic than the former because of the

---

[22] We ignore the fact that the *r* in Italian and MSG have different phonetic realizations. We also do not consider in our analysis the pronunciation of MSG /ʀ/ as [ɐ].

ranking Tense = Long ≫ IdentTense. This ranking means that it is better to lax a short stressed tense vowel than for the output vowel to be fully faithful to the corresponding input vowel. Of particular importance in the tableau in (47) is the form in (47 a), which loses out to the optimal candidate in (47 d) due to the ranking Align-3μ ≫ IdentTense. (Note that 47 c loses out for the same reason). The reason the form in (47 a) with [iː] is significant is that Italian [i] in words like *Firma* is phonetically closer to German [iː] than to any other vowel, in particular [ɪ], as we noted above in § 4 (see Lichem 1970). Thus, one would expect for phonetic reasons that the stressed vowel in (47) would lengthen in MSG, but our analysis correctly blocks this lengthening from occurring due to the high ranked constraint Align-3μ.[23]

To summarize up to this point we have accounted for the phonetic representations in MSG words like the ones in (43 a) by employing the ranking Markedness (i.e. Tense = Long and Align-3μ) ahead of Faith, which is independently required.[24]

Although our analysis in (47) selects the right phonetic representation, the underlying representation we assumed in (45) is unmotivated after the word has ceased to be an on-line adaptation and has become a lexical item on par with native words. Specifically, in the example discussed here the stressed vowel in the word *F[ɪ]rma* is not /i/ but /ɪ/. The reason the latter underlying form is correct is that there are no alternations in MSG which would cause one to assume /i/. This assumption has long been adopted in phonological theory (see, for example, Stampe 1973) and is captured in OT with the principle referred to as Lexicon Optimization (see Prince & Smolensky 1993:192): unless there is evidence to the contrary (e.g. alternations) we assume that the underlying and phonetic representations are identical. To illustrate this point we provide in (48) the correct underlying and phonetic representation for the sample word in (43 a):

(48) *Input:* *Output:*
/f ɪ̱ r m a/ [f ɪ ʀ m a]

---

[23] In note 14 we mentioned that there are no clear examples to our knowledge of loanwords in MSG in which a long vowel occurs in the donor language in pword-internal position, but that we predict vowel shortening, e. g. (… ɪːC.CV…)$_{\omega}$ → (… ɪC.CV…)$_{\omega}$. We mentioned in that footnote that potential examples illustrating this shortening come from Latin, e. g. *rēctor* ([reːk.tor]) vs. MSG (i.e. [ʀɛk.tɔɐ]). Note that the ranking in (46) will always select the candidate with a short lax vowel in pword-internal position.

[24] Our analysis only predicts shortening and laxing in stressed syllables. Laxing in unstressed closed syllables is also attested, e. g. Latin *s[y]mbolum* > MSG *S[ʏ]mbol.* This type of vowel laxing does not follow from our analysis in § 5 and hence we leave this topic open for further research.

Thus, after the initial on-line adaptation in (47), in which the input is set equal to the output of the donor language, we assume that the underlying representation in the borrowing language (i.e. MSG) will be restructured to its actual output in MSG, as in (48).

In the analysis we propose below we show first that the same ranking in (47) can be employed to obtain the correct output from the identical input, as in (48). We then conclude this section by showing how Lexicon Optimization correctly selects the underlying representation in (48) over the one in (45).

In the tableau in (49) the word *Firma* is evaluated given the input in (48):

(49)

	/fɪʀma/	Align-3μ	Tense = Long	IdentTense	IdentLong
a.	(.fiːʀ.ma)$_\omega$	*!		*	*
b.	(.fiʀ.ma.)$_\omega$		*!	*	
c.	(.fɪːʀ.ma.)$_\omega$	*!	*		*
d.→	(.fɪʀ.ma.)$_\omega$				

n examination of this tableau reveals that the fully-faithful output form in 49 d) is selected. (49 d) is more harmonic than (49 a–c) because the former three orms all violate at least two of the four constraints.

Our analysis selects the underlying representation in (48) (and not the one in 5) as optimal because the former input-output pair is more harmonic than the latter one. 'Harmonic' means that the correct input-output pair in (48) incurs fewer constraint violations than other ones. This point is illustrated in the tableau in (50) in which four such pairs are evaluated:

(50)

		Align-3μ	Tense = Long	IdentTense	IdentLong
a.	/fiʀma/ [fɪʀma]			*!	
b.	/fiːʀma/ [fɪʀma]			*!	*
c.	/fɪːʀma/ [fɪʀma]				*!
d.→	/fɪʀma/ [fɪʀma]				

In tableau (50) the constraints evaluate each pair. For example, candidate (50 a) is /fiʀma/ [fɪʀma], which violates IdentTense because it involves the change from /i/ to [ɪ]. The pair in (50 c) is not optimal because the change from /ɪː/ to [ɪ] also involves an IdentLong violation. (50 b) is the least harmonic of the four candidates because it violates IdentTense and IdentLong. By contrast, the pair in (50 d) is optimal because no constraint violations occur.

5.2 An OT analysis of vowel lengthening

Vowel lengthening in pword-final position in (44c) is illustrated here with the example *Atom*. During the on-line adaptation process, we assume the input to be the output form of the donor language, i.e. the vowel /o/, which is short and tense.[25]

(51)

	/atomus/	Align-3μ	Tense = Long	IdentTense	IdentLong
a.	(.a.tɔm.)$_\omega$			*!	
b.	(.a.tɔːm.)$_\omega$		*!	*	*
c.	(.a.tom.)$_\omega$		*!		
d.	→ (.a.toːm.)$_\omega$				*

This tableau shows that the fully-faithful candidate in (51c) loses out to (51d) because of the ranking Tense = Long ≫ IdentLong. (This ranking also predicts that 51b is less harmonic than 51d). What this ranking means is that it is better to lengthen a short stressed tense vowel than to have a fully-faithful output form. The ranking IdentTense ≫ IdentLong is necessary to account for the fact that the optimal candidate in (51d) is more harmonic than (51a). Put differently, it is better to lengthen a stressed tense vowel than to convert this vowel into its lax counterpart.

The tableau in (51) is significant because the same rankings which were shown in § 5.1 to predict vowel laxing (and shortening) of pword-internal stressed closed syllables correctly accounts for the lengthening of the stressed tense vowel in pword-final position.

In (51) it was assumed for the on-line adaptation that the stressed vowel is underlyingly /o/. For speakers of MSG who use this and similar words on par with native words (i.e. for the point after the on-line adaptation, where the word is fully integrated) the underlying form for this vowel is the same as in the phonetic representation, i.e. /oː/. We assume that the correct underlying representation (i.e. /oː/) is optimized in the same way as it was illustrated for *Firma* in (50).

Note that the input vowel in (51) (and for the point when /oː/ is taken as underlying) must be specified as tense. Were the input lax (i.e. /ɔ/) then the rankings in (51) would incorrectly select (51a). An additional reason for specifying input vowels for the tenseness feature is that short lax vowels do not

---

[25] The loss of the original ending *-us* is of no significance to our analysis and therefore will be ignored here. (Recall the discussion on this ending in note 19).

lengthen (recall 44b). This point can be illustrated by considering the following tableau for the word *Hotel*:

(52)

	/hotɛl/	ALIGN-3μ	TENSE = LONG	IDENTTENSE	IDENTLONG
a.	→ (.ho.tɛl.)$_{\omega}$				
b.	(.ho.tɛːl.)$_{\omega}$		*!		*
c.	(.ho.tel.)$_{\omega}$		*!	*	
d.	(.ho.teːl.)$_{\omega}$			*!	*

In this tableau we see that (52b, c, d) are less harmonic than (52a) because they do not satisfy TENSE = LONG or IDENTTENSE.[26]

5.3 Unassimilated loanwords

The phonetic forms of the MSG examples discussed above illustrate that these words all show the same phonotactic and prosodic restrictions as native German words. However, many languages also have unassimilated loanwords, which by definition do not conform to the phonotactics of the borrowing language, e.g. French *parole*, which surfaces in the unassimilated pronunciation in MSG as [pa.ʀol].[27] (This example can be identified as unassimilated because it has a short tense vowels in stressed position). Loanwords like this one can only stay unassimilated if speakers who have this pronunciation are aware of the phonology and phonotactics of the donor language.

The general ranking MARKEDNESS ≫ FAITH was shown to account for the fact that loanwords like Italian *Firma* become assimilated into the donor language. We hold that unassimilated loanwords exhibit the reverse ordering, as in (53b), a ranking which indicates that speakers have successfully deduced the constraint ranking for the donor language. (See also the literature on second language acquisition, in which it is shown that successful acquisition involves the reranking of constraints as in the target language, (e.g. Broselow, Chen & Wang 1998, Hancin-Bhatt & Bhatt 1997). The general ranking in (53b) translates into the specific ranking in (53a):

---

[26] Our analysis of vowel lengthening only holds for stressed closed syllables, but lengthening is also attested in stressed open syllables, e.g. Spanish *enz[e]bra* > MSG *Z[eː]bra*). Note that the explanation for this type of vowel lengthening follows from the ranking TENSE = LONG ≫ IDENTTENSE.

[27] Only the assimilated pronunciation is accepted by Drosdowski et al. 1990, i.e. *parole* with [ɔ].

(53) a. specific: IdentTense, IdentLong ≫ Tense=Long
b. general: Faith ≫ Markedness

The specific ranking in (53a) is illustrated in (54) for the word *parole*:

(54)

	/paʀol/	IdentTense	IdentLong	Tense = Long
a.	→ (.pa.ʀol.)$_\omega$			*
b.	(.pa.ʀoːl.)$_\omega$		*!	
c.	(.pa.ʀɔl.)$_\omega$	*!		
d.	(.pa.ʀɔːl.)$_\omega$	*!	*	*

The ranking of Faith above Markedness ensures that the output in (54a) is faithful to the perceptual output of the donor language. In this way, no change in the input takes place, as the donor output is stored as underlying representation in MSG according to lexicon optimization.

6. Conclusion

In this article we examined the changes that affect stressed vowels in the nativization of loanwords into MSG, namely the laxing of tense vowels and the lengthening of short tense vowels. We demonstrated that the former process is restricted to occurring in closed syllables which are internal to a pword but that the lengthening of short tense vowels transpires in closed syllables which are final in a pword. We proposed an OT analysis capturing vowel shortening and laxing in the nativization process which requires that two Markedness constraints outrank two Faith constraints. An important component of our analysis is that the same constraints and rankings required to account for the nativization of loanwords is necessary to capture phonotactic generalizations in the native lexicon. For this reason, we ultimately conclude that our analysis is superior to any conceivable rule-based one, since rule-based analyses would posit rules accounting for the nativization of loanwords which are otherwise unmotivated in the borrowing language.

References

Becker, Thomas (1996): Die Aufhebung des Vokallängengegensatzes in unbetonten Silben der deutschen Standardsprache. In: Deutsche Sprache 24, 268–281.
Becker, Thomas (1998): Das Vokalsystem der deutschen Standardsprache. Frankfurt: Peter Lang.

Benua, Laura (2000): Phonological Relations Between Words. New York: Garland.

Bielfeld, Hans Holm (1982): Die Slavischen Wörter im Deutschen. Leipzig: Zentralantiquariat.

Booij, Geert (1985): Coordination reduction in complex words: a case for prosodic phonology. In: Harry van der Hulst/Smith, Norval (Hgg.) Advances in Nonlinear Phonology. Dordrecht: Foris, 143–160.

Broselow, Ellen/Chen, S./Wang, C. (1998): The emergence of the unmarked in second language phonology. In: Studies in Second Language Acquisition 20, 261–280.

Cohn, Abigail C. (1989): Stress in Indonesian and bracketing paradoxes. In: Natural Language and Linguistic Theory 7, 167–216.

Davidson, Lisa/Noyer, Rolf (1997): Loan phonology in Huave: nativization and the ranking of faithfulness constraints. In: Brian Abgayani/Sze Wing Tang (Hgg.): Proceedings of the West Coast Conference of Formal Linguistics 15, 65–80.

Dixon, R.M.W. (1977a): A Grammar of Yidiɲ Cambridge: Cambridge University Press.

Dixon, R. M. W. (1977b): Some phonological rules of Yidi. In: Linguistic Inquiry 8, 1–34.

Drosdowski, Günther et al. (1990): Duden. Aussprachewörterbuch. Band 6. Mannheim: Bibliographisches Institut.

Drosdowski, Günther et al. (1994): Duden. Das große Fremdwörterbuch. Mannheim: Dudenverlag.

Duanmu, Sam (2000): The Phonology of Chinese. Oxford: Oxford University Press.

Féry, Caroline (1997): The mora as a measure of weight and syllable constituent. In: Pierre Marco Bertinetto et al. (Hgg.): Certamen Phonologicum III. Papers from the Third Cortona Phonology Meeting, April 1996. Torino, Rosenberg & Sellier, 91–110.

Gabka, Kurt (1987): Einführung in das Studium der russischen Sprache: Phonetik und Phonologie. Leipzig: VEB Verlag Enzyklopädie.

Golston, Chris/Yang, Phong (2001): Hmong loan phonology. In: Caroline Féry/Antony Green/Ruben van de Vijver (Hgg.): Proceedings of HILP 5. University of Potsdam, 40–57.

Green, Antony Dubach (2001): The tense-lax distinction in English vowels and the role of parochial and analogical constraints. In: Linguistics in Potsdam 16, 32–57.

Gussenhoven, Carlos/Jacobs, Haike (1998): Understanding Phonology. London: Arnold.

Gussenhoven, Carlos (2000): Vowel duration, syllable quantity and stress in Dutch. Ms. University of Nijmegen [ROA-381].

Güthling, Otto (1996): Langenscheidts Großwörterbuch Latein. Berlin: Langenscheidt.

Hall, T. A. (1992): Syllable Structure and Syllable Related Processes in German. Tübingen: Niemeyer.

Hall, T. A. (1998): A note on secondary stress in German prosodic morphology. In: Linguistische Berichte 174, 414–424.

Hall, T. A. (1999a): The phonological word: a review. In: T. A. Hall/Kleinhenz, Ursula (Hgg.): Studies on the Phonological Word. Amsterdam: John Benjamins, 1–22.

Hall, T. A. (1999b): Phonotactics and the prosodic structure of German function words. In: T. A. Hall/Kleinhenz, Ursula (Hgg.): Studies on the Phonological Word. Amsterdam: John Benjamins, 99–131.

Hall, T. A. (2001): The distribution of superheavy syllables in Modern English. In: Folia Linguistica XXXV(3/4), 399–442.

Hall, T. A. (2002a): Against extrasyllabic consonants in German and English. In: Phonology 19(1), 33–74.

Hall, T. A. (2002b): The distribution of superheavy syllables in Standard German. In: The Linguistic Review 19.4, 377–420.

Halle, Morris/Vergnaud, Jean-Roger (1980): Three-dimensional phonology. In: Journal of Linguistic Research 1, 83–105.

Hammond, Michael (1999): The Phonology of English: A Prosodic Optimality-Theoretic Approach. Oxford: Oxford University Press.

Hancin-Bhatt, Barbara/Bhatt, Rakesh Mohan (1997): Optimal L2 syllables: interactions of transfer and developmental effects. In: Studies in Second Language Acquisition 19, 331-378.

Hannahs, S.J. (1995a): Prosodic Structure and French Morphophonology. Tübingen: Niemeyer.

Hannahs, S.J. (1995b): The phonological word in French. In: Linguistics 33, 1125-1144.

Harris, James W. (1983): Syllable Structure and Stress in Spanish. Cambridge/MA.: MIT Press.

Hayes, Bruce (1989): Compensatory lengthening in moraic phonology. In: Linguistic Inquiry 20, 253-306.

Hayes, Bruce (1995): Metrical Stress Theory: Principles and Case Studies. Chicago: Chicago University Press.

Itô, Junko/Armin Mester (1995): The core-periphery structure of the lexicon and constraints on rekanking. In: Jill N. Beckman/Dickey, Laura Walsh/Urbanczyk, Suzanne (Hgg.): Papers in Optimality Theory. University of Massachusetts Occasional Papers 18. Amherst/MA.: GLSA, 181-209.

Iverson, Gregory/Salmons, Joseph (1992): The place of structure preservation in German diminutive formation. In: Phonology 9, 137-143.

Jacobs, Haike/Gussenhoven, Carlos (2000): Loan phonology: perception, salience, the lexicon and OT. In: Dekkers, Leeuw/Weijer, Jeroen van de (Hgg.) Optimality Theory: Phonology, Syntax, and Acquistion. Oxford: Oxford University Press, 193-210.

Kabak, Bariş/Vogel, Irene (2001): The phonological word and stress assignment in Turkish. In: Phonology 18.3, 315-360.

Kager, Rene (1999): Optimality Theory. Cambridge: Cambridge University Press.

Kang, Ongmi (1991): Korean Prosodic Phonology. Ph.D. Dissertation. University of Washington.

Kästner, H. (1981): Phonetik und Phonologie des modernen Hocharabisch. Leipzig: Verlag Enzyklopädie.

Kenstowicz, Michael (1996): Base identity and uniform exponence: alternatives to cyclicity. In: Jacque Durand/Laks, Bernard (Hgg.): Current Trends in Phonology: Models and Methods. Paris: CNRS, 363-393.

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

Kluge, Friedrich (1999): Etymologisches Wörterbuch der deutschen Sprache. Berlin: de Gruyter.

Krech, Eva-Maria et al. (1982): Großes Wörterbuch der deutschen Aussprache. Leipzig: VEB Bibliographisches Institut.

Ladefoged, Peter/Maddieson, Ian (1996): The Sounds of the World's Languages. Oxford: Blackwell.

Lichem, Klaus (1970): Phonetik und Phonologie des heutigen Italienisch. Berlin: Akademie-Verlag.

Macchi, Vladimiro (1982): Wörterbuch Italienisch-Deutsch. Leipzig: Orbis.

McMahon, April (2001): Lexical Phonology and the History of English. Cambridge: Cambridge University Press.

Moulton, William G. (1956): Syllabic nucleii and final consonant clusters in German. In: Morris Halle et al. (Hgg.): For Roman Jakobson. The Hague: Mouton, 372-381.

Muthmann, Gustav (1996): Phonologisches Wörterbuch der deutschen Sprache. Tübingen: Niemeyer.

Nespor, Marina/Vogel, Irene (1986): Prosodic Phonology. Dordrecht: Foris.

Paradis, Caroline/LaCharité, Darlene (1997): Preservation and minimality in loanword adaptation. In: Journal of Linguistics 33, 379–430.

Paradis, Caroline/LaCharité, Darlene (2001): Guttural deletion in loanwords. In: Phonology 18, 255–300.

Peperkamp, Sharon 1997. Prosodic Words. The Hague: Holland Academic Press.

Peperkamp, Sharon/Dupoux, Emmanuel (2001): Loanword adaptions: three problems for phonology. Ms. Université de Paris.

Pfeifer, Wolfgang (1995): Etymologisches Wörterbuch des Deutschen. München: Deutscher Taschenbuchverlag.

Prince, Alan/Smolensky, Paul (1993): Optimality Theory. Ms. Rutgers University and University of Colorado.

Raffelsiefen, Renate (1995): Conditions for stability: the case of schwa in German. Theorie des Lexikons. Arbeiten des Sonderforschungsbereichs 282, Nr. 69, Düsseldorf.

Raffelsiefen, Renate (2000): Evidence for word-internal phonological words in German. In: Rolf Thieroff et al. (Hgg.): Deutsche Grammatik in Theorie und Praxis. Tübingen: Niemeyer, 43–56.

Ramers, Karl Heinz (1988): Vokalquantität und -qualität im Deutschen. Tübingen: Niemeyer.

Reis, Marga (1974): Lauttheorie und Lautgeschichte: Untersuchungen am Beispiel der Dehnungs- und Kürzungsvorgänge im Deutschen. München: Fink.

Robinson, Orrin (2001): Whose German? The ach/ich Alternation and related Phenomena in "Standard" and "Colloquial". Amsterdam: Benjamins.

Rubach, Jerzy (1984): Cyclic and Lexical Phonology. The Structure of Polish. Dordrecht: Foris.

Schwarze, Christoph/Lahiri, Aditi (1998): Einführung in die französische Phonologie. Konstanz: Universität Konstanz.

Schulz, Hans et al. (1913–1983): Deutsches Fremdwörterbuch. Bd. I–VI. Strassburg etc.

Selkirk, Elisabeth (1995): The prosodic structure of function words. In: Jill N. Beckman/Dickey, Laura Walsh/Urbanczyk, Suzanne (Hgg.): Papers in Optimality Theory. University of Massachusetts Occasional Papers 18. Amherst/MA.: GLSA, 439–469.

Silverman, Daniel (1992): Multiple scansions in loanword phonology: evidence from Cantonese. In: Phonology 9, 289–328.

Stampe, David (1973): A Dissertation on Natural Phonology. New York: Garland.

Steriade, Donca (1999): Paradigm uniformity and the phonetics-phonology boundary. In: Michael Broe/Pierrehumbert, Janet (Hgg.): Papers in Laboratory Phonology 5. Cambridge: Cambridge University Press, 313–334.

Tranel, Bernard (1987): The Sounds of French. Cambridge: Cambridge University Press.

Wiese, Richard (1988): Silbische und lexikalische Phonologie: Studien zum Chinesischen und Deutschen. Tübingen: Niemeyer.

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

Yip, Moira (1993): Cantonese loanword phonology and Optimality Theory. In: Journal of East Asian Linguistics 2, 261–291.

Yu, Si-Taek (1992): Unterspezifikation in der Phonologie des Deutschen. Tübingen: Niemeyer.

Eingereicht:
Überarbeitete Fassung eingereicht:

T. A. Hall, Institut für Linguistik, Universität Leipzig, Beethovenstr. 15, 14107 Leipzig, hall@rz.uni-leipzig.de
Silke Hamann, Zentrum für Allgemeine Sprachwissenschaft, Jägerstr. 10/11, 10117 Berlin, silke@zas.gwz-berlin.de