THE ADAPTATION OF GERMAN FRONT ROUNDED VOWELS INTO JAPANESE

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1. INTRODUCTION

This paper examines the adaptation of front rounded vowels of German loanwords into Japanese. Japanese lacks front rounded vowels and does not incorporate these foreign sounds into its native phonological system. This raises the question of how Japanese adapts the front rounded vowels (henceforth called umlaut) of borrowed words. Speakers of the borrowing language adjust loanwords in such a way that its sound is as close to the source as possible while its resulting form is acceptable in terms of the native language's phonological system. For loanwords with umlaut in Japanese this poses the questions: Which features of umlaut are preserved? Which constraints determine the process of adaptation into the Japanese phonological system?

We will see in the paper that umlaut /ü/ and /ö/ seem to follow divergent adaptation-patterns in Japanese. Whereas /ü/ is adapted as a sequence of glide and vowel, /ö/ is adapted as a single segment. My major claim is that the difference between these divergent adaptation-patterns is caused solely by the fact that /ö/, as a mid vowel, faces a constraint that has no effect on the adaptation of /ü/. I claim that /ü/ ✍ /ju/ constitutes the less marked pattern, and that /ö/ cannot follow this pattern because it is a non-high vowel. If /ö/ were adapted as the sequence /jo/, it would require the addition of an extra feature ([+high] for the glide) that is not found in the source. Thus, in contrast to /ü/, the mid vowel /ö/ cannot be adapted as a sequence of glide and vowel, but is instead adapted as a single segment.

Section 2 deals with German umlaut and its general features. Chapter 3 introduces some research on loanword phonology concerning umlaut and gives some ideas about possible ways in which German umlaut could be expected to be adapted into Japanese. Chapter 4 then presents data concerning adaptation patterns of /ü/ and /ö/ into Japanese as well as a description of these patterns. Chapter 5 analyses the results of the preceding chapter in the framework of Optimality Theory (henceforth, OT). As will be shown, the divergent patterns can both be explained within the same constraint ranking.

My investigation is based on a corpus of German loanwords in Japanese taken mainly from Japanese loanword-dictionaries and a travel guide. The corpus comprises around 100 German loanwords. To support my analysis, I included French loanwords in Japanese, also taken from one of the loanword-dictionaries.

2. GERMAN UMLAUT

German umlaut developed due to an assimilation rule that caused a fronting of back vowels. Accordingly, umlauted vowels share the features [-back] while they maintain their input specification for roundness.

(1) German umlaut:

Umlaut:	/ü/		[+round]	[+high]	e.g. München
	/ö/	[-back]	[+round]	[-high]	e.g. Goethe
	/ä/		[-round]	[-high]	e.g. Händel

2.1. Umlaut /ä/

Low vowels are fronted and raised under the umlaut rule, and as a result surface as the mid unrounded vowel /ä/ that does not differ in its pronunciation from /e/[1]. Thus, the adaptation of /ä/ into Japanese causes no difficulties; /ä/ is substituted with the Japanese phoneme /e/ in all cases of which I am aware.

(2) German /ä/ ✍ Japanese /e/[2]

Gelände	[g?'lend?]	✍	*gerende*	ゲレンデ	'ski slope'
dämonisch	[de'mo:ni?]	✍	*demônisshu*	デモーニッシュ	'demoniac'
Märchen	['me:rç?n]	✍	*mêruhen*	メールヘン	'fairy tale'

This adaptation is very regular, therefore I will concentrate in this paper on the adaptation of the high umlaut /ü/ and the mid umlaut /ö/, which show an interesting and divergent adaptation-pattern.

2.2 Umlaut /ü/ and /ö/

It is essential to differentiate between long and short vowels in German. The distinctive contrast between long and short vowels is not only a quantitative, but also a qualitative one, namely a distinction between lax and tense vowels. However, as we will see later, long and short vowels do not differ in their adaptation patterns, so for reasons of convenience, I will use similar phonetic signs for short and long vowels; namely [ü] for short /ü/ and [ü:] for long /ü/ and analogously, [ö] for short /ö/ and [ö:] for long /ö/[3]. When written between slashes (/ü/ etc.), I make no distinction between short and long vowel, but refer to both. To sum up, the vowels I investigate in this paper are shown in (3).

(3) Umlaut /ü/
✍✍ Short vowel [ü] [-back], [+round], [+high], [-tense]
✍✍ Long vowel [ü:] [-back], [+round], [+high], [+tense]
✍✍ Grapheme in German: <ü>, <ue>, <y>
Umlaut /ö/
✍✍ Short vowel [ö] [-back], [+round], [-high], [-tense]

- ✍ Long vowel [ö:] [-back], [+round], [-high], [+tense]
- ✍ Grapheme in German: <ö>, <oe>

3. LOANWORD PHONOLOGY AND THE ADAPTATION OF UMLAUT

How could umlaut be adapted in a language lacking front rounded vowels? There are a variety of ways to deal with a sound that does not exist in the native sound inventory. One way of adapting umlaut is of course to incorporate this foreign sound into the system. However, umlaut is a highly marked sound[4], so many languages, among them Japanese, disallow an integration of this sound despite the fact that doing so would most respect the source.

In the second section of this chapter I will make some theoretical suggestions of how umlaut could be incorporated into Japanese. However, before that I will introduce some research on loanword phonology concerning umlaut, specifically, Trubetzkoy (1939) and Paradis and Prunet (2000). A comparison of these is interesting, because they draw different conclusions concerning the adaptation of umlaut.

3.1. Research on adaptation of umlaut

3.1.1. Trubetzkoy (1969)

Trubetzkoy investigated the adaptation of German umlaut into Bulgarian and pointed out that the features of umlaut, [-back] and [+round], are represented by a sequence of two phonemes, e.g. two vowels, or a sequence of glide and vowel, in which one segment maintains the feature [-back] and the other one [+round]; for example, German /ü/ becomes /ju/ in Bulgarian.

3.1.2. Paradis and Prunet (2000)

Paradis and Prunet give a further example of a foreign sound represented as a sequence, namely the adaptation of nasal vowels. Nasal vowels are in many cases adapted as a sequence of an oral vowel and a nasal consonant (VN) in borrowing languages lacking nasal vowels. Paradis and Prunet call this process of representing a single segment as a sequence of segments *unpacking*.

However, in contrast to Trubetzkoy, Paradis and Prunet come to the conclusion that in case of umlaut unpacking does *not* occur. Instead, umlaut is substituted by a single native segment, resulting in the loss of one of its features. Paradis and Prunet investigated the adaptation of French front rounded /ü/[5] in several languages, and the result of this investigation shows not a single case of unpacking. The front rounded vowel is substituted by a single segment, mostly by /i/ (maintaining the feature [-back] while loosing [+round]), as illustrated in the following table (Paradis und Prunet, 2000: 330)[6].

(4) Table: Adaptation of French front rounded vowel [ü(:)]

Language	Number of Adaptations	Type of Adaptation (y = /ü/)	Cases of Unpacking
Kinyarwanda	170/172 cases	y → i (119/172 = 69%) y → u (36/172 = 21%)	0
Fula	72/76 cases	y → i (56/76 = 73.6%) y → u (14/76 = 18.4%)	0
Lingala	142/155 cases	y → i (142/155 = 91.6%) y → u (13/155 = 8.4%)	0
Moroccan Arabic	143/161 cases	y → i (66/143 = 46.1%) y → u (67/143 = 46.8%)	0

3.2. Theoretical Considerations

We have just seen two ways of assimilating umlaut into borrowing languages lacking front rounded vowels - adaptation as a single segment and unpacking. Keeping this in mind, I would like to consider how umlaut could be adapted into Japanese.

Let us first assume a representation as a single segment. In that case, we loose one feature of umlaut, either [-back] or [+round]. The first one would be the result of backing the vowel in order to preserve the feature [+round] and would result in the back vowels /u/ for /ü/ and /o/ for /ö/. The loss of the second feature would be caused by delabialisation and would give us /i/ as the unrounded form of /ü/ and analogously, /e/ as the unrounded form of /ö/.

Let us next consider unpacking. As one possibility, unpacking could result in a hiatus or a diphthong, a sequence of two vowels where each vowel represents one of the features of umlaut. I assume umlaut would unpack to the diphthong /ui/ or the hiatus /iu/ in case of /ü/ and to a hiatus of the mid vowels /oe/ or /eo/ in the case of /ö/. However, because both hiatus and diphthongs are universally marked and moreover add a mora (or syllable) to the output, we should consider alternatives which would avoid vowel sequences[7]. One such alternative is unpacking into a sequence of glide and vowel. This would maintain both features of umlaut without adding an extra mora or syllable. Some possible results of such unpacking would be /wi/ or /ju/ for /ü/, and /we/ or /jo/ for /ö/. In these examples, the glide and vowel together maintain the features [-back] and [+round]. There are of course other forms one can expect as a result of unpacking, thus as /uj/, /ew/ etc., but they fatally violate Japanese syllable structure, which is why I do not take them into account here.

These considerations of possible umlaut adaptation strategies in Japanese can be summarized in the following table. The next chapter will show which patterns we actually find in Japanese.

(5) Theoretically possible adaptations of umlaut in Japanese

Input \ Possible outputs	Single segment: Delabialisation	Single segment: Backing	Unpacking as: Hiatus / Diphthong	Unpacking as: Glide + vowel
/ü/	/i/	/u/	/iu/, /ui/	/wi/, /ju/
/ö/	/e/	/o/	/eo/, /oe/	/we/, /jo/

4. ADAPTATION OF GERMAN UMLAUT INTO JAPANESE

Let us next investigate the patterns of umlaut adaptation that in fact occur in Japanese. As will be seen, /ü/ does not seem to follow a pattern as regular as /ö/, and what is most interesting is that we find divergent patterns when we compare /ü/ and /ö/.

4.1. Adaptation of /ü/-umlaut

As can be seen in the following examples, there are two ways of representing /ü/ in Japanese: by /ju/ as in the examples of (6), or by /i/ as in the examples of (7).

(6) Hütte ['hüt?] ✍ *hyutte* ヒュッテ 'mountain hut'
Gemüt [g?'mü:t] ✍ *gemyûto* ゲミュート 'one's feelings'
Kanüle [ka'nü:l?] ✍ *kanyûre* カニューレ 'hollow part of a syringe'

(7) Synthese [zün'te:z?] ✍ *jintêze* ジンテーゼ 'synthesis (philosophy)'
Hysterie [hüste'ri:] ✍ *hisuterî* ヒステリー 'hysteria'
Analyse [ana'lü:z?] ✍ *anarîze* アナリーゼ 'analysis (in music)'

(8) Table: Adaptation of /ü/ into Japanese

Output / Input	Single segment			Unpacking				Total
	[i]	**[i:]**	/u/	/iu/ or /ui/	/wi/	**[ju]**	**[ju:]**	
[ü]	**37 (80%)**	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**9 (20%)**	0 0%	46 (100%)
[ü:]	0 (0%)	**2 (9.5%)**	0 (0%)	0 (0%)	0 (0%)	0 (0%)	**19 (90.5%)**	21 (100%)
Total	39 (58.2%)		0 (0%)	0 (0%)		28 (41.8%)		67 (100%)

As is clear from looking at the table in (8), there are two adaptation-patterns for /ü/ into Japanese. The short vowel [ü] tends to be substituted by the unrounded front vowel [i]. For the long vowel however, unpacking occurs in most cases, leading to the sequence [ju:]. Despite the distribution seen in the table in (8), I will argue that the minority pattern of /ü/ ↴ /ju/ is in fact the default pattern for the incorporation of /ü/ into Japanese. The length distinction plays no role; rather, the occurrence of so many counterexamples to this default pattern (e.g. 80% of [ü] do not follow this pattern) can be explained by the influence of orthography. There are three graphemes in German corresponding to /ü/. These graphemes (which do not encode the length distinction) are <ü>, <ue> and <y>. We can see a clear difference in the adaptation of /ü/ depending on its grapheme. Compare the following tables in (9) and (10), which differentiate the output form of adaptation according to the source vowel's grapheme. German umlaut written with <ü> or <ue> is adapted as /ju/ in Japanese (cf. Table in (9) and examples in (6)). In contrast, German umlaut written with <y> regularly becomes /i/ in Japanese (cf. Table in (10) and examples in (7)).

(9) Table: Graphemes <ü>und <ue>: adaptation of /ü/ into Japanese

Output / Input /ü/	Single segment		unpacking		Total
	[i]	**[i:]**	**[ju]**	**[ju:]**	
grapheme <ü> (short vowel)	0 (0%)	0 (0%)	**9 (100%)**	0 (0%)	9 (100%)
grapheme <ü> (long vowel)	0 (0%)	0 (0%)	0 (0%)	**18 (100%)**	18 (100%)
grapheme <ue> (long vowel)	0 (0%)	0 (0%)	0 (0%)	**1 (100%)**	1 (100%)
Total <ü>, <ue>	**0 (0%)**		**28 (100%)**		**28 (100%)**

(10) Table: Grapheme <y>: adaptation of /ü/ into Japanese

Output / Input /ü/	Single segment		unpacking		Total
	[i]	**[i:]**	**[ju]**	**[ju:]**	
grapheme <y> (short vowel)	**37 (100%)**	0 (0%)	0 (0%)	0 (0%)	37 (100%)
grapheme <y> (long vowel)	0 (0%)	**2 (100%)**	0 (0%)	0 (0%)	2 (100%)
Total <y>	**39 (100%)**		**0 (0%)**		**39 (100%)**

To explain this orthography-based divergence, one needs to take a closer look at the origin of words containing /ü/ written with <y>. The grapheme <y> is used exclusively for loanwords in German, particularly Greek and Latin. These Greek and Latin loanwords are typically technical terms and as such were most likely incorporated into Japanese through written media (technical manuals, scholarly journals). As a result, the German pronunciation of these words probably had no influence on their representation in Japanese; rather a simple orthographic conversion rule was applied (<y> → <イ> (Katakana-letter for /i/)). This orthographic conversion rule could possibly be an extension of some conversion rule already established for Greek or Latin words having entered Japanese from languages other than German, and in which the grapheme <y> was pronounced as /i/.

(11) Early loans in Japanese with <y>

Portugese:	*mysterio*	→	*misuteriyo*	ミステリヨ	'mystery (Christianity)'
Dutch:	*cyan*	→	*shian*	シアン	'cyanogen'
English:	*system*	→	*shisutemu*	システム	'system'

Therefore, German words with <y> should be excluded from consideration (as they represent an orthographic process, not a phonological one). This eliminates all instances of German /ü/ being represented by Japanese /i/. So we are left with the result that German /ü/ is represented in Japanese by /ju/. This pattern is also seen in Japanese borrowings of French /ü/.

(12) French loanwords in Japanese: /ü/ ↴ /ju/

menu	[m?'nü]	✍	*menyû*	メニュー	'menu'
déjà-vu	[de?a'vü]	✍	*deja byu*	デジャ・ビュ	'déjà-vu'
luge	[lü:?]	✍	*ryûju*	リュージュ	'wooden sled'

(13) Table: Adaptation of French /ü/ into Japanese

Output / Input	Single segment		unpacking	**Total**
	/i/	/u/	**/ju/**	
French /ü/	2 (2.7%)	2 (2.7%)	**69 (94.5%)**	**73 (100%)**
Total	**4 (4.5%)**		**69 (94.5%)**	**73 (100%)**

To sum up, excluding all examples written with <y> (whose adaptation pattern is based on orthography), German /ü/ is regularly adapted into Japanese as /ju/. The pattern /ü/ ↴ /ju/ is caused by unpacking, resulting in a sequence of glide and vowel, whereby the glide /j/ represents [-back] and the vowel /u/ [+round][8]. This unpacking is in accordance with Trubetzkoy's (1969: 64) point of view. He explains this pattern as follows:

> "From a psychological point of view, these examples can be explained by the fact that the phonemes are not symbolized by sounds but by specific distinctive sound properties, and that a combination of such sound properties is interpreted as a combination of phonemes. However, since two phonemes cannot occur simultaneously, they must be interpreted as occurring in succession."

4.2. Adaptation of /ö/

As can be seen in the examples in (14) and in the table in (15), the adaptation of /ö/ follows a regular pattern. German /ö/ is consistently represented by /e/ in Japanese:

(14)

Ökumene	[öku'me:n?]	✍	*ekumêne*	エクメーネ	'area of settlement'
Röntgen	['röntg?n]	✍	*rentogen*	レントゲン	'roentgen (picture)'
Goethe	['gö:t?]	✍	*gête*	ゲーテ	Goethe
Blockflöte	['bl?kflö:t?]	✍	*burokkufurête*	ブロックフレーテ	Name of recorder

(15) Table: Adaptation of /ö/ into Japanese[9]

Output / Input	Single segment			unpacking			Total
	[e]	**[e:]**	/o/	/eo/ or /oe/	/we/	/jo/	
[ö]	**16 (100%)**	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	16 (100%)
[ö:]	0 (0%)	**14 (100%)**	0 (0%)	0 (0%)	0 (0%)	0 (0%)	14 (100%)
Total	**30 (100%)**		0 (0%)	0 (0%)			30 (100%)

German front rounded /ö/ is regularly adapted as the front unrounded vowel /e/ in Japanese. This delabialisation of umlaut leads to a single segment in Japanese, maintaining the feature [-back], but resulting in a loss of the feature [+round]. The adaptation pattern of /ö/ can be viewed as being in accordance with Paradis & Prunet's (2000) research, predicting that unpacking does not occur in case of umlaut.

4.3. Analysis of the adaptation-patterns

As seen in this chapter so far, /ü/ and /ö/ follow apparently different adaptation-patterns. German /ü/ becomes /ju/, two phonemes in sequence maintaining both [-back] and [+round]. In contrast, German /ö/ is substituted by /e/ in Japanese, a single native segment, maintaining the feature [-back], but loosing the feature [+round]. These divergent patterns are summarized in (16).

(16) Contrast in adaptation-patterns of /ü/ and /ö/
/ü/ ✍ /ju/: unpacking, sequence of glide ([-back]) and vowel ([+round])
/ö/ ✍ /e/: delabialisation, single segment maintaining [-back], loss of [+round]

This discrepancy constitutes an interesting problem requiring explanation. It raises not only the question of why there are two different patterns, but moreover, which of these patterns can be viewed as the less marked and for which reasons the other does not follow this pattern.

I claim that /ü/ ↴ /ju/ constitutes the less marked pattern, and that /ö/ cannot follow this pattern. This is because /ö/ is a mid-vowel and so does not contain the specification [+high]. If /ö/ were to be adapted as the sequence /jo/, the addition of a [+high] feature (for the glide) would be required. This creates a requirement for /ö/ (addition of a feature for height) that is not found in the adaptation of /ü/.

In the first section of this chapter I will describe the pattern of /ü/ ↴ /ju/, suggesting a preference to maintain both features of umlaut despite the addition of an extra segment. In the second section I will describe the pattern of /ö/ ↴ /e/, which shows the dominance of the feature [back] over the feature [round]. The last section finally gives an explanation for the difference in the adaptation-patterns.

4.3.1. /ü/ ↴ /ju/: Unpacking of both features

The pattern /ü/ ↴ /ju/ shows that there is a preference for preserving both features, [-back] and [+round] (unpacking). We will see in this section that unpacking into a sequence of glide and vowel is the most favoured compared to other ways of unpacking due to reasons of markedness and faithfulness.

One result of unpacking would be a vowel sequence in which each vowel represents one of the features, [-back] and [+round], of umlaut. Such a vowel sequence would be either a diphthong or a hiatus. Though both of these are marked structures, hiatus is the more marked sequence; in Japanese, as in many other languages, we find several strategies to prevent hiatus formation[10]. Moreover, hiatus results in the addition of a syllable (or a mora in the case of a diphthong) that is not present in the input.

A less marked output form of unpacking is a sequence of glide and vowel. This is similar to hiatus or diphthong in that it allows for the maintenance of both features of umlaut, however, in contrast to these vowel sequences, a glide-vowel sequence does not add a syllable or a mora, but only a segment (phoneme).

As stated in section 3.2., unpacking the features of umlaut into a sequence of glide and vowel would result in /wi/ or /ju/ for /ü/ and /we/ or /jo/ for /ö/. With respect to faithfulness to the source and the statement that the maintenance of the feature [back] is more essential than [round] (see chapter 4.3.2.), I would argue that unpacking to /wi/ in case of /ü/ and /we/ in case of /ö/ is more favourable. This is because these sequences preserve the more distinctive feature [-back] in the nucleus of the syllable, and umlaut (being a single segment) constitutes a nucleus, so its most distinctive features should accordingly be preserved in the nucleus of the output. However, sequences of velar glide and vowel are highly restricted in Japanese. The only sequence of velar glide and vowel we find in contemporary Japanese is /wa/ (which also has a restricted distribution, not being permitted after a consonant: *Cwa). The sequences relevant to our discussion, namely /wi/ and /we/, are absent in modern Japanese, having merged into the vowels /i/ and /e/ respectively. Thus, /wi/ and /we/ were no longer part of the Japanese phonological system when German loanwords first entered Japanese.

The alternative sequences of glide and vowel, namely /ju/ for /ü/ and /jo/ for /ö/, are not restricted in Japanese. In case of /ü/, the sequence of front glide and round vowel, /ju/, is what we indeed find as the representation for the umlaut. This representation is unfaithful to the source by adding an extra segment not found in the source. However, this way it allows to preserve both feature, [-back] and [+round], of umlaut in the output.

4.3.2. /ö/ → /e/: [back] >> [round]

The adaptation of /ö/ as the single segment /e/ shows the dominance of the feature [back] over the feature [round].

Adaptation of umlaut as a single segment (other than umlaut itself) - as we find in the case of /ö/ - unavoidably results in the loss of one of the features of umlaut. As seen in (16), /ö/ becomes a front, unrounded vowel preserving the feature [-back]. That [-back] is preserved in preference to [+round] is due to the fact that [back] is a more essential feature than [round] in Japanese. Lip rounding plays hardly any role in the Japanese sound system, whereas backness is a distinctive feature. The minimal role of lip rounding in Japanese can be seen in several aspects of the phonology, including the lack of lip rounding on the vowel /u/; the loss of the labio-velar glide /w/ in front of all but the low vowel; and the development of the phoneme /p/ (/p/→ /? /→ /h/).

[Back] being a more essential feature than [round] is not only a Japanese characteristic, but holds true for many languages. Generally, for the description of sound systems, highness and backness are basic, whereas roundness plays only a minor role, as pointed out by Lindau (1978:541):

> "The most basic vowel parameter is vowel height: all languages contrast high and low vowels. […] Another basic contrast is that between front and back vowels. Vowel height and backness form the foundation of a two-dimensional vowel space that is required to describe nearly all the languages of the world. Additional contrasts like variations in lip position […] can be considered as superimposed on this basic vowel space."

That backness plays a more important role than roundness can also be seen in the adaptation of umlaut into other languages, as researched by Paradis and Prunet (2000). They examined the adaptation of French umlaut in several languages, and their data show that when incorporation of /ü/ takes the form of a single segment, instances where the output is /i/ far outnumber instances where the output is /u/ (cf. table in (4) in chapter 3.1).

These facts suggest that it is more essential in languages like Japanese to preserve the specification for the feature [back] than for the feature [round]. Indeed we see that [-back] is preserved in the adaptation of both /ü/ and /ö/, whereas [+round] is only maintained in the case of /ü/[11].

4.3.3. Contrast in patterns: vowel height

First, the pattern /ü/ → /ju/ speaks to the tendency to preserve both features, [-back] and [+round], of umlaut. Secondly, the pattern /ö/ → /e/ shows the dominance of the feature [back] over the feature [round]. However, these observations can still not explain the difference in the adaptation patterns. Which difference in the source vowels or which constraints of the borrowing language cause this divergence?

One possibility might be to posit /ö/ → /e/ as the default pattern and to assume that /ü/ cannot follow this pattern due to an extra constraint. The only reason I can think of blocking /ü/ surfacing as a single, unrounded segment (namely /i/) is a restriction on the long vowel [i:] in Japanese, a vowel which in fact does not occur at all in the Sino-Japanese stratum of the lexicon. However, this approach has the undesirable consequence of only affecting the long vowel and thus predicting a divergence in the patterns of long and short vowels; such a divergence does not occur in Japanese. Moreover, this constraint against [i:] is not well motivated.

A more promising approach is to assume that the difference in the process of adaptation is the result of the different height specifications of the source vowels[12]. The vowel /ü/ is a high vowel and thus shares the feature [+high] with the output glide-vowel sequence /ju/. In other words, we find the same specification for height in all three phonemes: the source vowel as well as the glide and vowel of the output representation /ju/.

Adaptation of /ö/ as a glide-vowel sequence, however, is banned, as adaptation of /ö/ as /jo/ would result in the addition of the feature [+high]. The mid vowel /ö/ has a [-high] specification. So, the [+high] specification of the glide in the output sequence /jo/ disagrees with the [-high] specification of the source vowel. As a consequence, the glide would add an extra feature ([+high]) that we do not find in the source. Thus, the pattern /ö/ → /jo/ would constitute a more fatal violation of faithfulness to the source, which is why /ö/ surfaces as the single segment /e/ instead.

To sum up, the difference in the adaptation patterns of /ü/ and /ö/ is caused by the different height specifications of these vowels. Only the high umlaut (/ü/) shares the feature [+high] with both the glide and vowel of the output sequence, so adaptation as a glide-vowel sequence is possible. It is not possible in case of the mid vowel, because mid vowels and glides differ in the feature [high].

I would like to give independent motivation for this claim by referring to Rosenthall's (1997) and Casali's (1997) research. They investigated the occurrence of glide formation as a means of resolving hiatus in several languages. Their studies show that it is vowel height that determines whether glide formation occurs or not. Rosenthall (1997: 108) observes that in the languages he studied "the surface form of hiatus differs depending upon the height of the first vowel in the sequence. High vowels surface as secondary articulations and nonhigh vowels are either left unparsed or are parsed with hiatus”. Similarly, Casali (1997: 515) shows that glide formation in Okpe (Benue-Congo language spoken in Nigeria) occurs when the original vowel is high (cf. (17a)), but if it is “a nonhigh vowel, glide formation does not apply” (cf. (17b)).

(17) Hiatus resolution in Okpe (Casali 1997: 515)

a) Occurrence of glide formation (first vowel is a high vowel, /y/ = /j/)

/úó/	↴ /wó/	e.g.	/húó/	(die-FUT)	↴	/hwó/	‘will die’
/íá/	↴ /yá/	e.g.	/á-rí-á/	(IMPF-eat-IMPF)	↴	/á-ryá/	‘is eating’
/íó/	↴ /yó/	e.g.	/bí-ó/	(be.black-FUT)	↴	/byó/	‘will be black’

b) Non-occurrence of glide formation (first vowel is a non-high vowel)

/éó/	↴ /é/	e.g.	/è-sé-ó/	(INF-fall-INF)	↴	/èsé/	‘to fall’
/?á/	↴ /?/	e.g.	/á-z?-á/	(IMPF-run-IMPF)	↴	/áz?/	‘is running’

Although this is a different phenomenon (converting an underlying vowel of a hiatus into a glide), it is shown that vowels carrying the feature [+high] are more likely to become glides than vowels specified [-high]. Thus, we see the similarity of high vowels (in contrast to non-high vowels) and glides.

Unpacking?

When comparing the output of /ü/ and /ö/ in Japanese, the most obvious dissimilarity was shown to be that unpacking does not occur in case of /ö/, but does occur in case of /ü/. Thus, the adaptation-pattern of /ü/ in Japanese stands in complete contrast to Paradis and Prunet (2000: 332) who “suggest that the vowel *y* [represented in this paper by /ü/], like the vast majority of segments, is monophonemic, that is it has only one root node, and therefore is not structurally prompted to unpack”. I do not completely agree with Paradis and Prunet (2000). This generalisation does not hold true for Japanese, where the adaptation of /ü/ ↴ /ju/ indeed shows an example of unpacking. Moreover, with respect to the occurrence or non-occurrence of unpacking, one has to have a look at the sequences resulting from unpacking within a consonantal environment. Namely, many languages might, for instance, allow a sequence of glide and vowel as such, but not if preceded by a consonant (*CG, cf. Casali 1997: 499). In most cases umlaut follows a consonant and thus could not unpack in this environment because of a high-ranked constraint disallowing consonant-glide sequences. Restrictions like this might explain why unpacking does not occur in a number of languages.

I predict a divergence in the adaptation patterns for high /ü/ and mid /ö/ (unpacking only in case of /ü/) in languages other than Japanese, because unpacking into a glide-vowel sequence is, as was shown, more restricted in the case of mid-vowels. That is to say, I do not expect to find cases in which a language unpacks a mid vowel /ö/ into a sequence of glide and vowel, but does not unpack a high vowel /ü/ in the same manner. This prediction, of course, needs confirmation from languages other than Japanese.

4.3.4. Summary

The pattern of /ü/ ↴ /ju/ show the tendency to maintain both features, [-back] and [+round], while accepting the addition of a segment. In case of /ö/ ↴ /e/, we see the dominance of the feature [back] over the feature [round].

The vowels /ü/ and /ö/ only follow divergent patterns because /ö/ is faced with a constraint that does not affect the adaptation of /ü/. The pattern /ü/ ↴ /ju/ preserves both features of umlaut, [-back] and [+round], by unpacking the umlaut into a sequence of glide and vowel. The mid vowel /ö/, however, cannot undergo unpacking, because here it would result in the addition of an extra feature ([+high] of the glide).

5. ANALYSIS IN TERMS OF OPTIMALITY THEORY

In this chapter I will analyse the adaptation-patterns of /ü/ and /ö/ in terms of OT and posit a ranking of faithfulness and markedness constraints in Japanese that can explain the output of adapted umlaut that we find. First, though, I want to briefly describe the faithfulness and markedness constraints that are relevant to the discussion. I will then posit a ranking of these constraints that enables us to select the correct optimal output for both /ü/ and /ö/ in Japanese, as will be shown in the final tableaux.

5.1. Constraints

Faithfulness constraints

I posit the following faithfulness constraints, which enforce preservation of the features of umlaut ([-back] and [+round]) in the output[13] and ban the addition of a specification for the feature [high] in the output (cf. McCarthy and Prince 2004: 82, 84; Kager 1999: 250).

(18) MAX-IO(back)
Every feature [back] of the input has a correspondent in the output.

(19) MAX-IO(round)
Every feature [round] of the input has a correspondent in the output.

(20) DEP-IO(high)[14]
Every feature [high] of the output has a correspondent in the input.

The following INTEGRITY constraint (McCarthy and Prince 2004: 93) bans unpacking of a single segment into a sequence of segments.

(21) INTEGRITY (“No Breaking”)
No element of the input has multiple correspondents in the output.

Markedness constraint

The output satisfying all three of the above faithfulness constraints is umlaut itself. However, umlauted vowels are highly marked, militating against the following markedness constraint (cf. Klein 2000).

(22) $*V_{[-back]}$=[+round]
Front rounded vowels are prohibited.

One way to preserve both the [-back] and [+round] of umlaut - thus satisfying MAX-IO(back) as well as MAX-IO(round) - is to assimilate umlaut as a sequence of two phonemes. If these two phonemes are vowels, this creates a diphthong or a hiatus, both of which are marked structures. They are not optimal candidates for the representation of umlaut because they unpack a single segment (umlaut) into a sequence of two phonemes, each of which contributes a mora (or syllable). The markedness of hiatus and diphthong should be expressed by two constraints, one against hiatus, one against diphthong (cf. Rosenthall 1994). However, as the ranking of these constraints is irrelevant for my analysis, I will combine both into the following constraint (23) against vowel sequences[15].

(23) *VV
Vowel sequences are disallowed.

An alternative form of unpacking creates a sequence of glide and vowel. As mentioned in the previous chapter, an unpacking into the sequences /wi/ for /ü/ and /we/ for /ö/ would be most favourable. However, sequences of velar glide and non-low vowel are ruled out in contemporary Japanese. As a result, the only sequence of velar glide and vowel found in contemporary Japanese is /wa/, as expressed in the following constraint, posited by Kawai (2003:74).

(24) *wV[-low]
Velar glides are disallowed before non-low vowels.

As one can see in (25), any of the proposed candidates given in chapter 3.2. violates at least one of the constraints above.

(25) Adaptation-patterns and their constraint violations

Adaptation-pattern	Constraint violated
Adaptation of umlaut	*$V_{[-back]}$=[+round]
Adaptation as hiatus or diphthong	*VV, INTEGRITY
Adaptation as sequence of glide and vowel	INTEGRITY, *wV[-low], DEP-IO(high)
Delabialisation	MAX-IO(round)
Backing	MAX-IO(back)

The selection of the optimal candidate will depend on the ranking of these constraints in Japanese.

5.2. Ranking of constraints

In this section, I will work out the overall ranking of the constraints given above. This ranking will account for the adaptation-patterns of /ü/ and /ö/. I will show that all constraints but MAX-IO(round) and INTEGRITY are undominated; and that the dominance of the constraint DEP-IO(high) over MAX-IO(round) in combination with the dominance of MAX-IO(round) over INTEGRITY, causes the difference in the adaptation-patterns of /ü/ and /ö/.

(26) *Undominated markedness constraints*: *$V_{[-back]}$=[+round], *wV[-low], *VV

The fact that front rounded vowels simply do not occur in Japanese shows that *$V_{[-back]}$=[+round] is an undominated constraint in Japanese. The same holds true for the constraint *wV[-low]; except in some recent loanwords, the sequences /we/ and /wi/ do not occur at all. Furthermore, the non-representation of umlaut as hiatus or diphthong shows that *VV is undominated.

(27) *Undominated faithfulness constraints*: MAX-IO(back), DEP-IO(high)

As seen in section 4.3.1., [-back] is maintained for the adaptation of both /ü/ ✍ /ju/ (/j/=[-back]) and /ö/ ✍ /e/ (/e/=[-back]), which demonstrates that MAX-IO(back) is an undominated constraint.

The same holds true or DEP-IO(high): In the case of /ü/ ↴ /ju/, the glide and vowel of the output sequence correspond to the [+high] of the input /ü/. A representation of /ö/ as /e/ also maintains a correspondence of the specification for the feature [high] of input and output, both being [-high] vowels.

(28) MAX-IO(back), DEP-IO(high) >> MAX-IO(round) >> INTEGRITY

It is clear that INTEGRITY is not undominated, because /ü/ is adapted as /ju/ in Japanese, an output that results from unpacking and thus contains one more segment than the input.

MAX-IO(round) has to be higher ranked than INTEGRITY, otherwise we would incorrectly select /i/, instead of /ju/, as the optimal output for the adaptation of /ü/. Tableau (29) illustrates the ranking of these constraints, selecting the correct candidate.

MAX-IO(back) outranks MAX-IO(round), as is illustrated in the tableau for /ö/ in (30), which compares the single output segments /e/ and /o/. Moreover, DEP-IO(high) has to be higher ranked than MAX-IO(round). If this were not the case, we would incorrectly select /jo/, instead of /e/, as the optimal output for the adaptation of /ö/. The ranking of these constraints and the choice of the optimal output is shown in the tableau in (30).

(29) Tableau: MAX-IO(round) >> INTEGRITY

Input /[ü]/	MAX-IO(round)	INTEGRITY
☞ a. [ju]		*
b. [i]	*!	

(30) Tableau: MAX-IO(back), DEP-IO(high) >> MAX-IO(round)

Input /[ö]/	MAX-IO(back)	DEP-IO(high)	MAX-IO(round)
☞ a. [e]			*
b. [o]	*!		
c. [jo]		*!	

Summarizing all these considerations yields the following final ranking: five constraints are undominated, namely *$V_{[-back]}$=[+round], *VV, *wV[-low], MAX-IO(back) and DEP-IO(high). These constraints dominate lower ranked MAX-IO(round) and INTEGRITY. Of these two, MAX-IO(round) dominates INTEGRITY. A summary of the composite constraint ranking is given in (31).

(31) Final Ranking:

***$V_{[-back]}$=[+round], *VV, *wV[-low], MAX-IO(back), DEP-IO(high)**
>> MAX-IO(round)
>> INTEGRITY

5.3. Tableaux

As will be illustrated in the following tableaux in (32) – (35), the ranking in (31) gives us the observed outputs for the adaptation of both /ü/ and /ö/ umlaut in Japanese.

The tableaux for the selection of the optimal candidate of /ü/ is shown first, the short vowel, [ü], in the tableau in (32) and its long counterpart, [ü:], in the tableau in (33). The candidates (a) and (d)– (g) are ruled out, because they fatally violate one of the undominated constraints. The remaining candidates are /ju/ in (b) and /i/ in (c). However, /i/ violates the higher ranked (as compared to INTEGRITY) MAX-IO(round) constraint, and therefore we correctly select /ju/ as the optimal candidate for the adaptation of /ü/ into Japanese.

(32) Tableau: Adaptation of the short vowel [ü] ✍ [ju], e.g. Hütte ✍ *hyutte*

Input: [ü]	*$V_{[back]}$= [+round]	*VV	*wV [-low]	MAX-IO (back)	DEP-IO (high)	MAX-IO (round)	INTEGRITY
a. [ü]	*!						
☞ b. [ju]							*
c. [i]						*!	
d. [u]				*!			
e. [iu]		*!					*
f. [ui]		*!					*
g. [wi]			*!				*

(33)Tableau: Adaptation of long vowel [ü:] ✍ [ju:], e.g. Gemüt ✍ *gemyûto* ゲミュート

Input: [ü:]	*$V_{[back]}$= [+round]	*VV	*wV [-low]	MAX-IO (back)	DEP-IO (high)	MAX-IO (round)	INTEGRITY
a. [ü:]	*!						
☞ b. [ju:]							*
c. [i:]						*!	
d. [u:]				*!			
e. [iu]		*!					*
f. [ui]		*!					*
g. [wi:]			*!				*

The tableaux (34) and (35) show the selection of the optimal candidate for /ö/, (34) for the short vowel [ö] and (35) for the long vowel [ö:]. As can be seen in these two tableaux, the candidates (a) and (b) as well as (d) – (g) all violate an undominated constraint. Only the candidate in (c), namely /e/, satisfies all undominated constraints and as a result is selected as the optimal output. As we can see, /ö/ cannot surface as /jo/, because /jo/ violates the undominated constraint DEP-IO(high). The optimal candidates, therefore, are [e] and [e:] for the short and long umlaut respectively. The optimal output for these derivations is indeed what we find in Japanese.

(34) Tableau: Adaptation of the short vowel [ö] ✍ [e], e.g. Röntgen ✍ *rentogen* レントゲン

Input: [ö]	*$V_{[back]}$= [+round]	*VV	*wV [-low]	MAX-IO (back)	DEP-IO (high)	MAX-IO (round)	INTEGRITY
a. [ö]	*!						
b. [jo]					*!		*
☞ c. [e]						*	
d. [o]				*!			
e. [eo]		*!					*
f. [oe]		*!					*
g. [we]			*!		*		*

(35) Tableau: Adaptation of the long vowel [ö:] ✍ [e:], e.g. Goethe ✍ *gête* ゲーテ

Input: [ö:]	*$V_{[back]}$= [+round]	*VV	*wV [-low]	MAX-IO (back)	DEP-IO (high)	MAX-IO (round)	INTEGRITY
a. [ö:]	*!						
b. [jo:]					*!		*
☞ c. [e:]						*	
d. [o:]				*!			
e. [eo]		*!					*
f. [oe]		*!					*
g. [we:]			*!		*		*

We can see that the difference between the adaptation-patterns of /ü/ and /ö/ is solely caused by the ranking of DEP-IO(high) >> MAX-IO(round) >> INTEGRITY. Because INTEGRITY is so low ranked that it is effectively moot, /ü/ can surface as /ju/. However, /ö/ cannot surface the same way, because the undominated DEP-IO(high) rules out /jo/ as the optimal candidate. This can be clearly seen by comparing candidates (b) and (c) in the tableaux for /ü/ and /ö/, respectively.

To conclude, the ranking given in (31) selects /ju/ as the optimal candidate for /ü/ and /e/ as the optimal candidate for /ö/; these are the forms we do indeed find in Japanese.

6. CONCLUSION

In this paper we have looked at the adaptation-patterns of German /ü/ and /ö/ in Japanese. We saw that /ü/ undergoes unpacking, resulting in /ju/, a sequence of a front glide and a rounded vowel (I excluded all examples written with <y> due to the influence of orthography; see section 4.2), whereas /ö/ becomes a single front unrounded vowel /e/.

My major claim is that the difference between these divergent adaptation-patterns is caused solely by the different height specifications of the source vowels, which results in /ö/ facing a restriction that has no effect on the adaptation of /ü/. The pattern /ü/ ✍ /ju/ constitutes the less marked pattern, and /ö/ cannot follow this pattern because it is a non-high vowel and if it were adapted as the glide-vowel sequence /jo/, it would require an additional specifications for height ([+high] for the glide). Due to this fact, /ö/ cannot, in contrast to /ü/, be adapted as a sequence of glide and vowel, but is instead adapted as a single segment.

An analysis of the adaptation-patterns within the framework of OT gave us the forms we do indeed find in Japanese. Both patterns, /ü/ → /ju/ and /ö/ → /e/, could - despite their divergence - be analysed within the same constraint ranking. The crucial point of the analysis is the ranking of the constraint DEP-IO(high) over the constraint INTEGRITY, which allows for the addition of a segment, but not for the addition of an extra feature for height.

To sum up, I do not entirely agree with Paradis and Prunet's (2000) generalisation that umlaut is not represented by unpacking. The adaptation of /ü/ → /ju/ is indeed an example of unpacking. I assume a general tendency to unpack the high umlaut as long as this is not banned by native restrictions (e.g. *Cw or *Cj). In addition, I predict that languages other than Japanese will show a divergence between the adaptation pattern of the high vowel /ü/ and that of the mid vowel /ö/. I predict this because unpacking into a glide-vowel sequence is more restricted in the case of mid-vowels. To support this claim, further research on the adaptation of umlaut into languages other than Japanese is needed.

NOTES

1. Cf. Klein (2000: 17f.): "the nonfront, low monophthongs [a:] and [a] alternate with the front monophthongs [e:] and [e]" and Vennemann (1968: 371f.).

2. The transcription of the Japanese data follows the Hepburn style; note particularly that <y> corresponds to the pronunciation [j]. The meaning given for the examples is the meaning the data carry in Japanese, not necessarily in the source language.

3. The IPA symbols for German umlaut are: [œ] for [ö], [ø:] for [ö:] and [ʏ] for [ü], [y:] for [ü:].

4. No language has front rounded vowels without having unrounded ones, i.e., the existence of front rounded vowels implies the presence of front unrounded ones. On the markedness of front rounded vowels see e.g. Klein 2000, Calabrese 1995 and Kubozono 1999:35.

5. The symbols for the French high front rounded vowel in IPA are [y] for the short and [y:] for the long vowel.

6. The non-occurrence of unpacking cannot be explained by phonological restrictions of the languages concerned. Sequences of glide and vowel or two vowels are possible and unpacking could theoretically occur, cf. Paradis and Prunet 2000.

7. Vowel coalescence would be an alternative way. Vowel coalescence, however, results in a single vowel (e.g. Japanese [ui] → [i(:)]) and thus maintains only one feature. In that respect it does not differ from an adaptation as a single segment and can therefore be ignored.

8. Although Japanese /u/ is often phonetically transcribed as the back unrounded vowel [?], I do treat Japanese /u/ phonologically as a back rounded vowel (cf. Kubozono 1999: 35f.).

9. One exception is the German word 'schön' (シャン *shan*, 'beautiful'), a borrowing dating back to the Taishô period (1912-1926). In this case a representation by the unrounded phoneme /e/ leads to the sequence /she/. This sequence however did not occur in Japanese since Edo period (1600-1868). Whereas /she/ does occur in modern loanwords, one can assume that the sequence was restricted during the Taishô period, which is why /ö/ was not represented by /e/, but by the vowel /a/ (analogously the opposite 'unschön' → ウンシャン *unshan*). As this constitutes the only exception, I do not consider it any further.

10. A very detailed analysis of strategies to dissolve hiatus in OT framework is Casali 1997. For the case of Japanese, see Pintér 2004 and Kawahara 2003.

11. In order to give additional support to this claim, I take it as a task for further research to compare the formant frequencies of the input and output segments.

12. I would like to thank Stuart Davis for drawing my attention to the height factor.

13. As mentioned in the previous chapter, it is preferable to maintain the more essential feature in the nucleus (cf. 4.3.1.). The constraints I posit here do not account for this fact. An alternative would be to posit additional faithfulness constraints referring to the nucleus only, such as MAX-NUCLEUS(back) and MAX-NUCLEUS(round). That would constitute a differentiation between sequences like /wi/ (maintaining [-back] in the nucleus) on the one hand and /ju/ (maintaining [-back] only in the onset) on the other.

14. I would like to thank Dylan Herrick for suggesting the use of the DEP-IO(high) constraint.

15. In addition, I could posit the following WEIGHT IDENT constraint (McCarthy 2000, in Alderete 2004: 398).

WEIGHT IDENT

If a and ß are correspondent segments in input and output,
and a is monomoraic, then ß is monomoraic (= no lengthening)
and a is bimoraic, then ß is bimoraic (= no shortening).

This faithfulness constraint disallows any addition or deletion of a mora not found in the input, as would be the result of unpacking a single vowel into a diphthong or hiatus. It is independently needed to preserve the length distinction, namely that a short vowel is represented by a short vowel and a long vowel by a long vowel in Japanese. However, as the ranking of this constraint is irrelevant for my analysis, I do not consider it here any further.

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