

Vowel Selection in Japanese Loanwords from English

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1 Introduction

How words of foreign origin are adapted to the sound system of Japanese has been of considerable interest in phonological theorizing, particularly because Japanese has a very simple syllable structure and abundant loanwords. In the current literature, there are basically two ways of analyzing and explaining loanword adaptations, a phonological approach and a phonetic/perceptual approach. In phonological accounts of loanword adaptations, borrowers “accurately identify L2 (source language) sound categories: that is, they operate on the mental representation of an L2 sound, not directly on its surface phonetic form” (LaCharité and Paradis 2003:1). As a result, the forms produced in a borrowing language might not be the ones phonetically closest to the source pronunciation, but rather reflect the phonological categories of the source language. In the phonetic/perceptual accounts, on the other hand, loanword adaptation is “a process that applies during speech perception and that maps non-native sound structures onto the phonetically closest native ones” (Peperkamp 2005:2). Borrowers may misperceive foreign sounds and structures, but they try to adapt them as the phonetically closest sounds which are permissible in the borrowing language. In the case of loans from English into Japanese, however, it is not sufficient to review loanword adaptations only in these two contexts. Considering the intense exposure of Japanese people to English in particular, it is very likely that knowledge of English orthography also influences how English words are made to comply with Japanese phonology. In this paper, the influence of orthography on the selection of Japanese vowels in loanwords from English, both medial and epenthetic, is investigated.

Because most Japanese have at least six years of English education, it is nearly impossible to eliminate orthographic influence completely. However, a near spoken-language context can be recreated in an “on-line” adaptation experiment, in which new English words are borrowed “here and now.” Smith (2005) argues that the way English words are adapted in Japanese would be different from the currently observed ones if the borrowing occurred without written materials. In fact, Smith shows in Hawaiian Japanese and in older loans which were borrowed when the

exposure of Japanese people to English was not so extensive, adaptation rules were radically different. Vandelin and Peperkamp (2005) also show that loanword adaptations are influenced by orthography via an experiment in which French-English bilingual speakers produce on-line adaptations of English non-words. On the other hand, Shirai (1999) concludes that the influence of orthography is not significant based on her research with a 3,399-loanword corpus. Taking the previous work into consideration, I conducted an experiment of on-line adaptations of English-like non-words.

In this experiment, stimuli were presented under two conditions designed to investigate the role of orthographic influence. One was a “spoken-language context” or “oral condition” (Vandelin and Peperkamp 2005), in which no orthographic forms were available. The other was a more realistic context, a “mixed condition,” in which phonological forms were presented with their spelling. Vandelin and Peperkamp (2005:10) claim that “on-line adaptations based on orally presented non-words provide more reliable data.” More specifically, the predictions in this experiment are:

1. The selection of Japanese vowels in the oral condition is more varied than in the mixed condition
2. Orthography does have an influence. It both standardizes and interferes with vowel selection based on phonetic approximation.

In the following sections, I briefly describe the vowels of Japanese, then review the basic adaptation rules before discussing the experiment itself.¹

2 Japanese vowels

Japanese has five vowel phonemes. Figure 1 shows where the five vowels are mapped articulatorily. Figure 2 illustrates the English vowel system for comparison.

Figure 1: Mapping of Japanese Vowels²

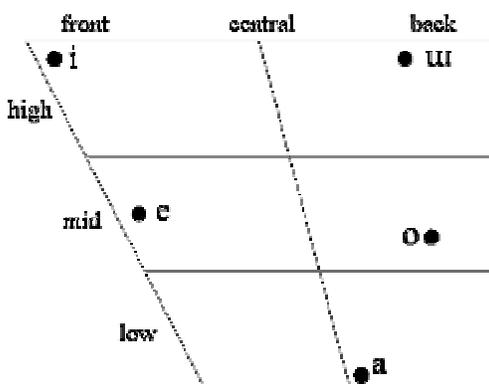
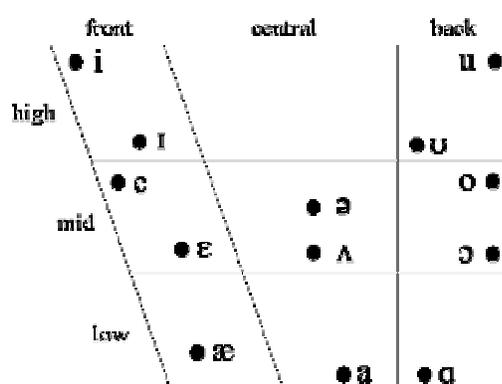


Figure 2: Mapping of English Vowels³



¹I wish to thank Gregory Iverson for his comments and support in this study.

²Wikipedia, http://en.wikipedia.org/wiki/Main_Page

The Japanese high front vowel [i] is similar to the English high front vowel [i], but the lips are not as spread as in English. The Japanese mid front vowel [e] is a little higher than the English mid front vowel [e]. The mid back vowel [o] resembles English [ɔ]. However, it is somewhat higher and slightly more front than the English counterpart. The Japanese low central vowel [a] is pronounced at about the same height as the English vowel [a], but it is more forward. The Japanese (especially standard Japanese) high back vowel is unrounded [u] while the English high back vowel is rounded (Tsujimura 1996:16-8).

3 Basic adaptations found in integrated loanwords

Research on integrated loanwords (loanwords which are listed in Japanese dictionaries) has fairly well established how foreign sounds are adapted into Japanese, both consonants and vowels. In this section, only rules relevant to vowels are described.

3.1 How nucleus vowels are adapted

The length of both vowels and consonants is contrastive in Japanese. Vowel length in Japanese loanwords is determined by the phonetic length of corresponding vowels in the source language. Japanese vowel phonemes are selected based on the “between-language grapheme-to-phoneme correspondence” which selects vowels “according to the way [borrowers] have learned to pronounce English graphemes” (Vandelin and Peperkamp 2005:3). Table 1 below summarizes how English vowels are typically adapted in Japanese. The table also identifies how each English vowel is spelled in this experiment and how it is pronounced based on the between-language grapheme-to-phoneme correspondence (BL-GPC), along with examples of the stimuli and predicted forms of adaptations.

Table 1. Nucleus vowel adaptation

Spelling (in this experiment)	Pronunciation in English	BL-GPC	Examples of stimuli	Predicted adaptations
<au>/<aught(t)>	ɔ	o:	‘baug’	bo:gu
<o>	ɑ	o	‘tot’	totto
<u>	ʌ	a	‘gud’	gaddo
<e>	ɛ	ɛ	‘kep’	keppu
<i>	ɪ	i	‘bib’	bibbu
<a>	æ	a	‘bab’	babbu
<ou>/<oo>	ʊ	u	‘should’	ʃuddo
C<a>C<e>	e	e:	‘tate’	te:to
<ea>	i	i:	‘keat’	ki:to

³Tsujimura, 1996

C<o>C<e>	o	o:	'dobe'	do:bu
<oo>	u	u:	'bood'	bu:do

The English low front vowel [æ] is realized as [ya] if it follows a velar stop [k] or [g]. This is because the frontness of [æ] is most readily interpreted as palatalization of the preceding consonant, particularly when it is a back consonant, i.e., velar. (Lovins 1975). But in most cases, the between-language grapheme-to-phoneme correspondence is the adaptation that is facilitated by orthography, as in the selection of the vowel [o], rather than [a], in *hotto* < English 'hot' [hat], as discussed below.

3.3 Epenthetic vowels

No syllable-final consonant is allowed in Japanese except the moraic nasal /N/ and the first half of a geminate. The disallowed final consonants and consonant clusters in a source language are made to be an onset of the following syllable by epenthesis. Vowels which are inserted are selected according to the final obstruent.

- (1) Epenthetic vowels
- (i) $\emptyset \rightarrow i / \{tʃ, dʒ\} _ \#$
 - (ii) $\emptyset \rightarrow o / \{t, d\} _ \#$
 - (iii) [u] everywhere else

The default epenthetic vowel is [u], which is the least marked vowel in Japanese. As rule (i) shows, after the palatal affricates [tʃ] and [dʒ], the high front vowel [i] is inserted instead of the high back vowel [u]. The reason for rule (ii) is that the sequences of [tu] and [du] are not fully accepted in Japanese. When /t/ is followed by /u/ as a result of grammatical inflection, /t/ is invariably affricated into [ts] as shown below.

- (2) Affrication of /t/ in /tat/ 'to stand'
- a. /tat/ 'to stand' + /anai/ (negative) > [tatanai]
 - b. /tat/ 'to stand' + /e/ (imperative) > [tate]
 - c. /tat/ 'to stand' + /u/ (non past) > [tatsuw]

Though the sequences [tu] and [du] are not accepted in native Japanese words, they do occur in recent loans.

- (3) Loanwords with [tu] and [du]
- tattoo* [tatu:]
 - Scooby Do* [sukuu:bi: du:]

4 On-line adaptation experiment

4.1 Participants

Vowel Selection in Japanese Loanwords from English

Seven Japanese living in the United States participated in this experiment. There is variation in the length of their stay in the U.S. as well as in their levels of English. The participants are listed below.

Table 2. List of participants

#	Stay in the U.S.	Sex	Age	TOEFL(CBT)
1	more than 5 yrs	M	late 20's	180-217
2	more than 5 yrs	F	older than 40 yrs old	n/a
3	1-3 yrs	F	early 20's	180-217
4	6 mo – 1 yr	M	early 20's	133-173
5	6 mo – 1 yr	F	early 20's	n/a
6	1 – 3 mo	F	late 20's	0-100
7	more than 5 yrs	F	late 30's	n/a

4.2 Stimuli and Procedure

41 stimuli were prepared. They were mostly non-words with permissible phonetic sequences in English. The stimuli were read by a specially trained native speaker of English and digitally recorded. Most of words have a syllable structure of CVC (*e.g.* [tab] spelled as 'tob', [tat] spelled as 'tot').

Participants were informed that words used in this experiment were English words which were not commonly used (except for the stimuli 'should' and 'stood'). They were also instructed to use them as nouns in Japanese.

4.3 Conditions

Following Vandelin and Peperkamp (2004), the stimuli were given in two different conditions, oral and mixed conditions. In the oral condition, the stimuli were played back without orthography. One second after the stimulus was played, a Japanese carrier sentence appeared on the screen. Four kinds of carrier sentences were prepared, in all of which the space for the first word was blank. The participants were expected to use the stimulus as a newly borrowed noun in the blank. In mixed condition, the stimuli were presented with orthography. The written stimulus was presented first on the screen, and then the recorded stimulus was played, immediately followed by the appearance of a carrier sentence. In both conditions, the Japanese sentences produced by the participants were digitally recorded.

The stimuli were divided into two groups. To three of the seven participants, the stimuli in Group 1 were presented in the oral condition and those in Group 2 were in the mixed condition. To the other four participants, the pattern was reversed; Group 2 in the oral and Group 1 in the mixed condition. An experiment in the oral condition preceded the mixed condition to prevent the participants from learning the pattern of how the stimuli were spelled.

5 Results and discussion

5.1 Source language vowels

In this section, I will discuss how English vowels are adapted and what kind of impact orthography has on the selection of source language vowels. In the tables below, cells that correspond to the predicted adaptation by the between-language grapheme-to-phoneme correspondence are in boldface.

5.1.1 Cases in which orthography facilitates the predicted adaptations

The adaptation of [ɪ] indicates a clear influence of the orthography. As Figures 1 and 2 in Section 2 show, the English [ɪ] is phonetically between [i] and [e] in Japanese. Without the information about the spelling, Japanese [e] is selected 30% of the time, which is reasonable if the adaptation is based on hearers' perception. In the mixed condition, however, the participants never produce [e].

Table 3. The adaptation of [ɪ]

source	grapheme	con	short [a]	long [i]	short [i]	long [u]	short [u]	short [e]
ɪ	<i>	oral			70.6%			29.4%
		mix		9.1%	90.9%			

Likewise, the English [æ] has the same height as the Japanese [a] but it is a front vowel. It is thus natural that the lower front vowel [e] is selected more often in the oral condition than in the mixed condition.

Table 4. The adaptation of [æ]

source	grapheme	condition	short [a]	short [e]	[ya]
æ / [k, g]	<a>	oral		9.1%	90.9%
		mix			100%
æ	<a>	oral	78.6%	27.3%	
		mix	93.3%	6.7%	

The mental connection between the grapheme <ea> and the sound [i:] seems to be fairly strong. Although it is adapted as a short vowel in the oral condition 40% of the time, when the stimulus is presented with orthography, it is adapted as a long vowel more than 90% of the time.

Table 5. The adaptation of [i]

source	grapheme	condition	long [i:]	short [i]
i	<ea>	oral	60.0%	40.0%
		mix	90.9%	9.1%

In the last case in this section, an anomaly occurs in the oral condition.

Table 6. The adaptation of [u]

source	grapheme	condition	long [u:]	short [u]	[yu]
u	<oo>	oral	45.5%	27.3%	27.3%
		mix	70.0%	30.0%	

In the oral condition, nearly 30% of the time, the stimuli are adapted with a glide [y] as Table 6 illustrates. The connection between the English vowel phoneme [u] and the Japanese [yu] in the oral condition is puzzling. Possibly, when participants hear stimuli such as ‘doot’ (pronounced as [dut]), they mentally reconstruct the orthographic representation as ‘dute’, which could be pronounced as [dyut] in English, and they adapt this stimulus as [dyu:to]. The lack of [yu] in the mixed condition is consistent with this explanation because the stimuli are spelled with <oo> as in ‘doot’ or ‘toop’.

5.1.2 Other cases

Phonetically based selection of the following three vowels is interfered with by orthography. The English low back vowel [ɑ] is phonetically closer to the Japanese low mid vowel [a] than [o]. Therefore, phonetic approximation predicts that the Japanese vowel [a] is selected. As expected, in the oral condition, it is adapted as [a] or [a:], but in the mixed condition, it is adapted as [o] more than half of the time, obviously because of orthographic influence. In the case of [ʌ] and [ʊ], the former spelled with <u> and the latter with <oo>, the adaptation was to [u] and [o], respectively, more often in the mixed condition than in the oral condition. Considering that the participants have good knowledge of English spelling conventions, or grapheme-to-phoneme correspondences to the effect that <u>=[ʌ] and <oo>=[ʊ], this is somewhat unexpected.

Table 7. The adaptation of [ɑ], [ʌ], [ʊ]

source	grapheme	condition	long [a:]	short [a]	long [u:]	short [u]	long [o:]	short [o]
ɑ	<o>	oral	11.8%	64.8%				23.5%
		mix		44.4%			5.6%	50.0%
ʌ	<u>	oral		82.4%		11.8%		5.9%
		mix		66.7%	11.1%	22.2%		
ʊ	<oo>	oral				80.0%		20.0%
		mix				66.7%		33.3%

To conclude this section, orthography does influence vowel selection in loanwords. The present experiment implies that if orthographic influence could be eliminated, vowels would be selected based on the hearers' perception. But LaCharité and Paradis (2005:77) maintain that "if perception at the surface level is held responsible for loanword adaptation, then we should see numerous cases where an L2 [source language] phoneme [is] identified with the 'wrong' phoneme in L1 [borrowing language]". In the present study, the phonemes in English are often identified with the "wrong" phoneme in Japanese. For instance, English [ɪ] is identified sometime as [i] and sometimes as [e], or English [æ] is identified sometimes as [a] and sometimes as [e] in Japanese. Based on the results of the present experiment, what prevents the vowel selection in loanwords from being erratic is not knowledge about the phoneme category of the source language, as LaCharité and Paradis maintain, but knowledge about orthography, because in the oral condition, where the participants' phonological knowledge of English phonemes should have been equally active, the adaptations were mostly based on phonetic approximation.

5.2 Epenthetic vowels

So far, the selection of Japanese vowels which correspond to vowels that are extant in source words has been examined. In this section, the selection of vowels which correspond neither to grapheme nor sound in the source language is reviewed. As described in Section 4.2, there are three basic rules determining which vowel is epenthesized after a final consonant. In this experiment, most epenthetic vowels follow those rules. However, rule (ii) ($\emptyset \rightarrow o / t, d _ \#$) is sometimes ignored so that the default vowel [u] is inserted via rule (iii), but only when the preceding vowel is also [u]; this gives rise to doublets with expected epenthetic [o] as well as unexpected epenthetic [u]. Examples are as listed in (4).

- (4) Unexpected [u]-epenthesis
 'bood' [bud] > [bu:du] / [bu:do]
 'should' [ʃud] > [ʃuddu] / [ʃudo]

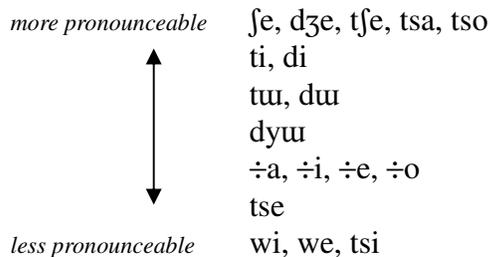
When the root vowel is not [u], on the other hand, only [o] is inserted after coronals, as epenthesis rule (ii) predicts.

- (5) ‘ged’ [gɛd] > [geddo], *[geddu], *[gedde]
 ‘dod’ [dad] > [daddo], *[daddu], *[dadda]

This suggests that the sound [u] is primed in participants’ minds when it is the root vowel, thus triggering the occurrence of exceptional [u]-epenthesis exemplified in (4). Interestingly, this takes place more frequently in the mixed condition, perhaps because the visual input — the grapheme for source [u] is <oo>, as in ‘doot’ — makes the source nucleus ([u], corresponding to Japanese [u]) more salient to borrowers. The fact that [tu] and [du] are being nativized now, as described below, is likely also responsible. These factors combine to inhibit expected [o]-epenthesis, especially in the mixed condition, resulting in default [u]-epenthesis.

The epenthesis of [u] after the sequence [w]+coronal is intriguing for another reason. It seems that this is also caused by a change in acceptability of these sound sequences by Japanese speakers. Before proceeding further with the discussion, it is necessary to make a distinction among Yamato vocabulary (the native lexicon), Sino-Japanese words (loanwords from Chinese), and the foreign lexicon (loanwords other than from Chinese). Yamato vocabulary is the most strictly constrained as to which sound sequences can occur. In the foreign lexicon, because the constraints are not as severe as in the other two strata, sound sequences which are impermissible in Yamato and Sino-Japanese can occur. Though the distinctions between these sublexica are not always straightforward (Ota 2004), the lexical stratification is psychologically very real for Japanese speakers. When a word contains sounds which are possible only in the foreign lexicon, Japanese speakers sense the “foreignness” of the words and appear able to discern their varying degrees of foreignness. Thirty years ago, using an aural perception study, Lovins (1975) identified a pronounceability or distinguishability hierarchy of foreign syllables in Japanese which relates directly to their degree of nativization.

(6) The Pronounceability Hierarchy of Foreign Syllables



Yamato and Sino-Japanese words are subject to mandatory palatalization, which alters /t+i/ into [tʃi] and /d+i/ and /z+i/ into [dʒi], thus making the sequences [ti] and [di] illegal in those strata. Reporting more than thirty years ago, Lovins (1975:144) observed that “/ti di/ [were] pronounced with ‘plain’ [non-palatalized] consonants in exceptional cases.” In other words, the foreign lexicon was also subject to palatalization in those days, so that [ti] and [di] occurred only exceptionally. This indicates that “suspension of an allophonic process” (Lovins

1975:148) was beginning to occur in the foreign lexicon. And now palatalization of [t] and [d] before the high front vowel is not nearly as productive as before, and generally does not apply in newly introduced loanwords. As a result, the sequences [ti] and [di] are now quite acceptable in the foreign lexicon. In fact, in the present experiment, English [ti], [ti], and [di] (there were no stimuli with [di]) are invariably adapted without palatalization. The same thing may be happening with [tu] and [du], which are just below [ti] and [di] in the pronounceability hierarchy, as these, too, are in the process of being accepted now by Japanese speakers, e.g. [ka:tu:n] < 'cartoon.'

6 Conclusion

Orthography plays a crucial role in loanword adaptations. The findings in this experiment are consistent with those of Vandelin and Peperkamp (2005). In most cases, orthography promotes adaptations based on between-language grapheme-to-phoneme correspondences, but in some cases, orthography interferes with the predicted adaptations of vowels.

The on-line adaptation experiment also reveals that the stratification of vocabulary into Yamato, Sino-Japanese and foreign words is psychologically real. The results indicate the nativization of foreign sound sequences is in progress presumably because of intensive borrowing from English. For instance, the constraint against */ti/ and */di/ has ceased to be a productive rule in the foreign lexicon. The constraint against */tu/ and */du/ is now weakening as well. These sequences are being nativized and they sound less foreign to Japanese ears. These changes in the status of formerly forbidden syllables can be revealed only through on-line adaptations of foreign words.

Overall, vowel selection in Japanese is based on phonetic approximation rather than preservation of the phonological categories of the source language. The explanation of loanword adaptations cannot be attributed to one factor. It can be better analyzed as the interplay of several factors, such as the prestige of the source languages and the number of bilinguals and their proficiency level (Vandelin and Peperkamp 2005). In the case of Japanese loanwords from English, phonetic approximation and knowledge of the source language are the major determinants of adaptation.

Appendix

Table 1: Stimuli

orthography	pronunciation	orthography	pronunciation
baug	[bɔ̃g]	pead	[pid]
paught	[pɔ̃t]	gick	[gɪk]
tob	[tab]	keak	[kik]
dod	[dad]	teap	[tip]
kog	[kag]	dobe	[dob]
togg	[tag]	boke	[bok]
tot	[tat]	pote	[pot]
gub	[gʌb]	bab	[bæb]
gud	[gʌd]	dabb	[dæb]
tudd	[tʌd]	gad	[gæd]
kug	[kʌg]	dag	[dæg]
kuck	[kʌk]	dap	[dæp]
ged	[gɛd]	toop	[tup]
kedd	[kɛd]	doot	[dut]
pague	[peg]	bood	[bud]
kep	[kɛp]	should	[ʃud]
kape	[kɛp]	stood	[stud]
tate	[tet]	nook	[nok]
dib	[dɪb]	pext	[pekst]
tibb	[tɪb]	bixt	[bɪkst]
		kaxt	[kækst]

(1) Carrier Sentences

_____ <i>o kocchi ni kudasai</i>	‘Please pass _____ to me.’
_____ <i>toiu hito ga kimashita yo</i>	‘Somebody whose name is _____ came.’
_____ <i>ga hoshiindesu.</i>	‘I want _____.’
_____ <i>wa doko desuka.</i>	‘Where is _____?’

Table 2: Adaptations of short vowels

source	graph-eme	condition	[a:]	[a]	[i:]	[i]	[ɛ:]	[ɛ]	[e]	[o:]	[o]	[au]	[ya]
ɔ	<au> <augh>	oral		12.5%						12.5%	75.0%		
		mix								66.7%	16.7%	16.7%	
ɑ	<o>	oral	11.8%	64.8%							23.5%		
		mix		44.4%						5.6%	50.0%		
ʌ	<u>	oral		82.4%				11.8%			5.9%		
		mix		66.7%			11.1%	22.2%					
ɛ	<e>	oral							88.2%				11.8%
		mix							100%				
ɪ	<i>	oral				70.6%			29.4%				
		mix			9.1%	90.9%							
æ / [k, g] _	<a>	oral							9.1%				90.9%
		mix											100%
æ	<a>	oral		78.6%					27.3%				
		mix		82.4%					5.9%				11.8%
ʊ	<oo>	oral						80.0%			20.0%		
		mix						66.7%			33.3%		

Table 3: Adaptations of long vowels

source	grapheme	condition	[i:]	[i]	[ɛ:]	[ɛ]	[e:]	[e]	[o:]	[o]	[ei]	[yɛ]	[ou]
e	<a>C<e>/<a> C<ue>	oral	18.2%	18.2%			36.4%	18.2%			9.1%		
		mix					50.0%	10.0%			40.0%		
i	<ea>	oral	60.0%	40.0%									
		mix	90.9%	9.1%									
o	<o>C<e>	oral							80.0%	20.0%			
		mix							72.7%				27.3%
u	<oo>	oral			45.5%	27.3%						27.3%	
		mix			70.0%	30.0%							

Table 4: [ɯ]-insertion

Mixed Condition (*Because the number of the samples is limited, I include the raw figures.*)

final consonant adaptation	preceded by [ɯ]		preceded by other than [ɯ]	
	[ɯ]-epenthesis	[o]-epenthesis	[ɯ]-epenthesis	[o]-epenthesis
t	2			9
t:	2			7
d	3			4
d:	4	1		2

Oral Condition

final consonant adaptation	preceded by [ɯ]		preceded by other than [ɯ]	
	[ɯ]-epenthesis	[o]-epenthesis	[ɯ]-epenthesis	[o]-epenthesis
t		1		7
t:	2	1		9
d	4	2	1	1
d:	6	4		20

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