Pronunciation of German Syllable Codas of Mandarin Chinese Speakers

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Abstract: This study investigated the production of German syllable codas by speakers of Mandarin Chinese, and found that the pronunciation of the second foreign language (L3) will not only be influenced by the native language (L1) but also by the first foreign language (L2). The structure of Chinese syllable is very simple, which ends either with a vowel or a nasal consonant /n/ or /ng/. German, however, can have consonant cluster codas up to 4 consonants. Different linguistic constraints will have effects on the German language pronunciation acquisition of Chinese students. In this study 6 Chinese students of three different levels and two native German speakers were asked to read 102 German words with different syllable codas, and 20 German words. The results revealed that Chinese speakers tended to modify the syllable codas by inserting epenthesis, deleting one or more consonants, or substituting features of the consonants. Some pronunciation deviations can be explained by the transfer from Chinese language, such as epenthesis after consonant codas and very strong aspiration of voiceless stops; others can be accounted by the transfer from English, such as substitution of clear /l/ with dark /l/ after a vowel. The results also show that the beginners employed more modifications than advanced speakers, which indicates that accuracy of foreign language pronunciation can be improved, it may take a long period of time. This investigation can thus supply implications for language teaching to facilitate the progress of improvement. On the other hand, the results can also provide more information for the development of a computer-aided pronunciation training system.

1 Introduction

The motivation of this study originated from the prosodic analysis [4] which was carried out to find measurable prosodic differences accounting for the perceptual results for a computer assisted pronunciation training system. In the prosodic comparison study of German produced by Russian and Chinese learners, it was found that Chinese students usually added additional schwa after consonant codas, which would have influence on the prosody by changing syllable numbers or syllable lengths. If foreign accent is considered to be the cause of incorrect production of vowels and consonants, and unusual realization of intonation, an epenthesis will have effect on both phonetic and prosodic aspects. The investigation of consonant syllable coda is thus nontrivial.

A number of researches have revealed the special mistakes of Mandarin speakers in English pronunciation acquisition, including English consonants acquisition [3], however few investigations [1] have been conducted on Chinese students in German language pronunciation acquisition. Moreover many attentions have been paid to L1 transfer on L2 language, too little is

known on the transfer of the first foreign language (L2) on the second foreign language (L3) acquisition. This paper aims to investigate effects of L1 and L2 on L3 by studying typical mistakes on syllable codas produced by Chinese students in learning German.

Prior researches on the second languages learning have found that most if not all individuals who learn a second language (L2) after the age of 15 years will speak it with a detectable foreign accent [2]. Chinese students usually begin to learn English as the first language before they are 10 year old, and most learners start to learn German as the second foreign language after they are 18 years old. Their capacity to learn the sound of German is actually reduced after the critical period, their perception and production of the new language can be influenced by both L1 and L2, especially when L3 is similar to L2. Being adolescents, however, the students' perception and production can still be greatly improved with visual and audio aids.

2 Methods

This study aims to address the following questions:

1. Does a preference for a CV syllable structure have any effect on German word-final coda acquisition?

2. Which modification strategies do Chinese learners employ in production of syllable codas?

3. Is there any relationship between length of codas and accuracy in pronunciation?

4. Can different categories of consonants demonstrate different degrade and different types of modification?

5. Does the phonological environment (e.g. next phoneme) have any influence on the coda modification?

6. Is there any difference of coda modification between learners at beginning, intermediate and advanced level?

2.1 Data Description

102 words and 20 sentences were selected as reading material.

1. Word selection was based on Celex German lexicon, which includes more than 80,000 entries. All kinds of consonant syllable codas at word final position were selected, and some consonant clusters which appear in non-word-final position are also included.

2. 20 Sentences were selected from corpus of Phondat-Project. Sentences should include more consonant syllable codas, and they should also be easy to read.

Based on Celex German lexicon, syllable codas can be found to range from 1 consonant to 4 consonants. Consonant syllable codas with one and two consonants are listed in Table 1 and Table 2 respectively. Their occurrences are more frequent than consonant clusters of three and four consonants.

There are many 3 consonant cluster codas, such as: *tst, tSt, pft, pst, pts, kts, kst, Cst, Cts, fst, fts, xst, xts, lkt, lft, sts, Sst, lks, lms, lmt, lps, lpt, lts, lfs, lCt, lst, lSt, lnt, lns, mts, mst, mpt, mps, mpf, mSs, nft, nkt, mfs, nts, nSt, nst, Nkt, Nks*, and four consonant cluster codas, such as: *mpfs, mpft, ntkt*. The carrier words of these codas will not be listed here, but they will also be included

Table 1 - Carrier words of one-consonant syllable coda

Syllable coda with 1 consonant						
plosives						
Symbol	**p**	**b**	**t**	**d**	**k**	**g**	
Word	Prinzip	Antrieb	Lehrzeit	Schwimmbad	Musik	Freitag	
Sampa	prIntsi:p	antri:p	le:6tsaIt	SvImba:t	mu:zi:k	fraIta:k	
fricatives						
Symbol	**f**	**v**	**s**	**z**	**S**	**C**	**x**
Word	Gasthof	kreativ	grundlos	Provinz	akustisch	zwanzig	einfach
Sampa	gastho:f	kre:ati:f	grUntlo:s	pro:vInts	akUstIS	tsvantsIC	aInfax
sonorants						
Symbol	**l**	**m**	**n**	**N**			
Word	Merkmal	einigem	einkaufen	Forderung			
Sampa	mE6kma:l	aInIg@m	aInkaUf@n	fO6d@rUN			

in the reading list. Isolated words are employed to investigate L1 and L2 transfer, relationship between length of codas and accuracy in pronunciation; while sentences are supplemented to study whether phonological environment (e.g. next phoneme) has any influence on the coda modification.

2.2 Participants

One male and one female speaker were selected from each of the three different levels, the students were classified to be of

1. beginning level, who have learned German for 18 weeks, with 5 hours every day, altogether 450 hours;

2. intermediate level, who have learned German for 36 weeks, with 5 hours every day, altogether 900 hours;

3. advanced level, who are master students of German major and have learned German for 5 years.

Production accuracy may vary among individuals who are in the same level of learning German, we thus selected the average speakers from these levels to avoid the best and the worst ones in pronunciation. The data are small but are representative.
In order to have a reference for labeling of the modification strategies, two native female speakers were also selected to read the same material. Their speech data would no be included in the statistics, but only served as a reference of normal standard pronunciation of native speakers.

2.3 Data collection and analysis

The recording was carried out in a quiet room with a sample rate of 16 kHz and 16 bit. The students should go through the reading list before recording to make sure that they knew the meaning of all words and sentences as well as their pronunciations. If they made some mistakes, prompting messages would be given for correction. Phonetic annotation were made with Praat. In order to annotate accurately, label would be made by observing the changes in waveform and spectrum as well as listening to the sounds. Labeling done by the annotators would be checked by an experienced expert once again.

Table 2 - Carrier words of two-consonant syllable coda

Syllable coda with 2 consonants							
consonant combinations with /l/ as the first consonant							
Symbol	**lp**	**ln**	**lf**	**lC**	**lS**	**ls**	**lm**	**lt**
Word	anderthalb	Floskeln	Golf	Vollmilch	fälschlich	Kessels	Film	anfällt
Sampa	and@6thalp	flOsk@ln	gOlf	fOlmIlC	fElSlIC	kEs@ls	fIlm	anfElt
consonant combinations with /m/ and /n/ as the first consonant							
Symbol	**mp**	**ms**	**mt**	**mf**	**mS**	**nf**	**nt**	
Word	Kohldampf	Universums	Landesamt	Triumph	Ramsch	fünf	Abstand	
Sampa	ko:ldampf	Uni:vE6zUms	land@samt	tri:Umf	ramS	fYnf	apStant	
consonant combinations with /n/ and /N/ as the first consonant							
Symbol	**nS**	**Nk**	**ns**	**nC**	**Ns**	**Nt**		
Word	Glückwunsch	Kühlschrank	Entleins	Mönch	Ausgangs	erbringt		
Sampa	glYkvUnS	ky:lSraNk	EntlaIns	m9nC	aUsgaNs	E6brINt		
consonant combinations with /f/, /s/, /S/, /x/ as the first consonant							
Symbol	**Ss**	**St**	**fs**	**ft**	**sk**	**st**	**xs**	**xt**
Word	Schreibtischs	enttäuscht	Bedarfs	ankauft	Kiosk	auslöst	Geruchs	aufsucht
Sampa	SraIptISs	EnttOYSt	b@da6fs	ankaUft	ki:o:sk	aUsl2:st	g@ru:xs	aUfzu:xt
consonant combinations with /t/, /k/, /p/ as the first consonant							
Symbol	**tS**	**ks**	**ts**	**kt**	**pf**	**ps**	**pt**	
Word	Schriftdeutsch	Nachwuchs	allseits	hochsteigt	Kochtopf	Nachschubs	Rezept	
Sampa	SrIftdOYtS	na:xvu:ks	alzaIts	ho:xStaIkt	kOxtOpf	na:xSu:ps	re:tsEpt	

2.4 Results

Results are presented with different realizations one consonant, two consonants and multi-consonants in Table 3, Table 4 and Table 5 respectively. The production of every consonant coda can fall into one of these four categories: correct, feature change, absence, and epenthesis.

Table 3 - Production results of one-consonant syllable codas

	In Words						In Sentences					
	Beginning		Intermediate		Advanced		Beginning		Intermediate		Advanced	
	Nr.	Per.	Nr.	Per.	Nr.	Per.	Nr.	Per.	Nr.	Per.	Nr.	Per.
Correct	71	**62.3%**	89	**78.1%**	98	**86.0%**	110	**84.6%**	122	**93.9%**	126	**97.0%**
Feature change	18	**15.8%**	19	**16.7%**	8	**7.0%**	2	**1.5%**	6	**4.6%**	2	**1.5%**
Absence	3	**2.6%**	3	**2.6%**	4	**3.5%**	4	**3.1%**	0	**0%**	0	**0%**
Epenthesis	22	**19.3%**	3	**2.6%**	4	**3.5%**	14	**10.8%**	2	**1.5%**	2	**1.5%**
Total Number	114	**100%**	114	**100%**	114	**100%**	130	**100%**	130	**100%**	130	**100%**

Now we can provide some tentative answers to the questions put at the beginning

1. It seems that beginners have some preference for a CV syllable structure on German word-final coda acquisition. But advanced learner are getting used to CVC pronunciation. The percentage of epenthesis of advanced speakers were not high, ranging from 0% to 11.9%.

2. Chinese students employ all kinds of modification strategies: epenthesis, feature change and absence with epenthesis as the major strategy.

3. There are certain relationship between coda length and accuracy of pronunciation, the longer the codas are, the more inaccurate are the pronunciation.

Table 4 - Production results of two-consonant syllable codas

	In Words						In Sentences					
	Beginning		Intermediate		Advanced		Beginning		Intermediate		Advanced	
	Nr.	Per.	Nr.	Per.	Nr.	Per.	Nr.	Per.	Nr.	Per.	Nr.	Per.
Correct	55	64.0%	69	80.2%	77	89.5%	23	54.8%	36	85.7%	36	85.7%
Feature change	7	8.1%	12	14.0%	6	7.0%	0	0%	0	0%	1	2.4%
Absence	3	3.5%	3	3.5%	3	3.5%	2	4.8%	0	0%	0	0%
Epenthesis	21	24.4%	2	2.3%	0	0%	17	40.4%	6	14.3%	5	11.9%
Total Number	86	100%	86	100%	86	100%	42	100%	42	100%	42	100%

Table 5 - Production results of multi-consonant syllable codas

	In Words						In Sentences					
	Beginning		Intermediate		Advanced		Beginning		Intermediate		Advanced	
	Nr.	Per.	Nr.	Per.	Nr.	Per.	Nr.	Per.	Nr.	Per.	Nr.	Per.
Correct	50	53.2%	57	60.6%	78	83.0%	3	37.5%	5	62.5%	7	87.5%
Feature change	3	3.2%	20	21.3%	4	4.3%	0	0%	0	0%	1	12.5%
Absence	4	4.3%	9	9.6%	11	11.7%	0	0%	0	0%	0	0%
Epenthesis	37	39.3%	8	8.5%	1	1.0%	5	62.5%	3	37.5%	0	0%
Total Number	94	100%	94	100%	94	100%	8	100%	8	100%	8	100%

4. Different categories of consonants demonstrate different degrade and different type of modification, clear /l/ is usually replaced by dark /L/ after vowels, which is classified as feature change. All kinds of consonants can be modified by epenthesis, but /t/ is by far the favorite phone for epenthesis.

5. The phonological environments have some influence on the coda modification, the epenthesis took place usually when a consonant is followed by a pause, or when the coda is accentuated. Occurrences of epenthesis in sentences are normally more than in words because of various prosodic environments.

6. There are different coda modification between the beginners, intermediate and advanced level of German learners. The number of modification is decreased from beginning level to advanced level; epenthesis is the favorite coda modification strategy for beginners, but not for the advanced learners.

Besides these four categories, there are some other observations. Instead of devoiced word-finals /p,t,k/, Chinese students produced these finals /p,t,k/ with the voiceless strong aspirated release, which is typical of Chinese voiceless stops. This pronunciation deviation was not counted as feature change, etc., but is generally demonstrated by beginners as well as advanced learners. Strong aspiration occurs frequently at word-final before a pause, less frequently at non-word-final positions.

A strong aspirated voiceless /t/ marked with ellipsis in word "Lehrzeit(apprenticeship)" by the male advanced speaker in Figure 1 can be compared with a devoiced /t/ with ellipsis by a German female speaker in Figure 2.
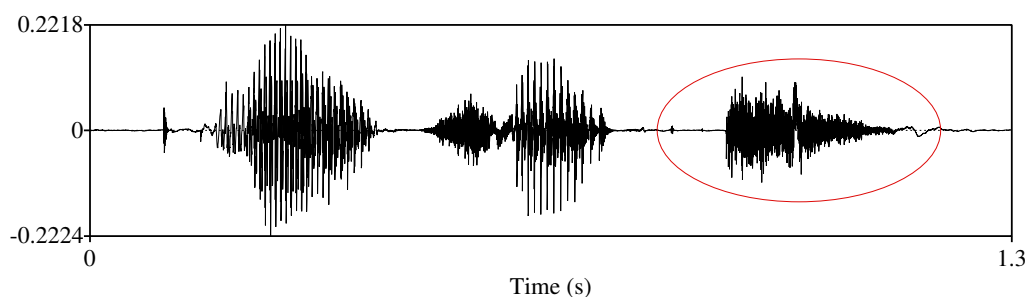
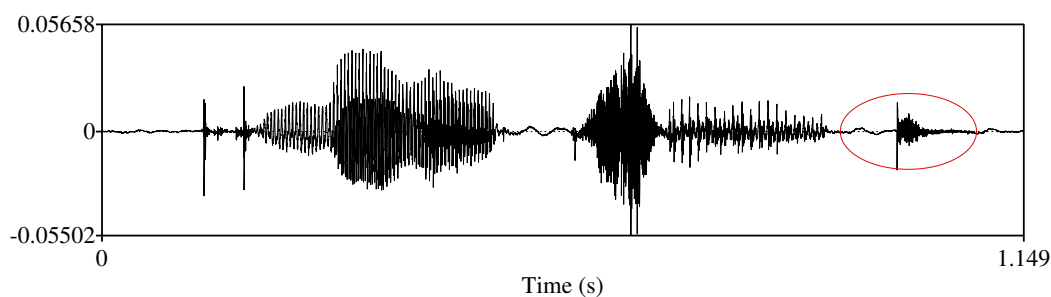**Figure 1** - Waveform of "Lehrzeit" from the Chinese male advanced speaker

Figure 2 - Waveform of "Lehrzeit" from a German female speaker

3   Discussion

Adults who learn a foreign language often have difficulty in producing sounds that are found in the foreign language but not in their native language. Prior research on the effect of linguistic constraints on the acquisition of English language has found that L1 transfer is a predominant factor in shaping English as a second language syllable-final coda production and acquisition, in terms of both error rate and errors made.

 If we analyze our results in detail, we will find that the most common pronunciation error for beginners is epenthesis. Intermediate and advanced speakers, however, do not employ epenthesis dominantly. Different individuals could have different difficulties, for example, the intermediate female speaker replaced all clear /l/ with dark /L/ after vowels, which is the case in English. Other speakers employed this feature change only occasionally. Similarly the intermediate male speaker often deleted certain coda stops at non-word final positions, which can also be found in English.

 If the differences between their deviated pronunciation and the pronunciation of native speakers are demonstrated with visual and audio aid, they would be aware of the mistakes, and they can learn the right pronunciation with some efforts. If epenthesis is due to the transfer of native Chinese language. Most cases of the feature change and absence can be attributed to the transfer of first foreign language - English.

 This study serves as a pilot study for syllable coda acquisition, larger scope investigation with more text corpus and more participants are still necessary. Moreover, a detailed analysis about the relationship of consonant cluster categories and modification strategy types can also be enlightening.

4 Conclusion

This study was focused on second foreign language learning of German by Chinese students, and demonstrated that the pronunciation accuracy was not only influenced by their native language (L1) - Chinese, but also their first foreign language (L2) - English. The results of the analysis would reveal the coda modification phenomenon, which is related to the foreign accent of Chinese learners of German. The results could provide implications for both language teaching and computer-aided pronunciation training systems.

5 Acknowledgements

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