AN ACOUSTIC AND PERCEPTIVE ANALYSIS OF POSTVOCALIC /l/ IN MANDARIN CHINESE LEARNERS OF GERMAN

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ABSTRACT

Mandarin Chinese does not allow consonant finals except /n/ and /ng/. This raises questions concerning how well Mandarin speakers learning German can produce a clear /l/ at syllable final positions. This study investigates 490 German speech tokens with embedded postvocalic /l/ produced by 12 Mandarin speakers from 3 different levels and 2 native German speakers. Acoustic analyses indicate that /l/ productions of Mandarin speakers are darker than those of native German speakers. No relationship could be found between darkness of /l/ and proficiency levels. The data reveal that preceding back vowels favor dark realization and vocalization of /l/. A perception test with 10 native German speakers of the produced tokens suggests that dark realization of /l/ contributes to foreign accent. The results help to shed some light on L1 and L2 contrast, and give some implications for L2 acquisition.

Keywords: foreign language acquisition, German, Chinese, dark /l/, clear /l/

1. INTRODUCTION

As a lingua franca, English is taught as the first foreign language in schools in China. Most Mandarin students begin to learn German as a second foreign language at universities.

Non-native language acquisition has been generally studied in terms of *foreign* or *second language acquisition* (SLA). Due to increasing multilingualism, cross-linguistic influence has been studied, and revealed that previously learnt foreign language can also have impact on the phonetic performance in a third language [6], especially at the initial stage. Thus we start with an analysis of the characteristics of the concerned languages.

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.

According to the phonetic implementation of /l/, languages can roughly be divided into three groups [4]:

1) Languages which exhibit a strongly dark variety of /l/ in all positions, i.e. American English, Russian, Polish, Bulgarian etc;
2) Languages in which larger acoustic differences occur as a function of syllable position, i.e. British English: clear [l] at word initial and dark [ɬ] at word final;
3) Languages in which a clear [l] is reported in all syllable positions, i.e. German, Spanish, French, etc.

For Chinese learners of German, they do not have /l/ at syllable final in their native language; they have already acquired dark realization of /l/ at word final in their first foreign language. Some students may have acquired British accent, others may demonstrate American accent. Both these English varieties exhibit dark realization of postvocalic /l/. We were interested to find out their performances of German postvocalic /l/.

2. METHOD

The study aims to address the following questions:

1) Does the acquired phonetic knowledge of dark realization of postvocalic /l/ in L2 have any phonetic transfer in learning L3 of German?
2) Are there any differences in /l/ realization among learners of beginning, intermediate and advanced level?
3) Is there any influence of the preceding vowel on the realization of the postvocalic /l/?
4) Does the acoustic deviation of /l/ realization of Chinese speakers bring any foreign accent into the pronunciation for native speakers?

2.1. Data description

29 words and 3 sentences containing different V-/l/ combinations were selected as reading material,

which should also facilitate the reading for beginners. As three words contain two postvocalic /l/s, we have got 35 tokens for each subject.

2.2. Participants

The investigation includes two parts: the production of Chinese students, and the perception of German native listeners.

In the production experiment, two male and two female speakers (age range 20-25) from:

- beginning level, who have learned German for 450 hours (18 weeks x 25 hours per week)
- intermediate level, who have learned German for 900 hours (36 weeks x 25 hours per week)
- advanced level, who are students in German major and have learned German for 5 years.

In order to obtain reference data, two female native German speakers also participated in the production experiment. Finally we have investigated 490 (14 speakers x 35 tokens) tokens.

In the perception test, 10 native German listeners were asked to assess the accent levels of 81 tokens which were taken from the production.

2.3. Data collection and analysis

The recording was carried out in a quiet room with 16 kHz and 16 bit. The students should go through the reading list before recording to make sure that they had no problem with the pronunciations.

The recordings were hand-labeled. Phonetic annotation and formant measurement were conducted in Praat. F1 and F2 values were taken at the midpoint of all /l/ and vowel sounds where the formant values are relatively stable.

3. RESULTS

Recent phonetic researches [4, 5] suggest that darkness ought to be considered as a gradual phonetic property, rather than a categorical attribute. It is commonly accepted [4] that an increase in degree of velarization causes an F1 increase and F2 decrease, thus F2-F1 value is inversely related to the degree of velarization.

In this investigation we take F2-F1 as an acoustic correlate of clearness/darkness and report the production and perception results.

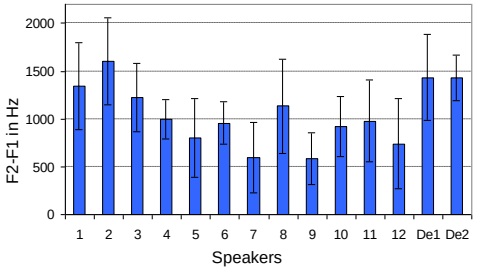
3.1. Acoustic analysis

It is reported [1] that the strategies of Chinese students to deal with German consonant codas can be divided into three categories: epenthesis, substitution and deletion. An analysis of the data we collected confirmed the findings. In the following analysis we just classify them into realization and deletion. In the realization a light [l] could be substituted by a dark [ɫ], an additional schwa is also possible. The acoustic measurements were carried out in the realizations of /l/.

3.1.1. Average values of F2-F1

F2-F1 frequency values of all realized /l/ tokens were averaged for each speaker. The average values with standard deviations are presented in Figure 1:

Figure 1: The average F2-F1 values with standard deviations of Chinese speakers (Nr. 1 to 12), De1 and De2 are Germany speakers.



Except for speaker 2, all other Chinese speakers have darker realization than both German speakers. Sproat & Fujimura [5] report that F2–F1 measures at the midpoint of /l/ with a range from 904.23 Hz to 1315.71 Hz for 'light' productions and a range of 515.34 Hz to 908.96 Hz for 'dark' productions in high front vowel contexts. It seems that our values are comparatively higher than theirs, which can result from different linguistic contexts, and different speakers. However, we can still take this measurement as a rough reference in our analysis.

F2-F1 averages of the two German speakers are 993Hz and 1061Hz, which fall into the 'light' category. And four Chinese speakers have mean value between 585-799Hz which belongs to 'dark' category. The other eight Chinese speakers with F2-F1 averages between 920-1606Hz could be classified to 'light' area; some are slightly over the range, but they also belong to 'light' realization.

3.1.2. Percentage of light /l/s

If the minimum threshold of light production is set at 908.96Hz [5], two German speakers have all light productions of postvocalic /l/ with the lowest value of 993Hz and 1016Hz respectively. All the Chinese speakers, however, have more or less dark productions of postvocalic /l/ in German; the

percentage of clear [l] among all 35 tokens of each speaker is illustrated in Figure 2.

Figure 2: The percentage of F2-F1 values of postvocalic /l/ above minimum 'light' production threshold of Chinese speakers.

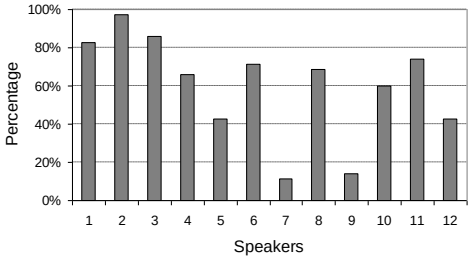


Figure 2 actually resembles Figure 1 that it can partially illustrate the accuracy of light [l] production in German.

3.1.3. Language levels and production of dark /l/

If we compare the German proficiency level with the percentage of dark [ɬ] production, there seems to be no correlation between them. These speakers were selected from different levels:

- Elementary: 3(w), 6(m), 10 (w), 12(m)
- Intermediate: 1(w), 5(m), 7(w), 8(m)
- Advanced: 2(w), 4(w), 9(m), 11(m)

(Number 1-12 are identifications of speakers; 'm' means 'male'; 'f' means 'female')

Among these four darkest producers (7, 9, 5, 12) two speakers (5, 7) are of intermediate level, one (12) of elementary and one (9) of advanced level. Three speakers (5, 9, 12) are male; and one speaker (7) is female.

3.1.4. Effect of preceding vowel on /l/

Previous study [5] has shown that a preceding long vowel is likely to be followed by higher levels of velarization than a preceding short vowel. The problem is that the vowel productions of Chinese students were not accurate enough to be classified into long or short groups. We thus compared all the duration values of the preceding vowel and F2-F1 values of /l/ of each speaker, the correlation coefficients of all speakers are below 0.35, including both German speakers. The vowel length effect can hardly be observed in our data.

A detailed investigation into the data revealed that the preceding vowels before dark productions [ɬ] are usually back and mid vowels. Therefore we calculated the correlation coefficient of F2 value of the preceding vowels and the F2-F1 of /l/s of each speaker, the results can be observed in Table 1.

Table 1: Correlation between F2 values of the preceding vowel and F2-F1 values of /l/.

Speaker Identification	Correlation Coefficient	Significance Level
1	**0.715**	**0.01**
2	**0.586**	**0.01**
3	**0.808**	**0.01**
4	**0.587**	**0.01**
5	**0.804**	**0.01**
6	0.380	0.05
7	0.340	0.05
8	**0.849**	**0.01**
9	0.202	-
10	**0.816**	**0.01**
11	**0.723**	**0.01**
12	0.460	0.05
De1	**0.491**	**0.01**
De2	**0.577**	**0.01**

F2-F1 measurements of /l/ have a high correlation with F2 values of the preceding vowels at 0.01 significance levels for 9 Chinese speakers and 2 German speakers. This implies a back vowel will be probably followed by a dark [ɬ], a front vowel by a light [l]. The speakers who have lower correlation coefficients are 6, 7, 9 and 12, among them 3 speakers (7, 9, 12) have darkest realizations of /l/. It seems that they were inclined to produce a dark /l/ at word final even after a front vowel.

Dark /l/s sometimes resemble [w] or [ɤ], which is also called vocalized /l/. It been also observed in [2] that back vowels favor vocalization, and font vowels disfavor vocalization of /l/. Our results coincide with this report. For example, after high front [I] in German word *Milch* (*milk*), most speakers keep to have high F2 and low F1 to produce a clear [l] as shown in Figure 3a. Speaker 7 however, gives more efforts to lower F2 to produce a dark [ɬ] as shown in Figure 3b.

Figure 3: Waveforms and spectrograms of two words.

Figure 3a: "*Milch*" with light [l] produced by Speaker 8.

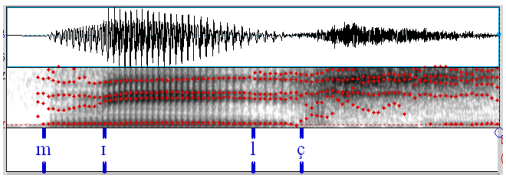
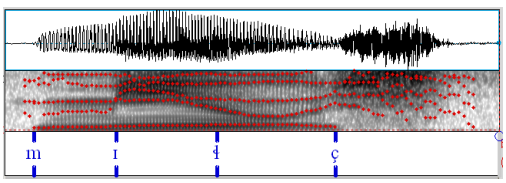


Figure 3b: "*Milch*" with dark [ɬ] produced by Speaker 7.



After back vowel [ɔ] in German word *Golf (Golf)*, most Chinese speakers continue to keep F2 low to produce a dark [ɬ] as shown in Figure 3c. The native German speaker, however, raises F2 to realize a light [l] shown in Figure 3d.

Figure 3c: "*Golf*" with dark [ɬ] produced by Speaker 5.

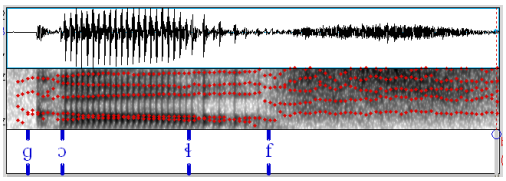
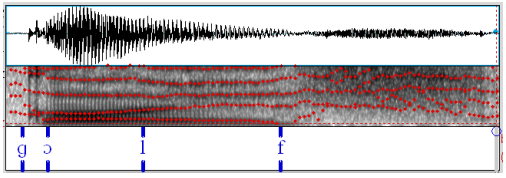


Figure 3d: "*Golf*" with light [l] produced by native speaker.



3.2. Perception test

10 native speakers were asked to carry out a perception test. It contained 81 tokens produced by 12 Chinese and 15 tokens by German speakers. All the tokens were randomly arranged, the listeners were asked to give assessments in scale 1-5 from 'very good', 'good', 'fair', 'insufficient', to 'poor'.

We take scale 3 (fair) as reference. 81 tokens were thus divided into 3 groups, 12 deleted tokens received worst scales (mean 4.41), and 34 tokens (mean 3.65) had lower average F2-F1 values (86,03Hz) than those (1209.66Hz) of 35 tokens (mean 2.54), as shown in Table 2.

Table 2: Results of perception test.

Scale	Tokens	Mean (F2-F1)
Range: 1.70-3.00 Mean 2.54	35	1209.66 Hz
Range: 3.10-4.60 Mean: 3.65	34	863,03Hz
Range: 4.10-4.80 Mean: 4.41	12	Deletion

The results suggest that tokens with better scales are mostly lighter /l/s and those with worse scales are mostly darker /l/s. With a detailed study into the data we found there are some darker tokens with scale over 3, they are usually preceded by dark vowels; those lighter tokens with scales below 3 are usually preceded by front vowels. This indicates that listeners were tolerant to darker /l/s which are preceded by back vowels than preceded by front vowels.

4. DISCUSSION AND CONCLUSION

We can now supply some explanations to the questions put forth at the beginning:

1) Some students employ dark [l] realization in English at word final to produce German light [l]s.
2) The number of participants is not large enough to shed light on the overall performance between different language levels. But we can conclude some beginners can produce light [l]s, and some advanced learners still retain dark [ɬ]s. If beginners' errors are transferred from their L2, those of advanced learners usually from their native language. Chinese CV structure also favors vocalization at syllable finals.
3) Preceding back vowels favor dark [ɬ], front vowels favor light [l] in both production and perception. However long/short vowel effect can hardly be observed in our experiment, because our data were not minimal pair contrast.
4) Deletion of postvocalic /l/s degrades the pronunciation performance considerably, darker realization of light [l] in German can only bring slight foreign accent.

Future investigations can be carried out with larger data and more subjects.

5. ACKNOWLEDGEMENTS

The first author would like to thank the Fund of Tongji University for Promoting Academic Exchange with Germany.

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