# A Phonetic Investigation of Intonational Foreign Accent in Mandarin Chinese Learners of German

*Hongwei Ding*[1], *Oliver Jokisch*[2] *and Rüdiger Hoffmann*[2]

[1]School of Foreign Languages, Tongji University, China
[2]Institute of Acoustics and Speech Communication, TU Dresden, Germany
hongwei.ding@tongji.edu.cn, {oliver.jokisch;ruediger.hoffmann}@tu-dresden.de

## Abstract

This study investigates the possible errors related to intonational foreign accent of Mandarin Chinese learners of German. 12 Chinese learners of different levels were asked to read 16 German sentences with typical tonal contours twice: for the first time reading utterances together with the communication intentions were presented; for the second time, additional information of accented syllables was also provided. Two German native speakers also participated in the production experiment as references. Some of the sentences were then assessed by native German listeners. Acoustic measures were conducted to analyze the production of 416 short sentences and phrases. Results show that the foreign accent of Mandarin Chinese learners of German can be attributed to incorrect placement and different phonetic realization of tonal categories, higher beginning pitch levels, more frequent and much greater pitch changes, as well as improper inserted pauses and unaccented syllables. Findings can provide implications for cross language studies and foreign language education.

**Index Terms**: German intonation, Mandarin Chinese learners, intonational foreign accent

## 1. Introduction

It is well known that Mandarin Chinese is a tone language, the pitch movement on the syllable determines the meaning of words, while nucleus tones and pitch range are employed to convey linguistic purposes in intonation languages such as German or English. In learning German intonation Chinese speakers have to acquire an entirely new phonological system with new phonological rules as well as their phonetic realizations. With the previous experiences achieved in English and the deep-rooted phonological understanding of their native tone language, Chinese learners will naturally exhibit some special characteristics in German intonation.

## 2. Method

Since ToBI (Tone and Break Indices) intonational events are closely associated with specific discourse meanings, the Tone Sequence Model approach is preferred for the intonational analysis conducted in this study, and G-ToBI is employed for the intonational labeling. This study aims to address the following questions with read speech:

- Do Mandarin learners use different tonal categories to convey communication intentions?
- If the accented syllables are indicated, do Mandarin learners employ different acoustic strategies to realize the tonal categories?
- What are the main acoustic deviations of Mandarin learners from native German speakers?
- Are there any great differences among learners of beginning, intermediate and advanced levels?

### 2.1. Subjects

The investigation includes two parts: the production of Chinese students, and the perception of German native listeners. In the production experiment 12 Chinese students aged between 20-25 were involved, with 2 male and 2 female subjects from each of the following groups:

- 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, 1 female (aged 22) and 1 male (aged 20) native German speakers also participated in the production experiment. All of them were university students, the Chinese students speak German with typical Chinese accent, the two German speakers exhibit no regional accent.

### 2.2. Data Description

The reading text should include different tunes that represent the main communication intentions in German. Since learners of beginning level are involved, reading material must also be easy enough for them to produce. The example sentences and phrases of the commonly occurring nuclear contours from Baumann et al. [1] can satisfy these requirements, these 16 short utterances were thus selected as reading material.

Because the Chinese subjects were required to read the material twice (384 = 16 sentences x 2 times x 12 subjects), while the German participants only once (32 = 16 sentences x 2 speakers), finally we have achieved 416 (416=384+32) reading tokens. In the perception test, 5 native German listeners were asked to assess foreign accent levels of 65 tokens which were taken from the production.

### 2.3. Data Collection and Analysis

Recordings were made in a quiet room with 16 kHz and 16 bit. Each Chinese subject should read these sentences twice. For the first time the subjects were presented the list of sentences in the normal printing mode such as “Mein Zahn tut weh. (My tooth hurts.)”, and the subjects were made clear that they should read these sentences to convey the prescribed intentions indicated in

the reading sheet. For the second time, such sentences were presented to the subjects with more information about nuclear syllables, e.g. "Mein **ZAHN** tut WEH". The capitalized syllables in bold indicate nuclear syllables, the plain capitalized syllables are postnuclear stresses. The subjects were instructed to fulfil the accentuation requirements phonetically, so that they could express their communication intentions better. While the German participants were asked to read these sentences in normal written form without any indication of accented syllables but the communication intentions were made clear.

The analysis of the readings without indication of accented syllable is expected to examine whether the Chinese learners can choose appropriate tunes to convey their communication intentions; that with indication of accented syllable is intended to compare the differences of phonetic realization of tonal categories between German native speakers and Chinese learners.

## 3. Results

Results are presented in production and perception analysis, with the emphasis on acoustic measures in production.

### 3.1. Perception Experiment

To keep the perception test per listener within one hour, we selected the following five sentences (Sentence 1, 4, 6, 9, 12) for perceptual assessment, and the version with indication of accented syllable of Chinese speakers were used for perception:

- Mein Zahn tut weh. (statement)
  *(My tooth hurts.)*
- Das weiss ich schon! (self-evident assertion)
  *(I already know that!)*
- Tauschen Sie auch Briefmarken? (yes/no-question)
  (*Do you also exchange stamps?)*
- Beckenbauer? (answering phone)
- Guten Morgen! (ritual expression)
  *(Good morning!)*

With 13 (12 Chinese + 1 German) speakers and 5 utterances we had 65 sentences for perception, the listeners should listen to each utterance and give two scores, one for clearness of the intention, the other for degree of foreign accent. The communication intentions were presented to them and they were asked to score the clearness of these intentions as well as the general impression of these utterances regarding accent, including segmental pronunciation and suprasegmental intonation. The MOS scale 1-5 mean 'poor', 'insufficient', 'fair', 'good', to 'very good' respectively, which was first explained to the listeners. The listeners could also write down what struck him or her as strong foreign accent as comments.

The German speaker has achieved almost full scores in each measurement. The scores of Chinese students are presented according to proficiency levels in Figure 1.

The left and right parts are scores on communication intension and foreign accent respectively. Intentions of statements (1), neutral questions (6), and ritual expression (12) of all proficiency levels could be well understood. But those of self-evident assertion (4) and answering phone (9) were not so convincing. However all Chinese speakers were assessed to exhibit certain foreign accents, with MOS between 1-5. The best scale achieved is "Guten Morgen" (12), the worst is "Tauschen Sie auch Briefmarken?" (6). No significant intonation differences had been noticed by German listeners among different levels

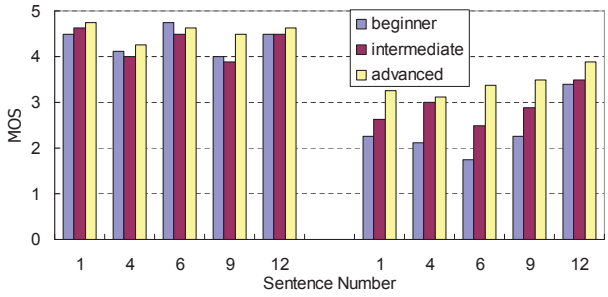


Figure 1: *MOS scores on clearness of communication intentions (left) and level of foreign accent (right) of Chinese learners*

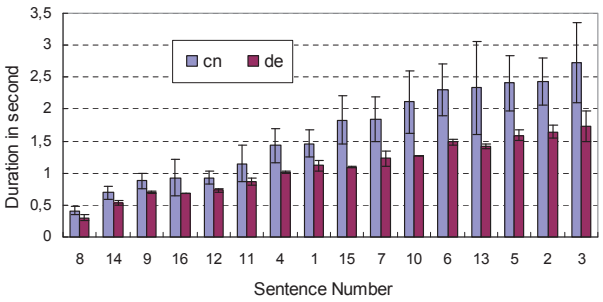


Figure 2: *Comparison of average duration values between German and Chinese speakers*

of speakers. The observed difference among them are segmental factors, advanced learners could pronounce certain sounds much better than beginners and intermediate learners [3].

### 3.2. Production Experiment

By comparing corresponding utterances between native and Chinese speakers of German, intonational deviations concerning duration, tonal category, pitch range are presented.

#### *3.2.1. Duration*

The average duration of the 12 sentences are compared between Chinese and native German speakers in Figure 2.

The longer the sentences the greater duration differences can be observed between Mandarin Chinese learners (cn) and German native speakers (de). A detailed analysis in spectrum reveals that German native speakers have reduced syllables and coarticualtion between neighboring phonemes, which can hardly be expected from Chinese learners. Advanced students have relatively shorter duration, however there are no significant differences among different levels of learners.

#### *3.2.2. Improper insertion of pause*

Chinese learners need more time to read the sentences, not only because of the apparent lack coarticulation patterns in German, but also because of inappropriate insertion of pause within Intonation Phrase (IP), even within words. There are 31 improper insertions of pause in 384 IPs (8.1%), pause values range from 86 ms to 1019 ms, which brings rhythmic disturbances.

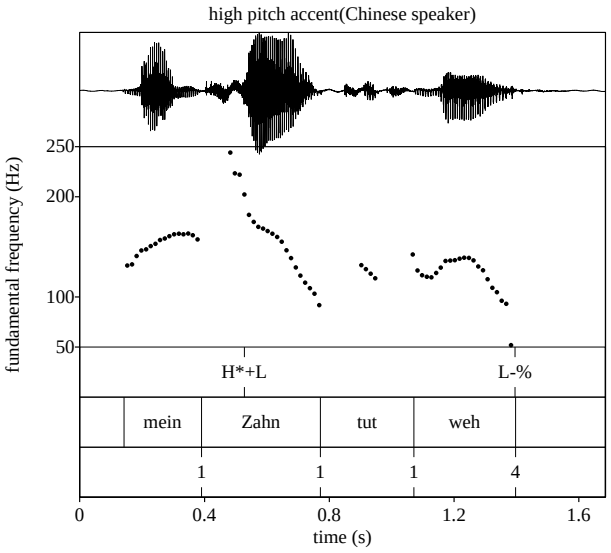


Figure 3: *A declarative sentence produced by a Chinese speaker*

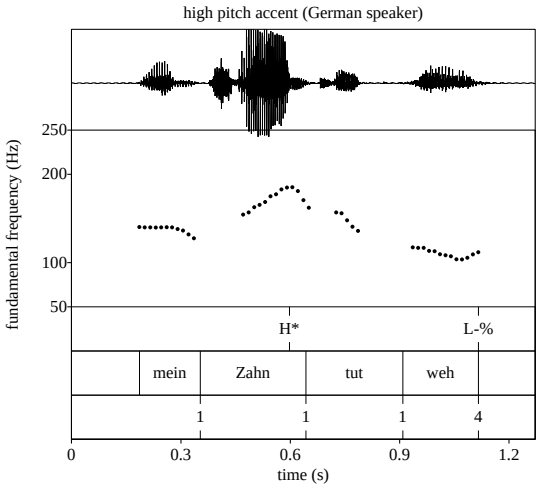


Figure 4: *A declarative sentence produced by a German speaker*

#### *3.2.3. Incorrect placement of tonal category*

Analysis of utterances without indication of accented syllables has revealed that among 192 utterances, 34.4% pitch accents are inappropriate, 22,4% boundary tones are incorrect. The typical Chinese nuclear accent for "Mein **ZAHN** tut WEH." is "Mein Zahn **TUT** WEH.". The most common boundary tone mistake is the frequent replacement of rising boundary H-ˆH% by falling boundary L-% at the end of an interrogative sentence.

#### *3.2.4. Different phonetic realization of tonal categories*

Analysis of utterances with accentuation indication has shown that Chinese learners tend to enlarge pitch ranges to realize the accented syllables, whereas German speakers only raise the pitch level. The following two figures can illustrate the contrast. In Figure 3 a Chinese male speaker used a high falling pitch accent to stress the syllable, while in Figure 4 the German male speaker used rising pitch accent to realize the accented syllable in a declarative sentence.

#### *3.2.5. Higher beginning pitch level of IP*

In German the contour often starts in the lower half of a speaker's pitch range, while in Mandarin Chinese the contour usually starts in the upper half of a speaker's pitch range. A Chinese male speaker began his first syllable almost on the topline in Figure 5, marked in an ellipse, while the German male speaker started his utterance almost on the baseline in Figure 6.

This phenomenon can be observed in almost every sentence of each speaker in the speech database, which also leads to Chinese-accented German speech.

#### *3.2.6. Frequent pitch changes*

Another character of Chinese-accented German speech can also be observed in Figure 5 and Figure 6 that Chinese speakers have much more pitch changes than German native speakers. F0 goes up and down for several times before it reaches the boundary for Chinese speakers, while German speakers begin low and remain low until the first high pitch accent comes.

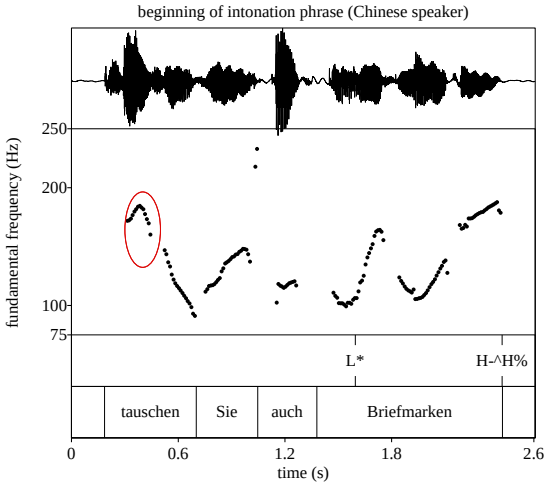


Figure 5: *An interrogative sentence produced by a Chinese speaker*

#### *3.2.7. Larger pitch range*

Chinese speakers typically use a wider pitch range, while German has an overall narrower pitch range [2]. Because the average pitch of Chinese speakers (female 274 Hz, male 179 Hz) are much higher than that of German speakers (female 227 Hz, male 123 Hz), f0 range in Hertz of Chinese learners are far more larger, the average f0 range in semitone are also larger, they are 12.4, 10.6, 8.3 and 7.1 for Chinese female (cn-f), Chinese male (cn-m), German male (de-m) and German female (de-f) respectively. The average pitch range measured for each sentence is demonstrated in Figure 7. The German male speaker displays relatively higher pitch range in some interrogative sentences because of the high rising end in contrast to his low voice.

## 4. Discussion

In order to include students of beginning level, only short sentences are employed. However they seem not long enough to investigate the effect of prosody. Longer sentences will be

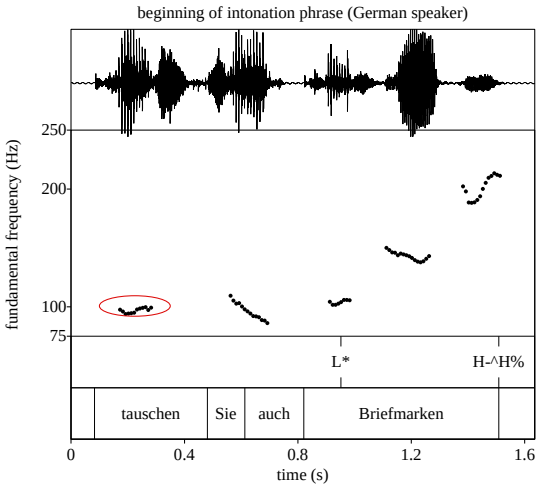


Figure 6: *An interrogative sentence produced by a German speaker*

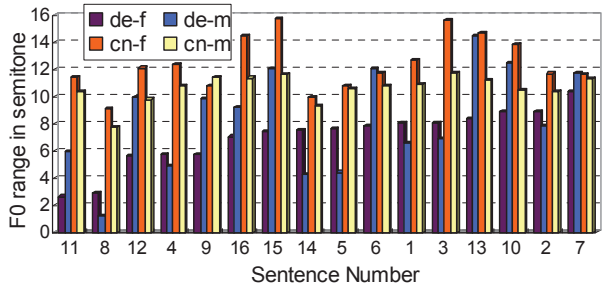


Figure 7: *Comparison of pitch ranges between German and Chinese speakers*

employed in future research. The communication intentions of "self-evident assertion" and "answering phone" were not so well perceived by German native listeners might due to the lack of identifiable lexical items.

As a preliminary investigation of possible prosodic errors in Chinese learners of German, we could still provide some differences between Chinese and German speakers.

Since the improvement of advanced learners against beginners are segmental pronunciations not intonational rhythm, which implies intonation education should be emphasized.

Because of less steep f0 contours of German speech, some intonational deviations of Chinese learners resemble those of American learners of German demonstrated in [6], including greater pitch range and higher beginning pitch level. However many deviations are due to the characteristics of tone language. Among which two phenomena observed in the data are closely related to these deviations, though not explicitly illustrated:

- While Mandarin Chinese has a syllable-timed structure rather than the stress-timed German language, Mandarin speakers could hardly reduce unstressed syllables in speaking German.
- Because of Mandarin CV-structure, Chinese speakers usually add schwa to closed syllables, creating additional open syllables. This also affects the rhythmic aspects of speech in perception [5].

We have described some acoustic deviations in Chinese-accented German speech. However to determine the quantitative influence of each deviation on the perception of native German speakers with regard to foreign accent should be further carried out with synthesis and resynthesis by putting other affecting factors under control.

## 5. Conclusion

Based on the results we can provide some replies to the questions put forth at the beginning. For the first two questions the answers are yes, examples are:

1) Mandarin learners are reluctant to use the rising boundary tone to express yes/no questions, while Chinese question particles can take the role of pitch movement in this case. The analyzed F0 contour is valid for a) polite yes/no questions; b) typical for read speech, esp. single sentences without context.

2) Mandarin learners tend to use falling pitch accent (H*+L) to stress syllables, which is not popular in German [1, 4].

3) The major deviations in the production of Mandarin speakers demonstrated in this study are summarized:

- Inappropriate insertion of pauses and non-reduced syllables
- Incorrect placement of pitch accent and boundary tones
- Different phonetic strategies to realize accentuation
- More frequent pitch changes and enlarged pitch ranges
- Higher beginning pitch levels of intonation phrase

4) The intonational differences between different language levels are not perceptible.

Listeners' impressions of foreign accent are usually triggered by the accumulation of many small individual deviations. Further investigation will be conducted to ascertain quantitative effect of each deviation on Chinese-accented German.

## 6. Acknowledgements

The first author is sponsored by Shanghai Pujiang Program (11PJC099), Shanghai Social Science project (2011BYY002) and key project (2010JDXM024) from Jiangsu Higher Institutions' Key Research Base for Philosophy and Social Sciences for this research work.

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