

Taiwan L2 German Database Design for Computer Assisted Language Learning

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Abstract

This paper reports on the progress of our joint Germany-Taiwan computer assisted language learning (CALL) project. In this year, our major goal is to collect a German speech corpus of L2 learners in Taiwan. A set of prompt sheets is thus designed to embed potential pronunciation and prosody errors in both segmental and supra-segmental level. The resulting database collection will be completed in two years.

1. Introduction

In this paper, we report on the progress of a joint Germany-Taiwan computer assisted language learning (CALL) project for L2 learners of German and Mandarin in Germany and Taiwan. This project is currently supported by respective local project funding [1], [2], and under the DAAD/NSC memorandum of understanding supporting travel activities between the two research teams [3].

Figure 1 shows a schematic diagram of the development of our CALL system. Basically, it relies on a set of *a priori* knowledge to detect possible pronunciation and prosody errors. It then learns a mapping model between the statistics of detected errors and the ground truth proficiency level given by native speakers/experts.

In the first year of this project, contrastive analysis between German and Mandarin was performed and a set of pronunciation and prosody error hypotheses generated [4], i.e., the two databases (Pronunciation and Prosody Error Hypotheses) in the bottom of Fig. 1. In the current year we focus on prompt sheet design and annotation guidelines for database collection, i.e., the other two necessary inputs on the left hand and top of Fig. 1.

We are interested in examining the proficiency level of L2 learners of German in Taiwan, especially for the beginners. The principle underlying the prompt sheet design is to embed potential error patterns not only on the segmental but also the supra-segmental level including words, sentences, short paragraphs and discourses. The content of the

prompt sheet can be divided into 5 sessions including (1) pronunciation, lexical and compound stress, (2) utterance-level stress and focus, (3) intonation and phrasing, (4) alphabet and number strings and (5) discourse.

The annotation guideline will ask recruited native speakers/experts to (1) rate the overall degree of proficiency (strength of accent and comprehensibility) using MOS-like scoring scale, (2) make binary correct/wrong decision for each phonetic unit and the corresponding error transcription (also for intelligibility) and (3) indicate the locations of prosodic breaks. The resulting database collection will be completed in two years.

This paper is organized as follows. Section 2 presents our methodology. Section 3 discusses the annotation guideline. Some conclusions are drawn in the last section.

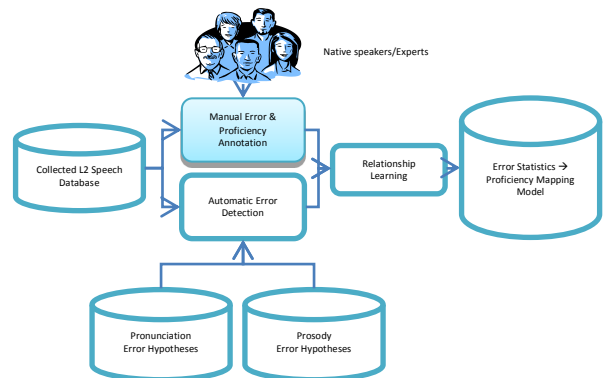


Figure 1: A schematic diagram of the development of the proposed CALL system.

2. Methodology

In Taiwan, Mandarin Chinese is the official language. However, the mother tongue of most people, especially those who live in central and south Taiwan, is Taiwanese (Southern Min languages, or Min-Nan). The first foreign language of most people is usually English. German often comes at best third. Therefore, language transfer may occur between Mandarin, Taiwanese, English and German.

After a detailed contrastive analysis on language transfer issues [4], we now want to design a set of German prompt sheets to elicit segmental and prosodic according to our error hypotheses in order to understand the behavior of Taiwanese learners of German, especially of the beginners.

The prompt sheet thus embeds potentially difficult phonemes, stress/timing and prosodic patterns for Taiwanese learners of German in commonly used words, sentences, short paragraphs and entire discourses. The context of prompt sheets is divided into five sessions, including (1) pronunciation, lexical and compound stress, (2) utterance-level stress and focus, (3) intonation and phrasing, (4) alphabet and number strings and (5) discourse. Details and illustrating examples are provided in the following subsections.

It is worth noting that we also attempted to cover all German vowels and consonants. An example of a prompt sheet is given in Appendix. Besides, a computer program will be developed for data collection.

2.1. Pronunciation, Lexical and Compound Stress

This session has three categories containing (1) lexical words with difficult phonemes, (2) compound words and (3) loan words. The main point of this session is to examine the production of some difficult phonemes and lexical stress including (1) stress assignment (application of stress rules), (2) vowel length in stressed syllables (long vs. short), and (3) contrast between stressed and unstressed syllables.

2.1.1. Lexical words with difficult phonemes

According to our pronunciation error hypotheses list, a set of words with difficult German phonemes is chosen. Some examples of those words and their corresponding error patterns are shown in Table 1.

2.1.2. Compound words

Due to the properties of German orthography, there are many compound words including high frequency compound nouns and less common compound verbs and adjectives [5].

There are three mechanisms to create German compound words, namely inflections, derivations, and compounding. Usually, inflections and derivations are formed with a limited number of short prefixes and suffixes [6]. Some examples of German prefixes and suffixes are listed in Table 2 and 3, respectively.

For compound suffixes, the stress assignment rule is simply on the first syllable. However, it is not an easy task for beginners to tell between German

separable prefixes (stress on prefix) and inseparable ones (stress on root). Therefore, some compound and polysyllabic words are chosen to test stress assignment and the production of stressed and unstressed vowels/syllables. Some examples are also shown in Table 2 and 3, respectively.

Table 1: Confusion table of difficult German phonemes for Taiwan L2 learners.

Alphabet	IPA	Form	Examples in Prompt Sheet	Error Hypotheses
e	[e:] [ɛ] [ə]	e, ee, eh e e	<i>Weg</i> [ve:g] <i>sechs</i> [zɛks] <i>lange</i> [ˈlaŋə]	[ɛ:] [ɛɪ] [a] [ɪ] [ər]
ö	[ø:] [œ]	ö, öh, oe ö	<i>Öl</i> [ˈø:l], <i>öffnen</i> [ˈœfnən]	[œ:] [œɪ] [y:] [ø:] [y]
o	[o:] [ɔ]	o, oo, oh o	<i>rot</i> [ro:t] <i>Woche</i> [ˈvʊxə]	[ɔ:] [ɔu] [ɔ:]
ch	[x] [ç]	ch	<i>Buch</i> [ˈbʊx] <i>Chinese</i> [ˈçiˈneːzə]	[ç] [ç] [çə] [ʃ] [tʃ]
g	[k] [ç] [ʒ]	g ig g	<i>weggehen</i> [ˈvɛkˈɡeːən] <i>selig</i> [ˈzɛliç] <i>Garage</i> [ɡaˈraːʒə]	[kə] [kʰə] [çə] [çə] [dʒ] [k]
h	[h]	h	<i>Himmel</i> [ˈhɪməl]	[x]
l	[l]	l, ll	<i>toll</i> [tɔl]	[ʔ] [lə]
m	[m]	m, mm	<i>Gymnasium</i> [ɡɪmˈnaziʊm]	[mə] [n]
n	[n]	n, nn	<i>Sinn</i> [zɪn]	
	[ŋ]	ng	<i>lang</i> [laŋ]	[ŋg] [ŋk]
	[ŋk]	nk	<i>Bank</i> [baŋk]	
r	[r]	r, rr, rh	<i>Rat</i> [ra:t]	[l]
	[ʁ]	r, er	<i>Leser</i> [ˈleːzɐ]	[ə] [ɛɪ]
	[pʁ] [f]	pf ph	<i>Pferd</i> [ˈpʁeːɐ̯], <i>Telephon</i> [ˈteˌlefoːn]	[pʁə] [pʁə]
	[ts]	ts, ds	<i>rechts</i> [rɛçts]	[s] [dz]
sch	[ʃ]	sch	<i>schön</i> [ʃøːn]	[s] [ʒ]

Table 2: Compound suffixes in German.

Type	Suffixes	Examples in Prompt Sheet	Stressed Syllable
None		<i>Risikokapital</i> (<i>Risiko</i> + <i>Kapital</i>)	on the first syllable
Additions	-s -n -en -nen -e -es -er -ien	<i>Arbeitsplatz</i> (<i>Arbeit</i> + <i>Platz</i>)	
Truncations	-e -en -n	<i>Südwesten</i> (<i>Süden</i> + <i>Westen</i>)	
Combinations	-us/-en -um/-en -um/-a -a/-en -on/-en -on/-a -e/-i	<i>Museenverwaltung</i> (<i>Museum</i> + <i>Verwaltung</i>)	
	umlaut+er	<i>Völkermord</i> (<i>Volk</i> + <i>Mord</i>)	

Table 3: Compound prefixes in German.

Type	Prefixes	Examples in Prompt Sheet	Stressed Syllable
Inseparable	be- emp- ent- er-ge- ver- voll- zer-	<i>erreichen</i> [ɛʁˈraɪçŋ]	on the second syllable
Separable	ab- abwärts- an-auf- aufwärts- aus- bei- da-daran- darauf- ein- empor- entgegen- gleich- her- hin- los- mit- nach- vor- weg- zu- zurück- zusammen-	<i>vorstellen</i> [ˈfɔ:vɛʃtɛlən] <i>einnehmen</i> [ainˈnɛ:mən] <i>weggehen</i> [vɛkˈgɛ:ən]	on the first syllable
Separable or Inseparable	durch- hinter- über- unter-	<i>überlegen</i> <i>umbauen</i>	accordingly

2.1.3. Loan words

In German, there are many loan words. In those words, stress usually falls on the penultimate syllable of the stem but the rule is not always consistent. To elicit stress errors made by L2 learners, loan words are put into the prompt sheets. Some examples are given below:

Charakter [kaˈrakter]
Chinese [çiˈne:zə]
Gymnasium [gɪmˈna:ziʊm]

2.2. Utterance-level Stress and Focus

2.2.1. Focus

In German, utterance-level stress (mainly narrow focus) is often utilized to highlight some important keywords of a sentence to emphasize certain information. Examples of narrow focus are given below:

*Das kannst nicht nur du, das kann doch **jeder**.*
*Er ist kein Chinese, sondern **Japaner**.*
*Ich komme nicht morgen, sondern **übermorgen**.*

However, Mandarin and Ming-Nan language may not follow that mechanism. To check if an L2 speaker could place a narrow focus in the appropriate location or not, several sets of confusable sentences are constructed. Each set is made up of two or three sentences with the same text but different meaning and therefore should have different narrow focus placement. An example is given below:

*Er hat **5 Jahre** länger Englisch gelernt als ich.*
*Er hat 5 Jahre länger **Englisch** gelernt als ich.*
*Er hat 5 Jahre länger Englisch gelernt als **ich**.*

2.2.2. Unstressed function words

Unlike Mandarin and Ming-Nan, German is a stress-timed language. In German, function words, such as pronouns, prepositions and auxiliary verbs are usually unstressed, since they carry minimal semantic information loading.

In this session, several sets of declarative sentences are designed to verify the proper reduction of function words. The lexical and compound words used in previous session are embedded into these sentences for recording, in order to better control the variations due to contextual factors. A typical example is as follows:

Function word: kann
Target words: Onkel, Chinesisch
Sein Onkel kann auf Chi nesisch reden.

2.3. Intonation and Phrasing

2.3.1. Intonation

In German, there are three major intonation templates: “falling left-to-right” ↘, “rising left-to-right” ↗, and “flat” →. Moreover, German intonation is typically marked around the last accented syllable of an utterance.

In this part, sentences were chosen from six different speech acts: (1) the final fall in declarative sentences, (2) the final rise of binary questions (yes-no-questions), (3) the final fall of complement questions - sentences begin with “wer”, “was”, “wie”, “wo”, “wann”, “wozu”, “weshalb”, “warum”, etc., (4) the continuation rise found in multiple-clause sentences, rhetorical questions, (5) imperative and (6) exclamatory sentences. A speaker will be asked to read those sentences aloud. For example:

Der Geschirrspüler hat 5 Programme. ↘
Kommst du mit? ↗
Warum ist es so heiß? ↘
Das Wohnzimmer, → das Esszimmer
→ und die Küche sind im Erdgeschoss. ↘

2.3.2. Phrasing

Proper prosodic boundary placement is also important to discriminate between syntactically ambiguous sentences (like the role of punctuation mark in text). The following two sentences are good examples (“//”: the proper prosodic phrase boundaries):

Er meint, // sie wird kommen.
Er, // meint sie, // wird kommen.

Our recording materials will contain several sets of syntactically ambiguous sentences to

investigate whether a L2 speaker could produce the prosodic cues correctly.

2.4. Alphabet and Number Strings

When L2 learners spell out names or other words in alphabetic letter strings or quote numbers, they usually have different intonation grouping behaviors compared with native speakers. To explore the prosodic behavior of L2 learners, a series of tasks will require them to spell their name, address, sponsoring institution and also telephone and credit card number strings. Example sentences are as follows:

Müllers Telefonnummer ist 2795-6831.

Meine Kreditkartennummer ist 5924-8013-6702-3516.

Ihre Handynummer ist 0938-476-219.

2.5. Discourse

The last session of the prompt sheet is a daily life conversation. The topics include: ordering dishes in a restaurant, self-introduction, shopping and asking for directions, etc.

In this task, L2 learners will be given a picture and asked to play a role in a scenario described by the picture. An example of the picture and a part of the corresponding prompt is given in the last session of Appendix.

The main purpose of this task is to study the prosody behaviors of L2 learners up to the discourse level. The content of the prompt will consider a greater range of utterance types, such as, wh-question, choice-question, judgment-question and echo-question; either/or imperative intonation.

3. Annotation Guideline

The collected Taiwanese L2 German speech data will be annotated by recruited native speakers/experts to provide ground truth for building our CALL system, especially for learning the mapping model in Fig. 1.

The annotation will have two tiers for Section 2.1~2.3 and three tiers for Section 2.4~2.5, respectively, including (1) overall degree of proficiency (foreign accent and comprehensibility) of an utterance/speaker and (2) binary correct or wrong decision for target error patterns mentioned in Section 2 and the corresponding error transcriptions and (3) locations of prosodic breaks.

For the top-level annotation, the annotator will rate all recordings on a MOS-like five-point scale [7] for (1) strength of foreign accent and (2) comprehensibility:

- Strength of foreign accent: 1= very strong accent, 2= strong accent, 3= moderate accent, 4= mild accent, 5= like native speaker.
- Comprehensibility: 1= cannot understand at all, 2= hard to understand, 3= moderate to understand, 4= easy to understand, 5= totally understandable.

It is worth noting that the binary correct or wrong decision could also be used to calculate the degree of intelligibility for each utterance/speaker.

For the prosodic breaks, we consider prosodic word, phrase and breathing group defined in [8]. The details and illustrating examples of our protocol for annotators are provided in the following subsections.

Finally, a computer program will also be developed to help annotators to easily input the scores, error transcriptions and break types and locations.

3.1. Pronunciation, Lexical and Compound Stress

For this session, annotators need to determine whether the pronunciation of each phoneme and stress assignment is correct (“✓”) or wrong (“✗”). If something is wrong, they need to transcribe what they have perceived. Annotation and transcription examples are as follows:

Käse [ˈkɛzə] → ✓ [ˈkɛzə]
 ✗ [ˈkɛzə] or N/A
erreichen [ɛʁˈraɪçŋ] → ✓ [ɛʁˈraɪçŋ]
 ✗ [ˈɛʁraɪçŋ] or N/A
Fahrrad [ˈfɑːrɑ:t] → ✓ [ˈfɑːrɑ:t]
 ✗ [ˈfɑːrɑ:t] or N/A
Qualität [kvaliˈtɛ:t] → ✓ [kvaliˈtɛ:t]
 ✗ [ˈkvalite:t] or N/A

3.2. Utterance-level Stress and Focus

3.2.1. Focus

The annotators should decide whether the focus assignment is correct or not and indicate its location if something is wrong. For example:

- ✓ Er ist kein Chinese, sondern **Japaner**.
- ✗ Er ist kein Chinese, sondern Japaner.
(no prominence)
- ✗ Er ist kein **Chinese**, sondern Japaner.
(wrong assignment)

3.2.2. Unstressed function words

Only a binary decision for each unstressed function word is needed here.

- ✓ *Sein Onkel kann auf Chiˈnesisch reden.*
- ✗ *Sein Onkel kann auf Chiˈnesisch reden.*

3.3. Intonation and Phrasing

3.3.1. Intonation

The annotators should tell between three typical intonations and make a binary decision, i.e., (a) fall-rise contour in yes-no-questions, complement questions, (b) rise-fall contour in declarative sentences, and (c) continuation rise contour in multiple-clause sentences, rhetorical questions, imperative and exclamatory sentences. For Example:

- ✓ *Der Geschirrspüler hat 5 Programme.* ↘
- ✗ *Der Geschirrspüler hat 5 Programme.* ↗
- ✓ *Kommst du mit?* ↗
- ✗ *Kommst du mit?* ↘
- ✓ *Warum ist es so heiß?* ↘
- ✗ *Warum ist es so heiß?* →
- ✓ *Das Wohnzimmer, → das Esszimmer → und die Küche sind im Erdgeschoss.* ↘
- ✗ *Das Wohnzimmer, → das Esszimmer → und die Küche sind im Erdgeschoss.* →

3.3.2. Phrasing

Beside the binary decision, the locations of prosodic phrase breaks have also to be transcribed for the wrong one.

- ✓ *Er meint, // sie wird kommen.*
- ✗ *Er meint sie, // wird kommen.*

3.4. Number Strings

Same as Section 3.3.2, the locations of prosodic phrase breaks have to be transcribed.

- Prompt:** *Müllers Telefonnummer ist 2795-6831.*
→ *Müllers Telefonnummer ist 27 // 95 // 68 // 31.*
→ *Müllers Telefonnummer ist 279 // 568 // 31.*

3.5. Discourse

In this session, each dialogue will be annotated with three extra break levels including (1) prosodic word, (3) phrase breaks and (3) breath group according to the definitions given in [8].

4. Conclusion and Discussion

This paper describes our Taiwanese L2 German speech database design for building a CALL system. So far, a set of 7 prompt sheets have been generated for Taiwanese L2 German speech corpus. A preliminary data collection has already been

performed (about 30 speakers) and data analysis is ongoing. Results of the test-trial will be used to revise our database design. We hope that the Taiwanese L2 German speech corpus will advance speech technology development for CALL systems.

5. References

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Appendix – Example Prompt Sheet for Database Collection

I. Pronunciation, Lexical and Compound Stress

- | | | |
|---------------------------|------------------------------|--------------------------------|
| (1) selig [ˈze:liç] | (8) Uhr [u:ʁ] | (15) erreichen [ɛʁˈraɪçŋ] |
| (2) öffnen [ˈɔfnən] | (9) euch [ɔyç] | (16) toll [tɔl] |
| (3) Stadt [ʃtat] | (10) Dieb [di:p] | (17) dumpf [dumpf] |
| (4) Rat [ra:t] | (11) Gymnasium [ɡɪmˈna:ziʊm] | (18) Qualität [kvaliˈtɛ:t] |
| (5) Leser [ˈle:zɐ] | (12) Käse [ˈkɛ:zə] | (19) Psychologie [psɪçɔloˈɡi:] |
| (6) Woche [ˈvɔxə] | (13) schön [ʃø:n] | (20) direkt [diˈrɛkt] |
| (7) Charakter [kaˈraktər] | (14) Chinese [çiˈne:zə] | |

II. Utterance-level Stress and Focus

(a) Focus

- (1) Er hat 5 Jahre länger Englisch gelernt als ich.
- (2) Er hat **5 Jahre** länger Englisch gelernt als ich.
- (3) Er hat 5 Jahre länger **Englisch** gelernt als ich.
- (4) Er hat 5 Jahre länger Englisch gelernt als **ich**.
- (5) Das kannst nicht nur du, das kann doch **jeder**.
- (6) Er ist kein Chinese, sondern **Japaner**.

(b) Unstressed function word

- (1) Die Quali **tät** ist gut.
- (2) Paris ist eine schöne **Stadt**.
- (3) Der **Dieb** wurde von der Polizei gefasst.
- (4) Angela **Merkel** wird nächste Woche kommen.
- (5) Sein **Onkel** kann auf Chi **nesisch** reden.
- (6) Herr **Meier** ist ein Mensch mit gutem Cha **rakter**.
- (7) Der Laden ist bis zehn Uhr geöffnet.
- (8) Herr und Frau **Bäcker** sind beide aufmerksame **Leser**.

III. Intonation and Phrasing

(a) Intonation

- (1) Der Geschirrspüler hat 5 Programme. ↘
- (2) Machen Sie sich keine Sorgen! ↘
- (3) Warum ist es so heiß? ↘
- (4) Ist es ein großes Haus oder ein kleines? ↘
- (5) Es ist durch und durch schlecht! ↘
- (6) Kommst du mit? ↗
- (7) Sie fahren mit dem Fahrrad? ↗
- (8) Herr Bauer, → sind Sie einverstanden? ↗
- (9) Das Wohnzimmer, → das Esszimmer → und die Küche sind im Erdgeschoss. ↘
- (10) Wenn du nicht hingehst, → gehe ich auch nicht hin. ↘

(b) Phrasing

- (1) Er meint, // sie wird kommen.
- (2) Er, // meint sie, // wird kommen.
- (3) Ja? Zur Not geht's? // Auch am Samstag?
- (4) Ja. Zur Not. // Geht's auch am Samstag?
- (5) Die Mutter befahl, // ihrer Tochter jeden Tag in der Küche etwas zu kochen.
- (6) Die Mutter befahl ihrer Tochter, // jeden Tag in der Küche etwas zu kochen.

IV. Alphabet and Number Strings

- (1) Müllers Telefonnummer ist 9791-5844.
- (2) Meine Kreditkartennummer ist 4475-2137-8875-1609.
- (3) Ihre Handynummer ist 0923-685-147.
- (4) Hans Telefonnummer ist 56-32-10-48.
- (5) Mein Familienname ist Müller. M-Ü -L-L-E-R.
- (6) Mein Name is Hans Müller, H-A-N-S M-Ü -L-L-E-R. Mein Telefonnummer ist 9702403.

V. Discourse



A: Wie heißen Sie, bitte?

B: Katrin Lehmann.

A: Wie ist Ihr Familienname?

B: Lehmann.

A: Noch einmal, bitte langsam!

B: Leh – mann.

A: Wie schreibt man das?

B: L – e – h – m – a – n – n.

Buchstabieren Sie, bitte!

A: Und Ihr Vorname?

B: Katrin. K – a – t – r – i – n.

A: Und wo wohnen Sie?

B: In Erfurt.

A: Ihre Adresse?

B: Ahornstraße 2, 99084
Erfurt.

A: Und wie ist Ihre Telefonnummer?

B: 3 – 8 – 9 – 4 – 5 – 2 – 7.

A: Danke schön!

B: Bitte schön!