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Stop Consonants in Chinese and Slovak: Contrastive Analysis by Using Praat

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***Abstract*—**The acquisition of the correct pronunciation in Chinese is closely linked to the initial phase of the study. Based on the contrastive analysis, we determine the differences in the pronunciation of stop consonants in Chinese and Slovak taking into consideration the place and manner of articulation to gain a better understanding of the students' main difficulties in the process of acquiring correct pronunciation of Chinese stop consonants. We employ the software Praat for the analysis of the recorded samples with an emphasis on the pronunciation of the students with a varying command of Chinese. The comparison of the voice onset time (VOT) length for the individual consonants in the students' pronunciation and the pronunciation of the native speaker exposes the differences between the correct pronunciation and the deviant pronunciation of the students.

***Keywords*—**Chinese, contrastive analysis, Praat, pronunciation, Slovak.

I. Introduction

THE understanding of the phonological system of the second language (L2) facilitates the acquisition of the correct pronunciation in L2. The study of the processes related to the acquisition of the pronunciation in L2 indicates that the description and explanation of the phonological system represent important knowledge for learners to be able to juxtapose it to the phonological system of their mother tongue (L1). Unlike the acquisition process of the pronunciation in the learner's L1, the acquisition of the correct pronunciation in L2 is influenced by various variables including the extent of the differences and similarities in the pronunciation between the learner's L1 and the studied language. The distinguishing features of the phonological systems in the learner's L1 and the target language often represent a difficulty leading to the learner`s erroneous pronunciation. The contrastive analysis is suitable for depicting these differences between Chinese representing L2 and Slovak as the learner's L1. We introduce the stop initials in Chinese and provide mean VOT values that are compared to VOT values of Slovak students. Because the consonants in Chinese only appear in the initial position, we refer to them as initials instead of consonants. We also introduce stop consonants in Slovak and provide mean VOT values for the consonants in the word-initial position.

II. Contrastive Analysis

The contrastive analysis represents the methodological framework for the comparison of the pronunciation of Chinese initials with the Slovak consonants in the word-initial position. The contrastive analysis serves for the comparison of two languages to determine the possible difficulties of the second language learners [1]. It is widely used for the comparative study of particular languages and their grammatical or phonological systems to facilitate the instruction of the second language [2]. The early usage of the expression contrastive in the field of linguistic research is related to the study of phonology and later evolved into the term used for comparative studies of two chosen languages for pedagogical purposes [3]. Based on the studies of second language acquisition, the contrastive analysis is suitable for comparing two languages on the phonological level because of its higher degree of predictability in comparison to the syntactic level [4], therefore the use of the term *contrastive phonology* is more appropriate for the purposes of defining phonological comparison. Contrastive phonology aims to determine the problematic aspects of pronunciation in second language acquisition. Apart from that, it represents a basis for the systematic error analysis and correction of learner's deviant pronunciation [5]. The contrastive phonology approach reveals the similarities and differences between the pronunciation of the stop initials in Chinese and Slovak stop consonants in the word-initial position. As a result, it is possible to evaluate the extent of the mother tongue's interference in the process of acquiring the correct pronunciation of the stop initials in Chinese.

III. Stop Initials in Chinese

We provide an overview of the Chinese stop initials according to the place and manner of articulation (Fig. 1). Stop initials in Chinese are composed of three pairs differing in the absence and presence of aspiration as their distinguishing feature, namely: unaspirated plosives *b, d, g* and their aspirated counterparts *p, t, k*. Based on the place of articulation, the three pairs of Chinese stop initials belong to labial, alveolar, and velar initials.

		labial	alveolar	velar
plosive	unaspirated	b [p]	d [t]	g [k]
plosive	aspirated	p [p`]	t [t`]	k [k`]

Fig. 1 Chinese stop initials in *Hanyu pinyin* and International Phonetic Alphabet (IPA) transcription in brackets [6]

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The articulation of Chinese plosives is characterized by the formation of a constriction in the oral cavity, the soft palate is lifted and the nasal cavity is closed. The explosion sound is generated after loosening the constriction in the oral cavity. Depending on the degree of tension, we distinguish fortis plosives (with strong tension) that are aspirated and lenis plosives (with weak tension) that are unaspirated. Both groups of Chinese stop initials are voiceless. In terms of the place of articulation, the articulation of labial initials *b* and *p* involves the lower as well as the upper lip, therefore we define these initials as bilabial. Articulation of the alveolar initials *d* and *t* involves the tip of the tongue touching the ridge behind the teeth. Velar initials *g* and *k* are articulated with the back part of the tongue against the posterior soft palate [6].

IV. Aspiration of Chinese Stop Initials

Taking into consideration Slovak as the native language of students of Chinese, from the point of the manner of articulation the main distinguishing feature is the aspiration present in Chinese and the absence of the voiced consonants in comparison to Slovak. Although aspiration is considered an unknown aspect for the Slovak learners, sufficient practice and exercises focused on the pronunciation of the unaspirated and aspirated initials facilitate the acquisition process as well as eliminates possible mispronunciation.

The presence or absence of aspiration is a determining factor that changes the meaning of individual morphemes in Chinese and the aspiration in Chinese is more evident when compared to other languages. Existing studies are primarily focused on the analysis of aspirated initials in Chinese and English [7]. There are limited studies devoted to the differences between Chinese and minor spoken languages such as Slovak. There is a relatively large number of examples denoting the change of the meaning of aspirated and unaspirated morphemes, for instance, the morpheme *du* [tu] 毒 as a noun meaning virus or poison and *tu* [t'u] 图 that is also a noun, but with the meaning of picture or scheme. Both morphemes are pronounced identically in the second tone, but the absence of aspiration in the second morpheme causes a significant shift in the intended meaning to be conveyed.

Based on the example describing the articulation of a voiceless aspirated initial in Chinese, the aspiration is described as follows: after releasing the stricture and before the vowel articulation starts, there is a short interval during which the air passes rather intensely through the vocal tract, the vocal cords are apart and they start vibrating when the voicing of the vowel begins [7].

V. Stop Consonants in Slovak

In comparison to the stop initials in Chinese, the aspiration is absent in Slovak and the distinguishing feature of the Slovak stop consonants is the counterpart of voiced and voiceless consonants composed of four pairs: voiceless plosives *p, t, ť, k* and their voiced counterparts *b, d, ď, g* (Fig. 2).

		labial	prealveolar	alveopalatal	velar
plosive	voiceless	p [p]	t [t]	ť [c]	k [k]
plosive	voiced	b [b]	d [d]	ď [ɟ]	g [g]

Fig. 2 Slovak stop consonants with IPA transcription in brackets

Based on the place of articulation, the bilabial consonants *p* and *b* are articulated by the bilabial closure without the tongue's participation and the soft palate closes the nasal cavity. The main difference is that *p* is a voiceless consonant, therefore it is produced without the vibration of the vocal cords whereas *b* as a voiced consonant is articulated with the vocal cords' vibration. Prealveolar consonants *t* and *d* are articulated by the tip of the tongue and the stop is formed with the tongue approaching the alveolar ridge. The lips do not participate in articulation. The stricture is formed by the tip of the tongue that is brought directly against lower teeth, and the air is pushed past the tongue. Alveopalatal consonants *ť* and *ď* are articulated with the blade of the tongue behind the alveolar ridge, and the body of the tongue raises toward the palate. The articulation is accompanied by the vocal cords' vibration, lips do not participate in the articulation. Velar consonants *k* and *g* are articulated by the full oral closure with the back part of the tongue against the soft palate and the tip of the tongue approaches the lower teeth ridge [8].

When comparing the distribution of stop consonants in Slovak and Chinese, there are four pairs in Slovak, whereas only three pairs in Chinese. However, there is a pair of alveopalatal consonants in Chinese *j* and *q*, but they differ from the point of the manner of articulation. These two initials belong to the group of affricates that are articulated as a combination of closure and friction – closure is formed in the oral cavity by lifting the soft palate and when the closure is released, instead of the sound effect of the explosion, there is friction [6]. Despite the evident difference in the transcription of these consonants in *Hanyu pinyin,* their articulation is often incorrectly replaced by the alveopalatal stop consonants *ť* or *ď* in Slovak due to their audial resemblance to these affricates in Chinese.

VI. Voice Onset Time

The studies devoted to VOT are related to research activities from the second half of the 20th century [9]. Based on the measured VOT values, it is possible to distinguish individual categories of consonants. VOT is defined as the timespan measured from the release of the stricture up to the moment of the vowel phonation when the vocal cords begin to vibrate. Depending on the consonant's category, the value of VOT also differs [10]. Voiced consonants have negative VOT values, unaspirated voiceless consonants have very low or zero value of VOT, and significantly positive values of VOT are characteristic for aspirated voiceless consonants [7]. According to the above-stated categorization of VOT values, negative VOT value is absent in Chinese and present in Slovak in the case of voiced consonants *b, d, ď, g*. On the other hand, significantly high values of VOT caused by the aspiration is absent in Slovak and they are observed in the case of Chinese

stop initials *p, t, k*. We use Praat as a tool for measuring the VOT values. Fig. 3 displays an oscillogram and spectrogram for Chinese unaspirated initial *g* in the user interface of the program Praat.

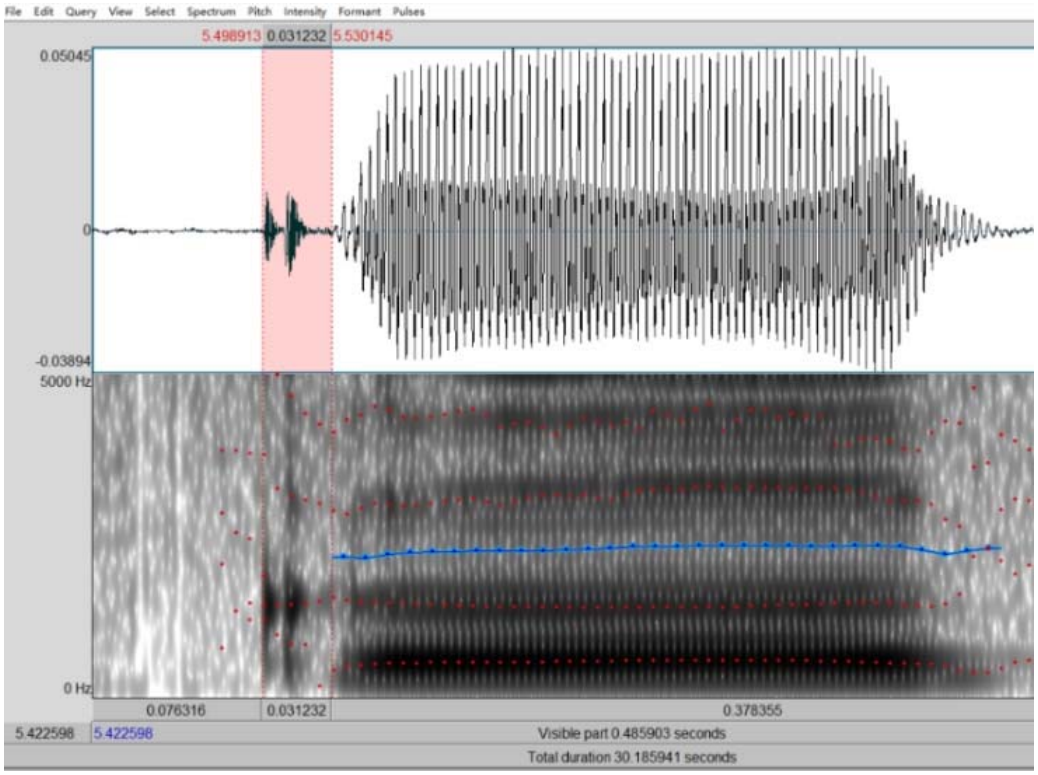


Fig. 3 Oscillogram and spectrogram of Chinese stop initial *g*

Based on the findings from measuring VOT values of the aspirated and unaspirated stop initials in Chinese, VOT values of aspirated stop initials are approximately 8 times longer than their unaspirated counterparts [11]. Table I displays mean VOT values of the aspirated and unaspirated stop initials in Chinese measured in milliseconds together with the range of standard deviation in the VOT length [12].

TABLE I
MEAN VOT VALUES OF CHINESE STOP INITIALS [12]

Initial	Mean Value (ms)	Standard deviation (ms)
b	13,9	6,6
d	15,3	5,7
g	27,4	9,6
p	77,8	23,7
t	75,5	18,4
k	85,7	19,4

Table II displays mean VOT values of Slovak stop consonants in word-initial position pronounced by male and female native speakers of Slovak [10]. When comparing the VOT values of unaspirated initials in Chinese – *b, d, g* and voiceless consonants in the word-initial position of Slovak – *p, t, k*, we observe similar VOT values in both languages, therefore after the successful acquisition of aspiration in Chinese, Slovak students can correctly pronounce these initials without significant problems. On the other hand, we expect the possible interference from the learner's mother tongue in case that Slovak students pronounce Chinese stop initials that are voiceless similarly to voiced consonants in Slovak. As a result, the positive VOT values characterizing Chinese voiceless initials are replaced by negative VOT values that are typical for voiced consonants in Slovak.

TABLE II
MEAN VOT VALUES OF SLOVAK STOP CONSONANTS IN INITIAL POSITION [10]

	Mean Value (ms), M	Mean Value (ms), F
b	-45,1	-64,9
d	-49,7	-54,9
d'	-47,4	-62,8
g	-74,5	-48,3
p	15,5	11,6
t	20,1	16,2
t'	41,8	42,9
k	33,9	29

We recorded four samples of female speakers and used Praat for measuring their VOT values. NS refers to a native speaker, student 1 is a beginner, student 2 is an intermediate learner and student 3 is an advanced learner of Chinese. Measured VOT values are displayed in milliseconds (Table III). Regarding the VOT values for individual initials, values for *b* and *d* correspond to the value of a native speaker and are within the standard deviation limit. Initial *g* in Chinese has a rather low VOT value and we observe two negative VOT values measured in the samples of students at the beginner and intermediate

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level. The negative VOT value is caused by the learners' mother tongue interference and it is comparable to the VOT value of voiced consonant *g* in Slovak (compare Table II). The low VOT value of the aspirated initial *p* present in the recording of the beginner student is caused by insufficient aspiration of the initial – its value is comparable to voiceless unaspirated consonants. VOT Values for *t* and *k* are within the standard deviation range (compare Table I).

TABLE III
EXPERIMENTAL MEASURE OF VOT VALUES

	NS	S1 (beg.)	S2 (int.)	S3 (adv.)
b	11	16	9	19
d	18	21	15	22
g	25	-37	-108	31
p	83	20	116	95
t	70	78	141	88
k	99	109	107	110

VII. TEACHING IMPLICATIONS

The process of acquiring correct pronunciation in Chinese is a long-term objective requiring precise teaching methods and unlike learning other foreign languages, such as English, the incorrect pronunciation in Chinese hinders the communication with the native speakers, especially when the native speakers are not used to strong foreign accents, therefore the proper guidance and methodology employed by the teachers play a crucial role in the acquisition of native-like pronunciation. The error fossilization is another reason for stressing the importance of the learner's correction from the novice level because the elimination of the deviant pronunciation in the later stages requires more effort [13]. Taking into consideration the available teaching materials, most of them are in the language combination Chinese – English or other languages based on the prevailing nationalities of the students studying Chinese, therefore the learners of minor spoken languages have to use another foreign language as intermediary language when learning Chinese.

VIII. CONCLUSION

Due to the limited availability of research devoted to the acquisition of the correct pronunciation in Chinese aimed at the Slovak learners, there is still a need to enrich the research finding in the field of Chinese language studies and explore the linguistic characteristics of Chinese and Slovak based on the contrastive phonology approach to determine the main difficulties of the Slovak learners. Consequently, these findings are applicable for the compilation of new teaching materials or can be further utilized for didactical purposes. We are convinced that the creation of teaching materials in the language combination Chinese – Slovak and continuous research in this field have the potential to enhance the acquisition process of Slovak learners studying Chinese.

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