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Application of Computer Software in Analyzing Sound Acquisition in Modern Standard Chinese

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Abstract

E-Prime is a suite of applications to fulfill researchers' computerized experiment needs. Praat is a free software program for the analysis of speech in phonetics with which phoneticians can analyze, synthesize, and manipulate speech. SPSS is a software program which can be used for doing statistical analysis of the collected data. These computer software programs are applied in the present study which aims to explore the consonant acquisition of Putonghua (Modern Standard Chinese) by native speakers of Uyghur. The difficulty hierarchy of the Chinese consonants for the Uyghur learners of Chinese is found out through the perception experiment. The results of the experiment support the Markedness Differential Hypothesis. In addition, it shows that the second language speech acquisition is influenced by both the first and also the target language phonological system.

Keywords: sound acquisition, modern standard Chinese, software program

1. Introduction

Cross-linguistic studies of language acquisition have made great progress in recent years [1, 2]. Jakobson [3] suggested that whether a sound would be acquired early could be explained by the distribution of the sound amongst the world's languages. According to his "laws of irreversible solidarity", nasals, front consonants and stops (found in virtually all the languages) would be acquired earlier than their oppositions, orals, back consonants and fricatives respectively. He proposed that there were certain sounds which were more basic and central to all human languages and these sounds would therefore be acquired earlier than other sounds.

In order to explain the effect of markedness on learners' native language transfer to target language, on the basis of the Markedness Theory [4, 5], Eckman [6] put forward the Markedness Differential Hypothesis (abbreviated as MDH). There are altogether three predictions in the hypothesis: 1) Those areas of the target language, which differ from the native language and are more marked than the native language, will be difficult. 2) The relative degree of difficulty of the areas of the target language, which are more marked than the native language, will correspond to the relative degree of markedness. 3) Those areas of the target language, which are different from the native language, but are not more marked than the native language, will not be difficult.

Language learner's sound acquisition is a highly complex process and influenced by a variety of sources. Further cross-linguistic research on learner's sound acquisition is needed, focusing on both the identification of universal tendencies and the influence of the ambient language. This study focuses on the sound acquisition of Putonghua (Modern Standard Chinese, or MSC) by native speakers of Uyghur.

In this research, the experiment is programmed in E-Prime, which is a suite of applications to fulfill researchers' computerized experiment needs. The software program Praat is also applied, which is an open-source program for speech analysis and speech synthesis, developed by Paul Boersma and David Weenink.

Chinese belongs to the Sino-Tibetan language family. Uyghur belongs to a member of the Turkic branch of the Altaic language family. Both Uyghur and Chinese are the official languages in Xinjiang, China. Uyghur is spoken by Uyghur people in Xinjiang, and Chinese is

their second language (L2). There are 22 consonant phonemes in Putonghua (Modern Standard Chinese). Except the voiced velar nasal / ŋ / which can only occur at the end of a syllable, all the other 21 consonant phonemes can appear at the beginning of a syllable; that is to say, there are 21 MSC onsets. Generally speaking, there are 24 consonant phonemes in Uyghur [7, 8].

The present research intends to address the following question: Which consonants in MSC are more difficult to learn for the Uyghur learners of Chinese?

2. Research Method
2.1. Consonant Phonemes in MSC and Uyghur

Consonant phonemes in MSC and Uyghur contrast with each other in the manner and place of articulation. The place and manner of articulation of MSC consonants and Uyghur consonants are shown in Table 1. Symbols representing the consonant phonemes in the table are both in IPA (The International Phonetic Alphabet) and in *pinyin* which is the official system to transcribe Chinese characters into Latin script.

Table 1. The Comparison of MSC and Uyghur Consonant Inventory

Manners			Places	Bilabial (upper lip / lower lip)	Labio-dental (upper teeth / lower lip)	Dental (front / tip teeth)	Alveolar (middle / tip alveoli)	Retroflex (back / tip pre-palate)	Laminal (blade upper teeth)	Palatal (front / blade pre-palatal)	Velar (back / root velum)	Uvular (blade / uvula)	Laryngeal (root larynx wall)
plosives	unaspirated	Voiceless	MSC	b/p/		d/t/					g/k/		
			Uyghur										
		Voiced	MSC										
			Uyghur	b/b/		d/d/					g/g/		
	aspirated	Voiceless	MSC	p/p^h/		t/t^h/					k/k^h/		
			Uyghur	p/p^h/		t/t^h/					k/k^h/	ʁ/q^h/	
affricates	unaspirated	Voiceless	MSC			z/ts/		zh/tʂ/		j/tɕ/			
		Voiced	Uyghur						j/dʒ/				
	aspirated	Voiceless	MSC			c/ts^h/		ch/tʂ^h/		q/tɕ^h/			
			Uyghur						q/tʃ^h/				
fricatives	Voiceless		MSC		f/f/	s/s/		sh/ʂ/		x/ɕ/	h/x/		
			Uyghur		f/f/	s/s/				x/ʃ/		h/χ/	h/h/
	Voiced		MSC					r/ʐ/					
			Uyghur	w/w/		z/z/			ʒ/ʒ/	y/j/		ɣl/ʁ/	
nasals	Voiced		MSC	m/m/			n/n/				ng/ŋ/		
			Uyghur	m/m/			n/n/				ng/ŋ/		
lateral	Voiced		MSC				l/l/						
			Uyghur				l/l/						
Trill	Voiced		MSC										
			Uyghur			r/r/							

(Note: The symbols inside the slashes are IPA (e.g. /p/) while the ones not in the slashes are *pinyin* (e.g. b))

2.2. Subjects

Thirty Uyghur university students (15 males, 15 females) were chosen according to the following criteria: (1) They were born in Kashgar, a city in the west of Xinjiang Uyghur Autonomous Region and their parents were both Uyghurs; (2) They all had learned Chinese for 12 years; (3) They had no reported history of speaking or hearing disability. Their age ranged from 20 to 22 years. These Uyghur students' Chinese proficiency was Level 6 according to the HSK Examination (the Chinese Proficiency Examination), so they could be considered as learners of Chinese at the intermediate level. Another thirty Han Chinese university students (15 males, 15 females) from Urumqi were chosen for the control group. They were at the same age as the Uyghur students with normal hearing, vision and reading capacity.

2.3. Stimuli

The stimuli appeared in two contexts: in isolation word and in the carrier sentence. In the carrier sentence "I say this word X", X referred to the 21 isolated words which were mono-syllable with the structure of CV. C meant the 21 onsets in MSC. V was the vowel / ā /.

These 21 isolated words, chosen from the Uyghur students' MSC course book *Basic Chinese*, are Chinese characters in common use. The stimuli were obtained by recording the pronunciation of a male speaker. The speaker, who was an announcer in Xinjiang People's Radio Station, read each isolated word and each carrier sentence five times with slow speed and fast speed. The materials were recorded in the recording studio of the radio station. The sound files were edited with Praat, the software for speech analysis. The stimulus sound files were randomized after the hinting sounds were added.

2.4. Procedure

After the speech samples were ready, the subjects/listeners were required to participate in the perception experiment [9, 10] individually in a quiet classroom. Each listener was seated with a set of headphones. When the listener heard a stimulus over the headphone, he/she should push one of the keys labeled with the Chinese characters that matched the sound. They had no opportunity to hear a stimulus again and were not allowed to re-correct their options. They were told not to worry if they realized that they had made a wrong selection or a mis-selection. Both accuracy and reaction time (RT) were recorded by the E-Prime program.

The 21 isolated words were divided into three groups. Each time one group of seven Chinese characters were displayed for the subjects. The requirement for the subjects was to judge which one was the very isolated word they heard in the isolated words and carrier sentences. The subjects were forced to choose one from seven items.

The 21 isolated words and their corresponding carrier sentences were repeated five times, and each stimulus was actually identified four times (perception on isolated word and carrier sentence in accurate and speed perception), so the total data for each MSC consonant were 1200 (5×4 stimuli × 60 subjects = 1200). In summary, the total data collected in the perception experiment amounted to 25,200 (1200 stimuli × 21 consonants =25,200).

Among the 25,200 data, the total missing number (the stimulus being not responded) was 1141, which was 4.5% of the total data. When the data were split into the Uyghur subjects' section (12,600) and the Han subjects' section (12,600), the missing data were 1069 and 72 respectively. The percentages of missing data for the Uyghur group and the Han group were 8.5% and 0.6% of the total data of its own group. In other words, there were 24,059 valid data altogether, i.e. the remaining data after the missing data were canceled, which occupied 95.5% of the total data. Among the total valid data, the Uyghur group or the experimental group had 11,531 valid data, and the valid data of the Han group amounted to 12,528. Then a series of descriptive analyses of the means of percentage of correct responses and reaction time for each group as well as analyses of variances (ANOVA) were conducted based on the collected data by using the statistical software SPSS17.0.

3. Results and Analysis
3.1. Overall perception of MSC consonants

First, an overall analysis on all subjects' perception of MSC consonants was done. The mean percentage of correct responses (PCR) was 92.04 and the mean reaction time (RT) was 2299.60 milliseconds (ms). The mean PCR for the Uyghur group and the Han group was 88.09 and 94.67 respectively, while the mean RT was 2347.85 ms and 2254.18 ms respectively. The results of the ONE-WAY ANOVA conducted on the perception by the Uyghur and the Han group showed that there was significant difference for the mean PCR [$F_{(1,24057)} = 480.367$, $p < 0.05$] and for the mean RT [$F_{(1,24057)} = 56.177$, $p < 0.05$] between the Uyghur group's and the Han group's perception of the MSC consonants. The Uyghur group's PCR was apparently lower than that of the Han group, and the speed of response was slower too.

Then the Uyghur group's and the Han group's perception of different MSC consonants were analyzed with Univariate Analysis of Variance. The results showed that, the main effect of listener type (Uyghur vs. Han) was significant, i.e. the difference between the Uyghur and the Han subjects' perception of the same consonants was significant, for the mean PCR [$F_{(1,24017)} = 586.164$, $p < 0.05$] and for the mean RT [$F_{(1,24017)} = 66.161$, $p < 0.05$]. The main

effect of MSC consonants was significant as well, that was to say, the difference between various consonants perceived by the same subjects reached a significant level. Moreover, the interaction of listener type with the MSC consonants was also significant as the perception of different MSC consonants by different types of subjects distinguished between each other, for the mean PCR [F (20,24017) = 53.123, $p < 0.05$] and the mean RT [F (20,24017) = 2.971, $p < 0.05$]. The above results revealed that as for the perception of the same consonants, the Uyghur subjects' performance was worse than that of the Han's. Significant difference was also found in the same subjects' perception of different consonants. This meant that the perception results varied with the different types of subjects and the various consonants. What was also revealed in the above results was that the PCR discrepancy was far more prominent than the RT difference.

3.2. Perception of MSC Consonants of Different Manners of Articulation

MSC consonants could be divided into four categories according to manners of articulation: plosives, fricatives, affricates, nasals and lateral (As there was only one lateral in MSC, and it belonged to the voiced phonemes along with the nasals, so the lateral and nasals were put together for the convenience of discussion).

In order to examine the effect of manners of articulation on the Uyghur and the Han subjects' perception of MSC consonants, ONE-WAY ANOVA on their perception was processed. The results showed that the mean PCR of the Uyghur subjects' perception on the same manner of articulation was significantly different from that of the Han subjects' [F (1,24051) = 373.548, $p < 0.05$]; so was the mean RT [F (1,24051) = 49.981, $p < 0.05$]. The difference of perception between MSC consonants of the four manners of articulation by the same subjects was also significant for the mean PCR [F (3,24051) = 71.144, $p < 0.05$] and for the mean RT [F (3,24051) = 24.194, $p < 0.05$]. The interaction between listener type and manners of articulation reached a significant level as well for the mean PCR [F (3,24051) = 44.973, $p < 0.05$], but not for the mean RT, which indicated that the Uyghur subjects' PCR was lower than the Han's when they perceived on the consonants of different manners of articulation, but the distinction between the RT was not significant.

To further test the effect of manners of articulation on perception, the mean PCR and the mean RT of the Uyghur's and the Han's perception of consonants of the four manners of articulation as shown in Table 2 were analyzed.

Table 2. PCR (%) and RT (ms) of the Uyghur's and the Han's perception of MSC consonants of different manners of articulation

Perception Results	Listener type	Plosives	Affricates	Fricatives	Nasals and lateral
PCR	Uyghur	89.88	84.98	84.81	96.79
	Han	93.65	96.87	94.03	98.61
RT	Uyghur	2409.17	2378.74	2318.86	2226.36
	Han	2284.18	2282.42	2249.82	2151.73

Table 3. ONE-WAY ANOVA on PCR and RT of the Uyghur's and the Han's perception of MSC consonants of different manners of articulation

Manners	Percentage of Correct Responses	Reaction Time
Plosives	F (1,6872) = 32.510, $p<0.05$	F (1,6872) = 29.344, $p<0.05$
Affricates	F (1,6830) = 314.383, $p<0.05$	F (1,6830) = 16.665, $p<0.05$
Fricatives	F (1,6844) = 207.023, $p<0.05$	F (1,6844) = 8.292, $p<0.05$
Nasals and lateral	F (1,3505) = 12.984, $p<0.05$	F (1,3505) = 6.493, $p<0.05$

The results in Table 3 of the ONE-WAY ANOVA on the 30 Uyghur subjects' and the 30 Han subjects' perception of MSC consonants of different manners of articulation showed that difference between the two groups of subjects was significant for the mean PCR and the mean RT. The results also indicated that both the PCR and RT of the Uyghur subjects were worse than those of the Han subjects from the perspective of manners of articulation.

Then, the 30 Uyghur subjects' perception of MSC consonants of different manners of articulation as shown in Table 2 was further analyzed with ONE-WAY ANOVA. The results displayed that there was significant difference between different manners of articulation for the mean PCR [F (3,11527) = 66.872, $p < 0.05$] and for the mean RT [F (3,11527) = 14.862, $p < 0.05$]. It meant that the Uyghur subjects' perception of MSC consonants of the four manners of articulation was significantly different.

In the same way, the effect-test on the manners of articulation of the Han subjects' perception revealed that the main effect was significant in that there existed significant difference between the different manners of articulation, for the mean PCR [F (3,12524) = 29.802, $p < 0.05$] and the mean RT [F (3,12524) = 9.774, $p < 0.05$]. It illustrated that the Han subjects' perception of MSC consonants of the four manners of articulation also arrived at a significant level, though the difference was much less than the difference of the Uyghur subjects.
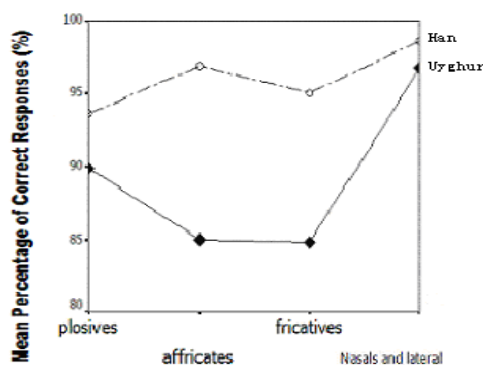
Figure 1. Mean Percentage of Correct Responses of the Uyghur's and the Han's Perception of MSC Consonants of Different Manners of Articulation
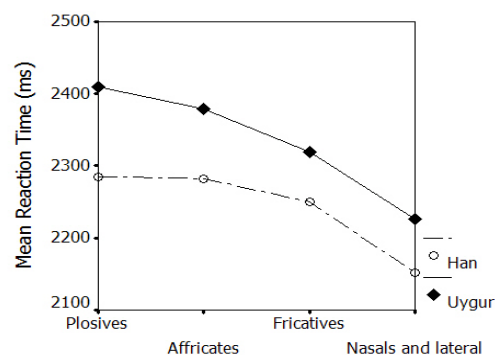
Figure 2. Mean Reaction Time of the Uyghur's and the Han's Perception of MSC Consonants of Different Manners of Articulation

Figure 1 showed that the mean PCR of the Uyghur's perception of the MSC nasals and lateral was the highest, compared with other manners of articulation; secondly the plosives; the mean PCR of affricates and fricatives were the lowest. Figure 2 revealed that the Uyghur's mean RTs of the plosives and the affricates were almost the same, with plosives slower than fricatives, and the speed of responses of nasals and lateral was the quickest.

To summarize, the Uyghur subjects basically had no difficulty in perceiving MSC consonants, because the mean percentage of correct responses for each manner was above 84%. But as L2 learners of Chinese, the Uyghur subjects' perception was significantly different from that of the Han subjects', i.e. the Uyghur's percentage of correct responses was lower than the Han subjects'; the speed of response was slower too. In addition, the Uyghur subjects' mastery of nasals and lateral was the best, and the mean PCRs of affricates and fricatives were the worst.

3.3. Perception of MSC Consonants of Different Places of Articulation

In terms of places of articulation, the MSC consonants could be classified into bilabial, labio-dental, dental, alveolar, retroflex, palatal and velar ones. The Univariate Analysis of Variance was conducted on the two types of subjects' perception of MSC consonants of different places of articulation. The results showed that main effect of the listener type was significant, as the difference between Uyghur subjects' perception and that of the Han subjects, for the mean PCR [F (1,24045) = 410.272, $p < 0.05$] and for the mean RT [F (1,24045) = 54.905, $p < 0.05$]. The main effect of place of articulation was significant, because the disparity between the consonants of the seven places of articulation perceived by the same subjects was significant, for the mean PCR [F (6,24045) = 127.053, $p < 0.05$] and for the mean RT [F (6,24045) = 53.761, $p < 0.05$]. The interaction between listener type and place of articulation also reached a significant level, which meant that both the Uyghur and the Han subjects perceived the consonants of the seven places of articulation distinctly, whether the mean PCR [F (6,24045) = 118.861, $p < 0.05$] or the mean RT [F (6,24045) = 4.437, $p < 0.05$] was analyzed.

The above results illustrated that as for the same place of articulation, the Uyghur subjects' perception was worse than that of the Han subjects, distinct of the degree of difficulty of the different places for the same subjects to perceive; a significant contrast was also obtained

between the Uyghur and the Han's perception of the consonants of the seven places of articulation. All the above results indicated that the distinction between the mean PCR for the two groups of subjects was far greater than the mean RT.

The mean PCR (%) and the mean RT (ms) of the Uyghur and the Han subjects' perception of MSC consonants of different places of articulation were given in Table 4.

Table 4. PCR (%) and RT (ms) of the Uyghur's and the Han's Perception of MSC Consonants of Different Places of Articulation

Perception Results	Listener type	Dental	Retroflex	Palatal	Alveolar	Velar	Bilabial	Labio-dental
PCR	Uyghur	68.38	87.16	94.46	91.25	96.11	91.03	80.04
	Han	97.26	97.19	96.77	94.77	96.75	93.75	83.72
RT	Uyghur	2651.85	2282.97	2188.47	2384.53	2279.90	2317.45	2410.17
	Han	2440.31	2249.57	2134.19	2262.44	2254.42	2176.91	2291.46

Separate ONE-WAY ANOVAs were conducted on the data in Table 4. The analysis on the Uyghur subjects' data showed that the degree of difficulty between the seven places of articulation was significantly different for the Uyghur subjects, for the mean PCR [$F_{(6,11524)}$ = 144.219, $p < 0.05$] and for the mean RT [$F_{(6,11524)}$ = 36.318, $p < 0.05$].

The similar case was also found in the Han subjects' perception of the consonants of the seven places of articulation for the mean PCR [$F_{(6,12521)}$ = 43.545, $p < 0.05$] and for the mean RT [$F_{(6,12521)}$ = 19.456, $p < 0.05$]. However, the disparity between perception results of different places of articulation was more prominent for the Uyghur subjects than for the Han subjects.

Figure 3 and Figure 4 showed that both the mean PCR and the mean RT of the Uyghur subjects' perception of MSC consonants of the seven places of articulation were lower or longer than the Han subjects'. The MSC dentals were the most difficult for the Uyghur subjects and the mean PCR of dentals (less than 70%) was much lower than that of the other six places of articulation (above 80%). Moreover, the Uyghur subjects' mean RT of dentals was also the longest with the gap as the biggest between that of the Uyghur subjects and of the Han. The mean PCR disparity between the Uyghur's perception of retroflex and the Han's could be ranked as second, and alveolar as third for both the mean PCR and the mean RT. On the other hand, the Uyghur subjects' perception of MSC velar and palatal consonants was ideal, which was approximately the same as that of the Han subjects. For the Uyghur subjects, the difficulty rank of MSC consonants according to places of articulation from easy to most difficult was as follows: velars → palatals → bilabials → alveolars → retroflexes → labia-dental → dentals.
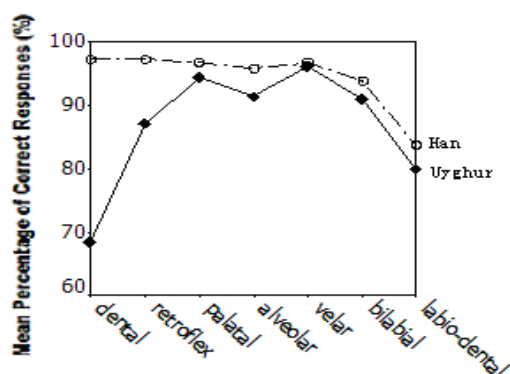

Figure 3. Mean Percentage of Correct Responses of the Uyghur's and the Han's Perception of MSC Consonants of Different Places of Articulation
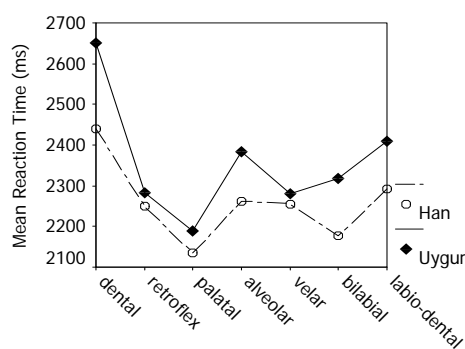
Figure 4. Mean Reaction Time of the Uyghur's and the Han's Perception of MSC Consonants of Different Places of Articulation

3.4. Difficulty Hierarchy of MSC Consonants for the Uyghur Subjects

In order to understand the Uyghur subjects' perception of the MSC consonants further, a contrastive analysis on the PCR and RT of the Uyghur and the Han subjects' perception of the individual consonant phonemes was made.
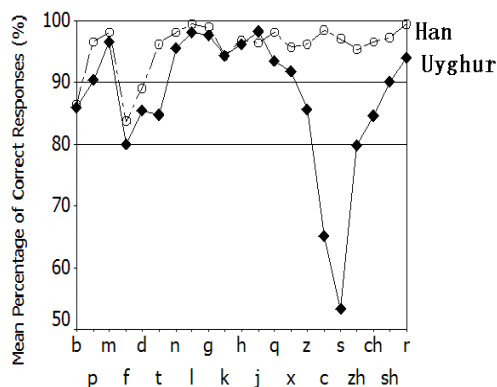

Figure 5. Mean Percentage of Correct Responses of the Uyghur's and the Han's Perception of MSC Consonant Phonemes
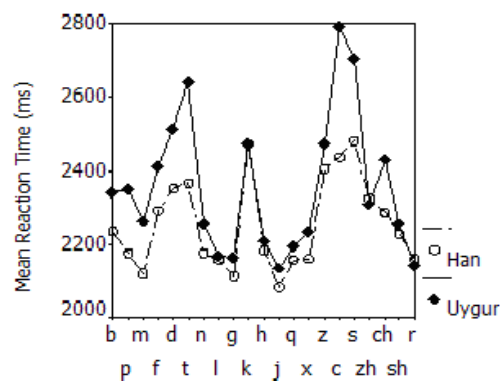
Figure 6. Mean Reaction Time of the Uyghur's and the Han's Perception of MSC Consonant Phonemes

It could be found, as shown in Figure 5, that the general tendency of the Uyghur subjects' perception of MSC consonant phonemes was basically similar to the Han subjects' perception. For example, the mean PCR of the Uyghur subjects' perception of the phonemes /b, m, l, g, k, h/ overlapped with or approached that of the Han subjects' perception of the same consonants; the Uyghur subjects' mean PCR on /j/ was a little higher than the Han subjects' mean PCR, which meant the Uyghur learners had mastered the consonant. However, another phenomenon must be paid attention to, i.e. the mean PCR of Uyghur subjects' perception of the MSC consonants /q, x, d, f, n/ was distinguished from that of the Han subjects', and especially the Uyghur's mean PCRs of perception of these phonemes /s, c, zh, ch, z, t, p, sh, r/ were much lower than the Han subjects' mean PCRs.

Figure 6 showed that, the Uyghur subjects' general speed of response was slower than the Han subjects', and in particular the consonants /s, c, t, d, ch, p, m, f, b, n/ were perceived much slower by the Uyghur subjects than the Han subjects. Meanwhile, the mean RTs of the Uyghur subjects' perception of the other consonants equaled with or approached the Han subjects' mean RTs.

If the relationship between PCR and RT were considered, it could be found that, consistent tendency appeared in the percentage of correct responses and the reaction time as a whole. For instance, the PCR of the Uyghur subjects' perception of the consonants /c, z, s/ was relatively low, and the RT was also longer or the speed of response was slower as well. Another case was for the consonants /l, k, h/, which were perceived best by the Uyghur subjects with least RT or fastest speed. The Uyghur's PCRs of other consonants were close to the corresponding Han's PCRs, and the RTs needed by the two types of subjects were almost the same. In relation to RT, the discrepancy between the Uyghur learners' PCR and the Han subjects' was more salient.

In summary, from the above analysis, it could be elicited that the difficulty hierarchy of MSC consonants for the Uyghur listeners was as follows (Here, the symbols in the slashes are IPA while the ones before the slashes are *pinyin*):

Level 0: the consonant phonemes with the mean PCR above 95%, such as j/tɕ/, l/l/, g/k/, m/m/, h/x/, n/n/.

Level 1: those with the mean PCR between 90% to 95%, including k/kʰ/, r/ʐ/, q/tɕʰ/, x/ɕ/, p/pʰ/, sh/ʂ/.

Level 2: those with the mean PCR around 85%, for instance b/p/, z/ts/, d/t/, t/tʰ/, ch/tʂʰ/.

Level 3: those with the mean PCR about 80%, referring to $f/f/$, $zh/t\c{s}/$.
Level 4: those with the mean PCR below 80%, namely $c/ts^h/$, $s/s/$.

4. Conclusion

Based on the experiment results of the perception of MSC consonants, the following conclusions are drawn.

Firstly, there is significant difference between the Uyghur subjects' perception and the Han subjects' perception of MSC consonants. The representation of such difference is, compared with the Han subjects, the lower accuracy and speed of the Uyghur subjects' performance. It is reckoned that the effect of the phonological system of the L2 learners' native language results in the significant difference. Moreover, the overall tendency of the Uyghur subjects' perception of MSC consonants is consistent with that of the Han subjects', which indicates that the phonological system of the target language itself also exerts influence on the perception.

Secondly, the difficulty hierarchy of MSC consonants for the Uyghur learners of Chinese is found out. According to manners of articulation, nasals and lateral are perceived the best, plosives second, affricates and fricatives the worst; and according to places of articulation, velars and palatals are the easiest, bilabials and alveolars are easier, retroflex, labio-dental and dental consonants are comparatively difficult for the Uyghur subjects. In terms of single phonemes, the difficulty rank of MSC consonants for Uyghur to learn is divided into five levels from easy to difficult: the consonants $j/t\c{c}/$, $l/l/$, $g/k/$, $m/m/$, $h/x/$ and $n/n/$ belong to Level 0; Level 1 is composed of the consonant phonemes $k/k^h/$, $r/z/$, $q/t\c{c}^h/$, $x/\c{c}/$, $p/p^h/$ and $sh/\c{s}/$; Level 2 consists of $b/p/$, $z/ts/$, $d/t/$, $t/t^h/$ and $ch/t\c{s}^h/$; the phonemes $f/f/$ and $zh/t\c{s}/$ are included in Level 3; and Level 4 includes the phonemes $c/ts^h/$ and $s/s/$.

Thirdly, the markedness of a specific phoneme or a certain distinctive feature determines how and to what extent the L2 speech perception is affected by the phonological systems of the native language and the target language. In other words, the Uyghur subjects' perception of MSC consonant phonemes is determined by the markedness of the corresponding part in Uyghur and MSC. So, for the Uyghur learners of Chinese, the difficulty hierarchy of the MSC consonants tallies with the degree of markedness of the MSC consonants, which validates the Markedness Differential Hypotheses [6].

Acknowledgements

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