

Learning Chinese: The differences from English and Spanish Speakers

■ An Interesting Survey for Mandarin Consonants

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The common language that's used in China is standard Mandarin (Pu Tong Hua in Chinese). It is the national language of the more than 1.3 billion inhabitants of China and millions more ethnic Chinese around the globe and is the world's most widely spoken language. In the United States, there are 24,000 children studying Chinese.¹ Learning Mandarin, to an English or a Spanish speaker, shall understand the phonemes of Mandarin consonants because it's different to English or Spanish consonant system.

I. STATEMENT OF THE PROBLEM

English has 24 consonants phonemes, according to Hertz (1997, p.10-9), they may each be described in terms of the phonetic features of voicing, point of articulation and manner of articulation:²

English Consonants

point →		bilabial	labio-dental	dental	alveolar	alveo-palatal	velar	glottal
manner	voicing							
stop (plosives)	vl	π			τ		κ	
	vd	β			δ		γ	
fricative (spirants)	vl		φ	T	σ	σ&		η
	vd		ϝ	Δ	ζ	ζ&		
affricate	vl					χ&		
	vd					—◇		
nasal		m			n		N	
lateral					⟩			
semivowel (glides)		(ω)			ρ	ψ	ω	

co-articulated

- vl = voiceless
- vd = voiced

For each consonant, there is a key word of English as following:

π pin	β book	τ tin	δ don	κ kite
γ go (not gem)	φ fast	ϖ vast	T thin	Δ that
σ send	ζ zoo	σ& shoe	ζ& pleasure	η hit
χ& chin	—◇ judge	> let	μ may	v no
N sing	ρ red	ψ yet	ω wet	

Mandarin has the same number of consonants as English, Lai (2006, World Wide Web), an Associate Professor, City University of Hong Kong, created his table below: ³

Mandarin Consonants (Pinyin [IPA: SIL Font])

	Bilabial	Labiodental	dental	post-alveolar	Palatal	Velar
Stop						
aspirated	π [πH]		τ [τH]			κ [κH]
unaspirated	β [π]		δ [τ]			γ [κ]
nasal	μ [μ]		ν [ν]			νγ [N]
Fricative		φ [φ]	σ [σ]	ση [♣]	ξ [ʃ]	η [ξ]
Affricate						
aspirated			χ [τHσ]	χη [τH♣]	θ [τHʃ]	
unaspirated			ζ [τσ]	ζη [τ♣]	φ [τ]	
Glide	ω [ω]			ρ [ʀ]	ψ [φ]	ω [ω]
Liquid			λ [λ]			

However, the 1958 official phonetic system of romanizing Chinese, Han Yu Pin Yin Fang An 汉语拼音方案 (A New Century Chinese-English Dictionary, 2004, p.2241) listed its Mandarin consonants pronunciation independently, that made each consonant phoneme to articulate always with a long vowel so all of them become voiced, in another word, there is no voiceless consonant in Mandarin language. The examples are such as: ⁴

Stops:

aspirated--	p	/π/	[πõ]	坡 (slope)
	t	/τ/	[τ↔]	特 (special)
	k	/κ/	[κ↔]	科 (division)

unaspirated--

b	/β/	[βõ]	波 (wave)	
	d	/δ/	[δ↔]	得 (get)
	γ	/γ/	[γ↔]	哥 (brother)

Nasal:

m	/m/	[mõ]	摸 (touch)	
	n	/n/	[n↔]	讷 (slow; of speech)
νγ	/νγ/	[N]		

**It is classified to Mandarin vowels by Han Yu Pin Yin Fang An

Fricatives:

f	/f/	[fõ]	佛 (Buddha)
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s	/s/	[s̄]	思 (think)	
sh	/ʃ/	[ʃ̄]	诗 (poetry)	*(tongue curled back)
x	/ɣ/	[ɣ̄]	希 (hope)	
h	/h/	[h̄↔]	喝 (drink)	

Comparing to English consonants/fricatives, this implies that Chinese once had the phonemes /T, Δ, σ&, ɸ/ but no longer have them now.

“z” is removed to affricate/unaspirate, and a new “sh” [ʃ̄] and a “x” [ɣ̄] are added.

Affricate:

Aspirated--

c	/tʃ/	[tʃ̄]	雌 (female)	
ch	/tʃh/	[tʃ̄h]	吃 (eat)	*retroflexive
q	/tʃ/	[tʃ̄]	欺 (cheat)	

unaspirate--

z	/tʃ/	[tʃ̄]	资 (fund)	
zh	/tʃh/	[tʃ̄h]	知 (know)	* retroflexive
j	/tʃ/	[tʃ̄]	鸡 (chicken)	

In English consonants/affricates, there are only two phonemes: “χ&” and “—◊”. “χ&” is closer to

“θ” while “—◊” is likely “φ” in Mandarin Pin Yin;

“c”, “ch”, “z”, and “zh” are added into the affricate glossary.

Glide:

The “Glide” item is similar to English consonants/semivowels.

ρ	/r/	[r̄]	日 (sun)
ψ	/y/	[ψ̄]	一 (one)

** “y” shows only in case of Mandarin vowel “i” is at the beginning of a word, the rule is /i/ → /y/ / #__.

w	/w/	[w̄]	乌 (black)
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** “w” shows while Mandarin vowel “u” is at the beginning of a word, the rule is /u/ → /w/ / #__.

“w”, such as the English semivowel, is coarticulated with points of labial and velar.

Liquid:

The “Liquid” category matches the English consonant/lateral. There is only one phoneme here:

ɣ	/ɣ/	[ɣ̄↔]	喇 (chatter)
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From the statement above, exactly to say, Mandarin consonants are 21 below which official name is “Sheng Mu 声母” that means “the long-voiced phonemes” while Mandarin 35 vowels are called “Yun Mu 韵母” - the rhyme:

1.	b	[βō]	p	[πō]	m	[μō]	f	[φō]
2.	d	[δ↔]	t	[τ↔]	n	[ν↔]	ɣ	[ɣ↔]
3.	γ	[ɣ↔]	k	[κ↔]	h	[η↔]		
*in English, /b d γ/ are voiceless.								
4.	j	[ɣ̄]	q	[tʃ̄]	x	[ɣ̄]		
5.	z	[tʃ̄]	c	[tʃ̄]	s	[s̄]		

6. zh [ʈʂʊ̯] ch [ʈʂHʊ̯] sh [ʂʊ̯] r [ʀʊ̯]

Thus, the articulation of first three rows (1, 2, and 3) above are closer to English consonants, while the phonetic features of rows of 4, 5, and 6 are not familiar with an English speaker. Therefore, English speakers might have difficulty perceiving the difference between pairs of words uttered in isolation, such as words zi [ʈʂʊ̯], ci [ʈʂHʊ̯], si [ʂʊ̯], and zhi [ʈʂʊ̯], chi [ʈʂHʊ̯], and shi [ʂʊ̯], which are distinguished only by these pairs sounds because zi [ʈʂʊ̯], ci [ʈʂHʊ̯], si [ʂʊ̯] are without the [ʂʊ̯] sound (tongue curled back) as zh [ʈʂʊ̯], ch [ʈʂHʊ̯], sh [ʂʊ̯].

In addition, Mandarin is a tone language with four tones (Si Sheng Diao 4 声调) according to Han Yu Pin Yin Fang An (汉语拼音方案):

- The 1st tone is marked with a line ("a" + "ˉ" = "ā"). This is a high, even and constant tone as “Yin Ping 阴平”, like /mā/ that means “mother”.
- The 2nd tone is marked with a rising line ("a" + "ˊ" = "á"). This is a rising tone that grows stronger as “Yang Ping 阳平” like /má/ that means “hemp”.
- The 3rd tone is marked with a hook ("a" + "ˇ" = "ǎ"). This tone is first falling and fading, then rising and growing strong as “Shang Sheng 上声” like /mǎ/ that means “horse”.
- The 4th tone is marked with a falling line ("a" + "ˋ" = "à"). This is a quickly falling and fading tone as “Qu Sheng 去声” like /mà / that means “scold”.
- Tone markings are written over the central vowels in most syllables. Some syllables have no specific tone, and then no sign is put above any vowel. It is called “light voice” as “Qing Sheng 轻声”, and it’s usually used as a noun suffix or the word at the end of a question sentence, “ma 吗? ” for example.

In Chinese it is always very important to pronounce words with correct tone. Otherwise, it may make big mistakes. It works in the minimal pairs of such as “zi” (fund) and “zhi” (know) below (the little dot on “i” is removed while a tone marker putting on):

“Yin Ping 阴平”	/zī /	资(fund)	/zhī /	知(know)
“Yang Ping 阳平”	/zí /	滋(a sound)	/zhí /	直(straight)
“Shang Sheng 上声”	/zǐ /	子(son)	/zhǐ /	指(finger)
“Qu Sheng 去声”	/zì /	自(self)	/zhì /	质(quality)
“Qing Sheng 轻声”	/zi /	(a noun suffix)	/zhi /	(a sound)

The Mandarin consonants zi, ci, si and zhi, chi, and shi plus their tones are not in English, nor in Spanish. So Spanish speakers who want to learn Mandarin have the similar issues as English

Table 2: Consonant chart for Spanish (Jimenez, 1987).

	Bilabial	Labio-dental	Inter-dental	Alveolar	Palatal	Velar	Glottal
Stops	p b			t d		k g	
Fricatives		f		s		x	
					ʎ		
	m			n		ŋ	
Lateral				l			
Tap-trill				ɾ r			
Glides	w				j	w	

speakers. Different from Mandarin and English, Spanish has its own consonant system. There are 24 consonants in Spanish, seven stops, nine fricatives, one affricate, three nasals, two liquids, and two glides (Jimenez, 1987, p. unknown, cited by [Shereef](#), 2001. World Wide Web).⁵ Please see the table below which illustrates the place, manner, and voicing of **Spanish consonants**:

In Spanish consonants, there are some rules for their articulation (Penick and expanded. 1997. World Wide Web).⁶ For example:

c [k] -- before a consonant or **a, o, or u**, like the **c** in *cat*; before **e or i** like an **s**

ch [tʃ] -- like the **ch** in *church*. Historically, the Spanish **ch** has been treated as a separate letter although this has recently been changed. Therefore, many dictionaries list words beginning with **ch** after the **c**'s and before the **d**'s.

s -- before consonants **b, d, g, l, m, n**, like a **z**; otherwise like an **s**

x -- when between vowels, like the **x** in *box*; before a consonant, like an **s**

z -- like an **s**

** According to Pharies, Professor of Spanish, University of Florida, Editor in Chief of The University of Chicago Spanish Dictionary, (2002. World Wide Web),⁷ **z** is subject to dialectal variation as well. In most parts of Spain, except the southwest, it is pronounced as the *th* in Eng. *thin, cloth*. In southwestern Spain and all of Spanish America, in contrast, it is pronounced *s*. Examples: **zagal, hallazgo, luz**.

Since Spanish doesn't have the same, even similar or closer consonant sounds like Mandarin's such as "zi" (fund) and "zhi" (know), "ci" (female) and "chi" (eat), and "si" (think) and "shi" (poetry), it will cause the difficult while Spanish speakers, as well as English speakers, to learn Mandarin language.

II. HYPOTHESES

Based on the features of Mandarin consonants, the possibilities are that speakers of English and Spanish will be:

- (1) totally unable to distinguish words that are separated only by the consonants /zi/ and /zhi/, /ci/ and /chi/, as well as /si/ and /shi/ when these words are uttered in isolation because their languages do not have those sounds; or
- (2) totally able to distinguish words with the consonants /zi/ and /zhi/, /ci/ and /chi/, as well as /si/ and /shi/ when these words are uttered in isolation because at least there are some similar or closer sounds in their own languages, or
- (3) able to distinguish few of the words that are separated only by the consonants /zi/ and /zhi/, /ci/ and /chi/, as well as /si/ and /shi/ when these words are uttered in isolation because their languages do not have those sounds; or
- (4) able to distinguish most of the words with the consonants /zi/ and /zhi/, /ci/ and /chi/, as well as /si/ and /shi/ when these words are uttered in isolation because at least there are some similar or closer sounds in their own languages.

III. METHODOLOGY

In the interest of data collection for further analysis, a questionnaire is created as bellow to ask five English and five Spanish speakers. It's composed by three parts: "Part 1" is about the answer's background that includes the answer sheet number which will sort as E1 (English speaker, #1) or S1 (Spanish speaker, #1) and so on by the surveyor; age group; sex; country of origin; and whether the person heard or learned Mandarin Chinese before. Below is a copy of part 1:

Part 1: Answers' Background (Form)

Answer sheet number:

(The blue words are in Spanish)

Brief Background/ Resumen historial

Please check one in each question that describes you properly:

Per favor marque una respuesta para cada pregunta:

1. Native language/ **Primer lenguaje**: English / **Ingles** ___ Spanish /**Espanol** ___
2. Do you speak bilingual English and Spanish? Yes _____ No _____
Usted habla bilingue Ingles y Espanol? Si _____ No _____
3. Gender/ **Sexo**: Male/ **Masculino** _____ Female/ **Femenino** _____
4. Birth place/ **Lugar de nacimiento**: U.S. or other English speaking country/
Estades Unidos o otro pais de habla Ingles ___
 South America or other Spanish speaking country/ **Sur America o otro pais de habla Espanol**

5. Age group/ **Edad**: 18 to 25 ___ 26 to 30 ___ 31 to 35 ___
 36 to 40 ___ 41 to 45 ___ 46 to 50 ___
 51 to 55 ___ 55 to 60 ___

6. How often are you exposed to Mandarin Chinese?
Que tan oeguido es espuesto a Mandarin Chinese?
 Usually/ **Seguido** ___ sometimes/ **Aveces** ___ never/ **Nunca** ___

7. Have you learnt to speak Mandarin Chinese before?
A abrendo a hablar Mandarin Chinese antes?
 Yes/ **Si**: for a while/ **por un tiempo** ___
 for few words only/ **por unas cuanlas palabras solamente** ___
 No/ **No**: never/ **nunca** _____

“Part 2” is an answer sheet that includes the hearing test minimal pairs item number 1 to 32 with a “Same” or a “Different” checking space for answering. Here is the simple of a copy.

Part 2: Answer Sheet (Form)

Question #: Check one only for each pair of sounds you heard:

	Same Iguales	or	Different Diferente
1.	_____		_____
2.	_____		_____
3.	_____		_____
4.	_____		_____
5.	_____		_____
6.	_____		_____
7.	_____		_____
8.	_____		_____
9.	_____		_____
10.	_____		_____
11.	_____		_____
12.	_____		_____
13.	_____		_____
14.	_____		_____
15.	_____		_____
16.	_____		_____
17.	_____		_____

- | | | |
|-----|-------|-------|
| 18. | _____ | _____ |
| 19. | _____ | _____ |
| 20. | _____ | _____ |
| 21. | _____ | _____ |
| 22. | _____ | _____ |
| 23. | _____ | _____ |
| 24. | _____ | _____ |
| 25. | _____ | _____ |
| 26. | _____ | _____ |
| 27. | _____ | _____ |
| 28. | _____ | _____ |
| 29. | _____ | _____ |
| 30. | _____ | _____ |
| 31. | _____ | _____ |
| 32. | _____ | _____ |

“Part 3” below lists 32 scramble minimal pairs of Mandarin words with consonants zi, ci, si, zhi, chi, and shi in four tones. It will be held by surveyor only and read to the informants during the hearing test.

Part 3: Mandarin Consonants Hearing Test (Form)

Question Item:

- | | | | |
|-----|----------------|---|-----------------|
| 1. | zī (fund)资 | / | zī (fund)资 |
| 2. | zhī(know)知 | / | zī (fund)资 |
| 3. | zí (a sound)滋 | / | zhí (straight)直 |
| 4. | cǐ (this)此 | / | chǐ (tooth)齿 |
| 5. | zhǐ(finger)指 | / | zǐ (son)子 |
| 6. | zì (self)自 | / | zì (self)自 |
| 7. | zhì(quality)质 | / | zì (self)自 |
| 8. | cī (flaw)疵 | / | chī(eat)吃 |
| 9. | cí (word)词 | / | cí (word)词 |
| 10. | chí (pool)池 | / | cí (word)词 |
| 11. | cì (sting)刺 | / | chì (wing)翅 |
| 12. | sī (silk)丝 | / | shī(poetry)诗 |
| 13. | shí (stone)石 | / | shí (stone)石 |
| 14. | sǐ (die)死 | / | shǐ (history)史 |
| 15. | sì (four)四 | / | shì (city)市 |
| 16. | zhí(straight)直 | / | shí (stone)石 |
| 17. | zī (fund)资 | / | cī(flaw)疵 |
| 18. | shī(poetry)诗 | / | cī(flaw)疵 |
| 19. | cǐ (this)此 | / | zǐ (son)子 |
| 20. | zì (self)自 | / | cì (sting)刺 |
| 21. | shī(poetry)诗 | / | sī(silk)丝 |
| 22. | cí (word)词 | / | shí(stone)石 |
| 23. | chǐ (tooth)齿 | / | sǐ (die)死 |

24. zì (self)自	/	zì (self)自
25. sī (silk)丝	/	zī(fund) 资
26. chí (pool)池	/	cí (word)词
27. sǐ (die)死	/	shǐ (history)史
28. chì(wing)翅	/	shì (city)市
29. zì (self)自	/	cì (sting) 刺
30. zhí (straight) 直	/	shí (stone)石
31. zhǐ(finger) 指	/	sǐ (die)死
32. cì (sting) 刺	/	zì (self)自

IV. FINDINGS

The hearing test was put in practice at the Art Institute, Santa Monica, where five native English speakers were random selected, and at the Rio Hondo College, Whittier, where five native Spanish speakers were willing to be volunteers on November 9, 2006. The results were very interesting as bellow:

A. English Speakers:

(1) Answers' Background Information:

Table: Data 1 - English Speakers' Brief Background

Mandarin Chinese Consonants Listening Survey					
Part 1: Brief Background	Answer sheet number				
Background Item #	E1	E2	E3	E4	E5
1	E	E	E	E	E
2	Y	Y	N	N	N
3	F	M	M	M	F
4	US	US	US	US	US
5	18-25	18-25	31-35	18-25	26-30
6	some	never	never	some	some
7	never	never	never	never	never

From the **Data 1** table above, the answer sheet numbers were E1, E2, E3, E4, and E5. All of them were native English speakers. Two of them were bilingual English and Spanish speakers, while other three were not. There were two females, and three males. Five of them were born in the U.S. or other English speaking countries. Their ages were between 18 and 35. Three of them exposed to Mandarin Chinese sometimes, however, all of them had never learnt to speak Mandarin Chinese before.

(2) Answer Sheet Statistics:

The total testing items were 32. The right answers were 76.90 percent, while 23.10 percent was wrong. There were 26 items correct answers which rate were 60 percent and over, while only 6 items were incorrect that rate were more than 60 percent. The 100 percent correct question item numbers were 2, 3, 6, 8, 9, 13, 14, 18, 22, 23, 24, 26, 30, and 31, plus, the 60 to 80 percent correct answer items were 1, 4, 5, 7, 10, 11, 12, 15, 16, 21, 27, 28, and 29, while the 60 to 100 percent incorrect answer items were 17, 19, 20, 25, and 32. From the individual's answers, four of them got right rate were 71.9, 81.3, 84.4, and 90.6, while there was only one 56.3 percent. This is in the chart on the next page **Table: Data 2**.

Table: Data 2 - English Speakers' Answer Sheet Statistics

CSA Academic Perspective

Question Item	E1	E2	E3	E4	E5	Wrong	Right	Total	% of Wrong	% of Right
1	R	R	W	R	R	1	4	5	20	80
2	R	R	R	R	R	0	5	5	0	100
3	R	R	R	R	R	0	5	5	0	100
4	R	R	R	W	R	1	4	5	20	80
5	R	W	R	W	R	2	3	5	40	60
6	R	R	R	R	R	0	5	5	0	100
7	R	W	R	R	R	1	4	5	20	80
8	R	R	R	R	R	0	5	5	0	100
9	R	R	R	R	R	0	5	5	0	100
10	R	W	R	R	R	1	4	5	20	80
11	R	R	R	W	R	1	4	5	20	80
12	R	W	R	R	R	1	4	5	20	80
13	R	R	R	R	R	0	5	5	0	100
14	R	R	R	R	R	0	5	5	0	100
15	R	W	R	W	R	2	3	5	40	60
16	R	R	W	R	R	1	4	5	20	80
17	W	W	W	W	R	4	1	5	80	20
18	R	R	R	R	R	0	5	5	0	100
19	W	W	R	W	W	4	1	5	80	20
20	W	W	W	W	W	5	0	5	100	0
21	W	W	R	R	R	2	3	5	40	60
22	R	R	R	R	R	0	5	5	0	100
23	R	R	R	R	R	0	5	5	0	100
24	R	R	R	R	R	0	5	5	0	100
25	R	W	W	W	R	3	2	5	60	40
26	R	R	R	R	R	0	5	5	0	100
27	R	W	R	R	R	1	4	5	20	80
28	R	W	R	R	R	1	4	5	20	80
29	R	W	W	R	R	2	3	5	40	60
30	R	R	R	R	R	0	5	5	0	100
31	R	R	R	R	R	0	5	5	0	100
32	W	W	R	W	W	4	1	5	80	20
Wrong	5	14	6	9	3	37	0	160	23.10%	76.90%
Right	27	18	26	23	29	0	123			
Total	32	32	32	32	32	160	160	160		
% Wrong	15.6	23.7	18.7	28.1	9.4	23.10%	0			
% Right	84.4	56.3	81.3	71.9	90.6	0	76.90%			
* R: right W: wrong										

B. Spanish Speakers:**(1) Answers' Background Information:****Table: Data 3 - Spanish Speakers' Brief Background**

Mandarin Chinese Consonants Listening Survey					
Part 1: Brief Background	Answer sheet number				
Background Item #	S1	S2	S3	S4	S5
1	S	S	S	S	S
2	Y	Y	Y	N	Y
3	M	M	F	F	F
4	SA	SA	SA	SA	SA
5	26-30	18-25	18-25	31-35	36-40
6	some	some	some	never	some
7	never	few words	never	never	never

From the **Data 3** table above, the answer sheet numbers were S1, S2, S3, S4, and S5. All of them were native Spanish speakers. Four of them were bilingual English and Spanish speakers, while only one of them was not. There were three females, and two males. Five of them were born in the South America or other Spanish speaking countries. Their ages were between 18 and 40. Four of them exposed to Mandarin Chinese sometimes, and one of them even had learnt to speak Mandarin Chinese for few words before.

(2) Answer Sheet Statistics:

The total question items were 32 as same as the English one. The right answers were 82.50 percent, while 17.50 percent was wrong. There were 27 items correct answers which were 60 percent and over, while only 5 items were incorrect that were more than 60 percent. The 100 percent correct question item numbers were 1, 2, 5, 7, 8, 9, 10, 11, 13, 18, 21, 23, 26, 27, 28, 30, and 31, plus, the 60 to 80 percent correct answer items were 3, 4, 6, 12, 14, 15, 16, 17, 22, and 24, while the 60 to 100 percent incorrect answer items were 19, 20, 25, 29, and 32. From the individual's answers, three of them got right rate were 62.5, 81.3, and 84.4, and even one of them got 100, while there was nobody lower than 60 percent. This is in the chart on the next page **Table: Data 4**.

Table: Data 4 – Spanish Speakers' Answer Sheet Statistics

Question Item	S1	S2	S3	S4	S5	Wrong	Right	Total	% of Wrong	% of Right
1	R	R	R	R	R	0	5	5	0	100
2	R	R	R	R	R	0	5	5	0	100
3	R	R	R	W	R	1	4	5	20	80
4	R	R	R	W	R	1	4	5	20	80
5	R	R	R	R	R	0	5	5	0	100
6	W	R	R	R	R	1	4	5	20	80
7	R	R	R	R	R	0	5	5	0	100
8	R	R	R	R	R	0	5	5	0	100
9	R	R	R	R	R	0	5	5	0	100
10	R	R	R	R	R	0	5	5	0	100
11	R	R	R	R	R	0	5	5	0	100

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12	W	R	R	R	R	1	4	5	20	80
13	R	R	R	R	R	0	5	5	0	100
14	R	R	R	W	R	1	4	5	20	80
15	R	R	R	W	R	1	4	5	20	80
16	R	R	R	W	R	1	4	5	20	80
17	R	R	R	W	W	2	3	5	40	60
18	R	R	R	R	R	0	5	5	0	100
19	W	R	W	W	W	4	1	5	80	20
20	R	R	W	W	W	3	2	5	60	40
21	R	R	R	R	R	0	5	5	0	100
22	R	R	R	W	R	1	4	5	20	80
23	R	R	R	R	R	0	5	5	0	100
24	W	R	R	R	R	1	4	5	20	80
25	R	R	W	W	W	3	2	5	60	40
26	R	R	R	R	R	0	5	5	0	100
27	R	R	R	R	R	0	5	5	0	100
28	R	R	R	R	R	0	5	5	0	100
29	W	R	W	W	W	4	1	5	80	20
30	R	R	R	R	R	0	5	5	0	100
31	R	R	R	R	R	0	5	5	0	100
32	R	R	W	W	W	3	2	5	60	40
Wrong	5	0	5	12	6	28	0			
Right	27	32	27	20	26	0	132			
Total	32	32	32	32	32	160	160	160		
% Wrong	15.6	0	15.6	37.5	18.7	17.50%	0		17.50%	
% Right	84.4	100	84.4	62.5	81.3	0	82.50%			82.50%
* R: right W: wrong										

V. INTERPRETATION OF FINDINGS

1. About the Hypotheses

The data indicate that most of the informants seemed to be able to distinguish the similar sounds of the minimal pair of Mandarin Chinese consonants, both of native English and Spanish speakers, because the English speakers' hearing correction rate was 76.90 percent (**Table: Data 2**), and the Spanish speakers were even higher than English one, that up to 82.50 percent (**Table: Data 4**). The correct answer average rate among them was 79.70 that almost reached **80 percent**. This result denied the hypotheses (1): they "will be totally unable to distinguish" those 32 pairs of Mandarin words, (2): "totally able to distinguish" the words on the hearing test, and (3): "able to distinguish few of the words". The only one hypothesis that was proved is (4): they will be "able to distinguish most of the words with the consonants /zi/ and /zhi/, /ci/ and /chi/, as well as /si/ and /shi/ when these words are uttered in isolation because at least there are some similar or closer sounds in their own languages."

2. English Speakers vs. Spanish Speakers

The data indicate that the correct answer rate 82.5% of Spanish speakers was 5.6% higher than English speakers' one (76.9%). However, it doesn't simply mean that Spanish speakers were better understanding Mandarin Chinese than English speakers because some of other factors were involved among those informants, such as their ages and language experiences. In this survey, the age group and language exposed to Mandarin Chinese between English and Spanish speakers were unbalance as shown in the **Table: Background** above.

Table: English vs. Spanish Speakers' Background

Background Item #		English Speakers	Spanish Speakers	Total
5. Age Group	18-25	3	2	5
	26-30	1	1	2
	31-35	1	1	2
	36-40		1	1
	Subtotal	5	5	10
2. Do you speak bilingual English and Spanish?	Yes	2	4	6
	No	3	1	4
	Subtotal	5	5	10
6. How often are you exposed to Mandarin Chinese?	Sometimes	3	4	
	Never	2	1	
	Subtotal	5	5	10
7. Have you learnt to speak Mandarin Chinese before?	Sometimes	0	1 (knew few words)	1
	Never	5	4	9
	Subtotal	5	5	10

(Source: from **Table: Data 1** and **Data 3**)

3. Age Group Comparison

Based on these 10 informants' age statistics, it shows the rate of correct answer of age 18 to 30 was 81.7% while the age group of 31 to 40 was 75% (see the table below, the informants order is rearranged by age group from younger to elder).

Table: Younger vs. Elder of Informants

Age Group:	18-25	18-25	18-25	18-25	18-25	26-30	26-30	Average right rate	31-35	31-35	36-40	Average right rate
Question Item	E1	E2	E4	S2	S3	E5	S1		S4	E3	S5	
1 through 32								Among age 18 to 30				Among age 31 to 40
Wrong	5	14	9	0	5	3	5		12	6	6	
Right	27	18	23	32	27	29	27		20	26	26	
Total	32	32	32	32	32	32	32		32	32	32	
% of Wrong	15.6	23.7	28.1	0	15.6	9.4	15.6		37.5	18.7	18.7	
% of Right	84.4	56.3	71.9	100	84.4	90.6	84.4	81.7%	62.5	81.3	81.3	75.0%

(Source: from **Table: Data 2** and **Data 4**)

It seems that the younger age people (81.7%) were doing better than the elder age group (75.0%) while they distinguished the minimal pairs of Mandarin Chinese consonants, especially two of them reached 90.6% and 100%. However, either the younger or elder, their correct answer average rate was 79.7% that almost reached 80%. It shows that they are able to distinguish different Mandarin

Chinese consonant sounds. In another word, they have potential ability to learn Mandarin Chinese, the language contains some consonants that do not exist in their own language.

4. Single Language Speakers vs. Bilingual Speakers

Among these informants, there were six of them bilingual English and Spanish speakers, while four spoke single language, either English or Spanish. The percentage of correct answer of the bilingual speakers was higher than the single language speakers (see the table below, the informants order is rearranged from “Yes” to “No” by answer to “2. Do you speak bilingual English and Spanish?”).

Table: Bilingual vs. Single Language Speakers

2. Do you speak bilingual English and Spanish?	Y	Y	Y	Y	Y	Y	Right Average rate	N	N	N	N	Right Average rate	
Question Item	E1	E2	S1	S2	S3	S5	Among bilingual language speakers	E3	E4	E5	S4	Among single language speakers	
1 through 32													
Wrong	5	14	5	0	5	6		6	9	3	12		
Right	27	18	27	32	27	26		26	23	29	20		
Total	32	32	32	32	32	32		32	32	32	32		
% of Wrong	15.6	23.7	15.6	0	15.6	18.7		18.7	28.1	9.4	37.5		
% of Right	84.4	56.3	84.4	100	84.4	81.3	81.8%	81.3	71.9	90.6	62.5	76.6%	

(Source: from **Table: Data 2** and **Data 4**)

According to this comparison, it seems the people who had bilingual language skills (81.8%) were doing better than the single language speaker (76.6%) in distinguishing the minimal pairs of Mandarin Chinese consonants, especially one of them reached the perfect 100%.

5. Male vs. Female

The table below is the comparison of five males versus five females. It looks like the female listeners were doing better than the male, no matter one male reached 100% correct answer (see table below).

Table: Male vs. Female of the Informants

3. Gender	M	M	M	M	M	Right Average rate	F	F	F	F	F	Right Average rate
Question Item	E2	E3	E4	S1	S2	Among male	S3	S4	S5	E1	E5	Among female
1 through 32												
Wrong	14	6	9	5	0		5	12	6	5	3	
Right	18	26	23	27	32		27	20	26	27	29	

Total	32	32	32	32	32		32	32	32	32	32	
% of Wrong	23.7	18.7	28.1	15.6	0		15.6	37.5	18.7	15.6	9.4	
% of Right	56.3	81.3	71.9	84.4	100	78.8%	84.4	62.5	81.3	84.4	90.6	80.6%

(Source: from **Table: Data 2** and **Data 4**)

6. Experiences of Mandarin Chinese

From the statistics, it shows the different correct answer rate among the informants with different degree in experiences the language of Mandarin Chinese:

Table: Exposure to Mandarin Chinese among the Informants

6. How often are you exposed to Mandarin Chinese?	some	some	some	some	some	some	some	Right Average rate	never	never	never	Right Average rate		
Question Item	E1	E4	E5	S1	S2	S3	S5	Among People exposed sometime	E2	E3	S4	Among People never exposed		
1 through 32														
Wrong	5	9	3	5	0	5	6		14	6	12			
Right	27	23	29	27	32	27	26		18	26	20			
Total	32	32	32	32	32	32	32		32	32	32			
% of Wrong	15.6	28.1	9.4	15.6	0	15.6	18.7	23.7	18.7	37.5				
% of Right	84.4	71.9	90.6	84.4	100	84.4	81.3	85.3%	56.3	81.3	62.5	80.6%		

(Source: from **Table: Data 2** and **Data 4**)

Table: Learned to Speak Mandarin Chinese among the Informants

7. Have you learnt to speak Mandarin Chinese before?	never	never	never	never	never	never	never	never	never	never	Right Average rate	few words	Right Average rate	
Question Item	E1	E2	E3	E4	E5	S1	S3	S4	S5	Among People never learnt	S2	Among People learnt few words		
1 through 32														
Wrong	5	14	6	9	3	5	5	12	6		0			
Right	27	18	26	23	29	27	27	20	26		32			
Total	32	32	32	32	32	32	32	32	32		32			
% of Wrong	15.6	23.7	18.7	28.1	9.4	15.6	15.6	37.5	18.7	0				
% of Right	84.4	56.3	81.3	71.9	90.6	84.4	84.4	62.5	81.3	77.4%	100	100%		

(Source: from **Table: Data 2** and **Data 4**)

Based on the two tables above, it looks like the people who exposed to Mandarin Chinese sometime got correct answer with 85.3% are higher than those who have ever heard it before with 80.6%; and the person who've learned and could say few Mandarin words getting 100% correct answer that was much higher than those people who've ever learnt to speak Mandarin (77.4%).

7. The most Right vs. Most Wrong Answer Items

The table below shows the most right and most wrong answer items that made by the English and Spanish answers:

Table: Most Wrong vs. Most Right Items in the Survey

	Question Item	English Speakers			R % of English	Spanish			R % of Spanish	R % of Average
		W	R	Total		W	R	Total		
A	1. zī (fund)资 / zī (fund)资	1	4	5	80	0	5	5	100	90
	6. zì (self)自 / zì (self)自	0	5	5	100	1	4	5	80	90
	24. zì (self) 自 / zì (self)自	0	5	5	100	1	4	5	80	90
	9. cí (word)词 / cí (word)词	0	5	5	100	0	5	5	100	100
	13. shí (stone)石 / shí (stone)石	0	5	5	100	0	5	5	100	100
B	3. zí (a sound)滋 / zhí (straight)直	0	5	5	100	1	4	5	80	90
	8. cī (flaw)疵 / chī (eat)吃	0	5	5	100	0	5	5	100	100
	22. cí (word)词 / shí (stone)石	0	5	5	100	1	4	5	80	90
	4. cǐ (this)此 / chǐ (tooth)齿	1	4	5	80	1	4	5	80	80
	11. cì (sting)刺 / chì (wing)翅	1	4	5	80	0	5	5	100	90
	12. sī (silk)丝 / shī (poetry)诗	1	4	5	80	1	4	5	80	80
	14. sǐ (die)死 / shǐ (history)史	0	5	5	100	1	4	5	80	90
	27. sǐ (die)死 / shǐ (history)史	1	4	5	80	0	5	5	100	90
15. sì (four) 四 / shì (city)市	2	3	5	60	1	4	5	80	70	
C	2. zhī (know)知 / zī (fund)资	0	5	5	100	0	5	5	100	100
	16. zhí (straight)直 / shí (stone)石	1	4	5	80	1	4	5	80	80
	30. zhí (straight)直 / shí (stone)石	0	5	5	100	0	5	5	100	100
	5. zhǐ (finger)指 / zǐ (son)子	2	3	5	60	0	5	5	100	80
	31. zhǐ (finger) 指 / sǐ (die) 死	0	5	5	100	0	5	5	100	100
	7. zhì (quality)质 / zì (self)	1	4	5	80	0	5	5	100	90
	10. chí (pool)池 / cí (word)词	1	4	5	80	0	5	5	100	90
	26. chí (pool)池 / cí (word)词	0	5	5	100	0	5	5	100	100
	23. chǐ (tooth)齿 / sǐ (die) 死	0	5	5	100	0	5	5	100	100
	28. chì (wing)翅 / shì (city)市	1	4	5	80	0	5	5	100	90
	18. shī (poetry)诗 / cī (flaw)疵	0	5	5	100	0	5	5	100	100
21. shī (poetry)诗 / sī (silk)丝	2	3	5	60	0	5	5	100	80	
D	20. zì (self)自 / cì (sting)刺	5	0	5	0	3	2	5	40	20
	29. zì (self)自 / cì (sting)刺	2	3	5	60	4	1	5	20	40
	17. zī (fund)资 / cī (flaw)疵	4	1	5	20	2	3	5	60	40
	19. cǐ (this)此 / zǐ (son)子	4	1	5	20	4	1	5	20	20
	32. cì (sting) 刺 / zì (self) 自	4	1	5	20	3	2	5	40	30
	25. sī (silk) 丝 / zī (fund)资	3	2	5	40	3	2	5	40	40

(Source: from **Table: Data 2** and **Data 4**)

The source in the table above is from the **Table: Data 2** and **Data 4** but rearranged by A, B, C, and D four areas.

The area **A** (with blue highlight) contains five exact same minimal pairs of Mandarin consonants that are zi, ci, shi and their different tones. There was no problem for both most of the English and Spanish listeners to mark they are the “Same”, no matter they are initial with zi and ci without the [ʈʂɨ] sound (tongue curled back) but shi [ʈʂɨ] is with it.

The area **B** includes nine minimal pairs. The left side of them is zi, ci, and si while the right side lists zhi, chi, and shi which are with the [ʈʂɨ] sound (tongue curled back). The informants’ responds were good with correct check from 70% to 100%.

The area **C** (with grey highlight) indicates that there were 12 pairs with initial words zhi, chi, and shi with the [ʈʂɨ] sound (tongue curled back) while their opposite were zi, ci, si, or shi. Half of the pairs were marked correctly with 100% and another half were with 80% to 90% right rate.

The most wrong answers were in the area **D** in contrast to the most right answer were in the area **C**. The right answer percentage numbers were highlighted with red that meant the six minimal pairs of Mandarin consonants, zi, ci, and si with their different tones, were as low as 20, 30, and 40 percent. The special note here is that there were no any [ʈʂɨ] sound (tongue curled back) consonants as their pair-mates in these minimal pairs, zi, ci, and si. In another word, they were the hardest distinction without their comparison of the [ʈʂɨ] sound (tongue curled back).

The further analysis could be turning the data of the area **C** and **D** into a phonemic representation:

(i) the area C:

__ V

2. zhī (know)知 / zī (fund)资	zh post-alveolar, affricate (unaspirated)	z dental, affricate (unaspirated)
16. zhí (straight)直/ shí (stone)石		
30. zhí (straight)直/ shí (stone)石		
5. zhǐ (finger)指/ zǐ (son)子		
31. zhǐ (finger)指/ sǐ (die)死		
7. zhì (quality)质/ zì (self)自		
10. chí (pool)池 / cí (word)词	ch post-alveolar, affricate (aspirated)	c dental, affricate (aspirated)
26. chí (pool)池 / cí (word)词		
23. chǐ (tooth)齿 / sǐ (die)死		
28. chì (wing)翅/ shì (city)市		
18. shī (poetry)诗/cǐ (flaw)疵	sh post-alveolar, fricative	s dental, fricative
21. shī (poetry)诗/ sī (silk)丝		

** /zh ch sh / and /z c s/ are complementary distribution

(ii) the area D:

__ V

20. zì (self)自/ cì (sting)刺	z dental, affricate (unaspirated)	c dental, affricate (aspirated)
29. zì (self)自/ cì (sting)刺		
17. zī (fund)资/ cǐ (flaw)疵		
19. cǐ (this)此 / zǐ (son)子	c dental, affricate (aspirated)	z dental, affricate (unaspirated)
32. cì (sting)刺/ zì (self)自		
25. sī (silk)丝 / zī(fund)资	s dental, fricative	

** As a contrastive distribution, /z c s/ = C dental

Thus it can be seen that the most correct answer were at the area **C** that was because the Mandarin phonemes /zhi chi shi / and /z c s/ are complementary distribution, while the most incorrect answers were at the area **D** that was since the phonemes /z c s/ are at the same point of articulation which made the hearing test receivers cannot distinguish them exactly.

VI. DIRECTIONS FOR FURTHER WORK

After completing each part above, we feel that this project was very interesting. We love to do the library and internet research for the problem statement, set up the hypotheses with the method of science study, designed the methodology for our on going survey, and found the surprise results at the last – we even thought that it would be nobody who can distinguish the 32 pairs of Mandarin consonants! Now we believe that there are great potential ability of learning Chinese from English and Spanish Speakers.

For further work, we will be able to:

- (1) use professional theories such as speech organs, phonetic and phonemic, problems in phonemicization, and many more to describe the problem statement and the interpretation of findings;
- (2) design carefully for the questionnaire that contains and covers the point and manner of articulation equally, for example, there were only “c” and “z” as the pair-mates on the right side in the **(ii) the area D** analysis above. It missed “s”;
- (3) apply the statistics method, SPSS (Statistical Package of the Social Sciences) software, for instance, to find the meaningful data of significant difference, not only the percentages;
- (4) select informants with similar background so the comparison is on the equal base; and
- (5) collect data from a wider scope, another word, have more informants to be involved in the survey. The more informants, the more persuasions.

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