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The psychological reality of phonological representations: The case of Mandarin fricatives

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This study investigates the psychological reality of the phonological representations of two Mandarin fricatives [s] and [ɕ] by comparing these sounds with a contrastive sound [f], and with the same sounds in Korean in which the two sounds are allophonic. Three tasks were employed to test contrast/allophony in perceiving and processing [ɕ] and [s]: discrimination on a continuum, similarity rating, and semantic priming. Taken together, the categorical perception on a [s]-[ɕ] continuum, and the phonemic-like judgment on the similarity rating task suggest that the relationship between [s] and [ɕ] are more phonemic than allophonic. The different results from the semantic priming task are due to a different level of processing.

1. Introduction

Mandarin Chinese has three palatals [tɕ, tɕʰ, ɕ] that are in complementary distribution with the velars [k, kʰ, x], the dentals [ts, tsʰ, s], and the retroflexes [tʂ, tʂʰ, ʂ]. The palatals co-occur with the high-front-vowels [i, y] and glides [j, ɥ] while other series do not (Duanmu 2007), as shown in (1).

(1) COMPLEMENTARY DISTRIBUTION OF MANDARIN FRICATIVES

tɕ, tɕʰ, ɕ	before [i, y] or [j, ɥ]
ts, tsʰ, s	before non-high-front vowels/glides
k, kʰ, x	
tʂ, tʂʰ, ʂ	

Several hypotheses on the representations of the palatals are therefore proposed as to which series they should be identified with. Chao (1934) uses data from word games to argue that [tɕ, tɕʰ, ɕ] should be underlying /k, kʰ, x/[1], while Hartman (1944) and

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[1] Chao (1934) reports on a set of word games that appear to show [k]~[tɕ] alternation.

(i) tʰa → tʰai **k**a
kʰʊŋ → kʰwai **k**ʊŋ

Duanmu (2007) argue that [tɕ, tɕʰ, ɕ] should be identified with /ts, tsH, s/ from an etymological point of view and phonotactic restrictions, respectively. On the other hand, Cheng (1968) argues that some instances of [tɕ, tɕʰ, ɕ] should be identified with /ts, tsH, s/, and some instances should be identified with /k, kʰ, x/ etymologically, but Cheng (1973) later argues that [tɕ, tɕʰ, ɕ] should be independent/underlying segments.

Wan (2010) conducted four experiments, onset similarity, sound contraction, sound similarity, and sound expansion, aiming to investigate the psychological status of palatals.[2] The results show that there was an asymmetrical response from Mandarin native speakers in terms of palatals and dentals with respect to the other series, and thus suggest that palatals should not be independent, and should be identified with dentals. However, two of these experiments used real words (words that are legal phonotactically) as stimuli, and employed tasks that directly compared the similarity among palatals, dentals, velars, and retroflexes. One can argue that the results only show that the palatals are perceptually more similar to the dentals than the other series.

The current study investigates the palatal [ɕ] and the dental [s], two sounds that are suggested to be underlyingly related in Wan (2010). To avoid direct comparison with the other series in complementary distribution, this study uses a contrastive sound, [f], as a comparison in Mandarin. If [ɕ] and [s] are perceived not different from those with [f], then [ɕ] and [s] should be considered different categories. This study also compares [ɕ] and [s] in Mandarin with the same pair of sounds in Korean, in which the two sounds are allophones. If Mandarin listeners' perception of [ɕ] and [s] are similar to Korean listeners' perception of the same sounds, then [ɕ] and [s] should be considered variants of the same category.

Three previously established methods of testing speakers' perception and processing of sounds are employed to test contrast/allophony in perceiving and processing [s] and [ɕ], discrimination on a continuum, similarity rating, and semantic priming. The results suggest that the perception of [s] and [ɕ] is similar to the perception of separate categories, and thus suggest that [s] and [ɕ] should be of different categories.

This paper reports the results from the three experiments that suggest [ɕ] and [s] are perceived as separate categories in sections 0, 0, and 0, respectively, and a conclusion is provided in section 0.

2. Experiment I – Discrimination on a continuum

Studies of discrimination on a continuum show that speakers discriminate better when sounds are categorically/phonemically different in their native language (Best et al. 1988; Lasky et al. 1975; MacKain et al. 1981; Werker & Lalonde 1988). Werker & Lalonde (1988) show that Hindi speakers identified three categories (two categorical boundaries) from an eight-step continuum from [pʰa] to [ba], and when presented with pairs from the same continuum, Hindi speakers discriminated better when the pairs

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ɕjʊŋ	→	ɕɥɛ **tɕ**jʊŋ
liŋ	→	lje **tɕ**iŋ

[2] The participants in these four tasks were instructed to choose one from the three items played acoustically to them per trial. The tasks were to see, in the absence of palatals, which series, dentals, velars, or retroflexes, the participants would choose to replace palatals.

crossed the categorical boundaries, consistent with the Hindi three-way contrast of stops (aspirated, unaspirated voiceless, voiced). On the other hand, when English speakers were presented with the same continuum, only two categories were identified (one categorical boundary), and only discriminate better when the sound pairs crossed the categorical boundary, reflecting the two-way contrast of stops in English (voiceless, voiced).

2.1. Methodology

Following up on the previous research, this experiment was designed to see how Mandarin listeners behave when presented with a continuum from [s] to [ɕ].[3] I used an eight-step synthesized continuum from [s] to [ɕ] to test Mandarin listener's discrimination of pairs along the continuum.[4] Another eight-step continuum from [f] to [s] was synthesized as a comparison. If there is a categorical boundary present only for the [f]-[s] continuum, and no boundary present for the [s]-[ɕ] continuum, it suggests that [s] and [ɕ] are perceived as variants of the same category. If there is a boundary present for both continua, it suggests that [s] and [ɕ], just like [s] and [f], are perceived as separate categories.

The experiment was in ABX discrimination paradigm. 12 two-step pairs (6 pairs from each continuum) in four orders (ABB, ABA, BAA, BAB) were presented in different random order for each participant, using E-Prime software (v2.0; Psychological Software Tools, Pittsburgh, PA). 20 Mandarin listeners took part in the experiments in a group of up to four people, or individually, using a computer that was connected to a keyboard with two keys labeled '1' and '2.' In the experiment, participants were instructed in Mandarin that they would hear three sounds in one trial, and they were asked to judge if the 1st sound was the same as the 3rd sound, or the 2nd sound was the same as the 3rd sound. The participants completed a 10-trial practice, and had the opportunity to ask questions before proceeding to the experiment.

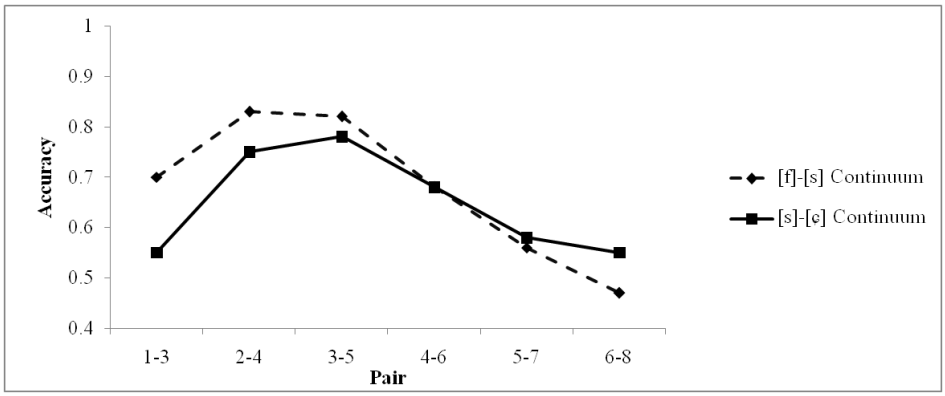
[3] Due to the restrictions of the phonotactics of Mandarin, [s] and [ɕ] cannot be compared in identical vowel contexts. Therefore, I used just the frication part from syllables [si] and [ɕi].

[4] The endpoints [s] and [ɕ] were spliced out using Praat software package (http://www.praat.org) from natural productions of [si] and [ɕi]. The endpoints were synthesized proportionally to create an eight-step continuum using Audacity (http://audacity.sourceforge.net/). Step 1 was created by overlap 7 tracks of the endpoint [s], and step 2 was created by overlapping 1 track of endpoint [ɕ] with 6 tracks of endpoint [s], etc. The intensity of the stimuli was scaled to 56 dB, the averaged intensity of the endpoints [s] and [ɕ]. The continuum of [f]-[s] was created similarly.

2.2. Results

The accuracy of discrimination on the two continua is illustrated in (2).

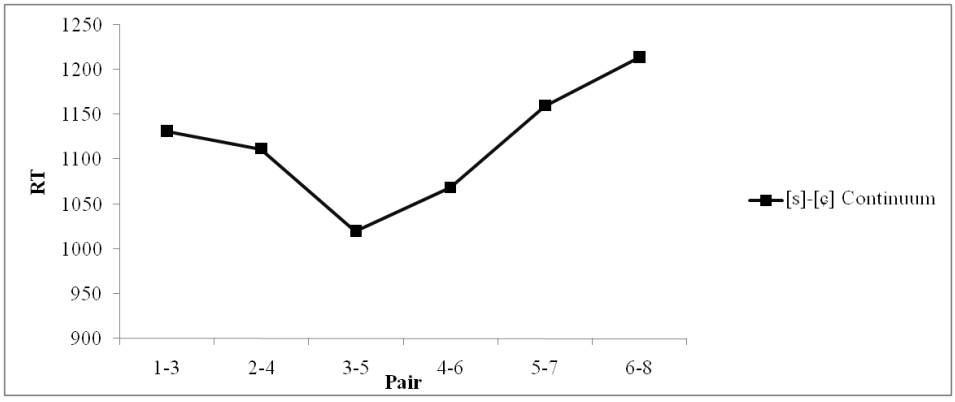
(2) ACCURACY ON THE TWO CONTINUA



As we can see from the line movements in (2), there was a boundary present in both continua around pairs 2-4 to 3-5 for [f]-[s] continuum, and around 2-4 to 4-6 for [s]-[ɕ] continuum. A repeated measure analysis confirmed this observation. For [f]-[s] continuum, there was a main effect of PAIR ($F(5,95)=22.149$, $p<.001$), which means that the accuracy was not the same for all the pairs. Pairwise comparisons showed that pairs 2-4 and 3-5 were not significantly different ($p=.859$), but pairs 1-2 and 2-4, and pairs 3-5 and 4-6 were significantly different (both $p<.001$). This suggests that the perceptual boundary is around pairs 2-4 and 3-5. Similarly, a repeated measure analysis was run on the [s]-[ɕ] continuum. There was also a main effect of PAIR ($F(5,95)=9.610$, $p<.001$). Pairwise comparisons among pairs 2-4, 3-5, and 4-6 were shown not significant (all $p>.05$). On the other hand, pairs 1-2 and 2-4, and 4-6 and 5-7 were significantly different (both $p<.05$).

The results from the response time (RT) also suggest that there was a perceptual boundary around pairs 2-4 to 4-6 on the [s]-[ɕ] continuum, as shown in (3).

(3) RT FOR [s]-[ɕ] CONTINUUM



The RTs showed a quadratic trend. The valley (pairs 2-4 to 4-6) corresponded nicely to the peak of the accuracy. In other words, Mandarin listeners took less time and responded more accurately around pairs 2-4 to 4-6. The results for the Mandarin group parallel the finding reported in other studies in which RT serves as a positive function of uncertainty (Pisoni & Tash 1974): when the comparisons of two sounds were across categorical boundary, the RTs were shorter; when the comparisons of two sounds were within a category, the RTs were longer.

The results from accuracy and RT showed that there was a perceptual boundary on the [s]-[ɕ] continuum, just like on the [f]-[s] continuum. This suggests that the perception of [s] and [ɕ] is not different from that of two contrastive sounds.

3. Experiment II – Similarity Rating

In similarity rating tasks, listeners tend to rate allophones as more similar than phonemes (Babel & Johnson 2010; Boomershine et al. 2008; Johnson & Babel 2010). Boomershine et al. (2008) tested native English and Spanish speakers' similarity judgments of [ð], [d], and [P] using an AX paradigm. [ð], and [d] are contrastive in English but allophonic in Spanish while [d] and [P] are contrastive in Spanish but allophonic in English. Participants were asked to rate the similarity between a pair of sounds that they just heard from the following VCV sequences, [ada], [aPa], [aða], [idi], [iPi], [iði], [udu], [uPu], and [uðu], on a scale of 1-5, in which 1 was 'very similar' and 5 was 'very different'. The results show a clear native language effect with English speakers rating [d] and [P] as most similar, but Spanish speakers rating [ð] and [d] as most similar.

3.1. Methodology

This set of experiments was designed to investigate how Mandarin and Korean listeners rate the target sounds, [s] and [ɕ]. Korean is chosen to be the comparing language because [s] and [ɕ] display complementary distribution and take part in rich morphological alternations. We expect a more similar rating between [s] and [ɕ] for Korean listeners due to their allophonic status. The goal of this experiment is to see how Mandarin listeners rate the similarity between the two target sounds. If the ratings are comparable to those of Korean listeners, then [s] and [ɕ] are allophonic, just like those in Korean. If the ratings are not comparable to those of Korean listeners, then [s] and [ɕ] are perceived as different categories.

12 disyllabic VCV stimuli were used in this set of experiments. They were composed of the target fricatives [s, ɕ] along with two other fricatives [f, h] as controls, embedded in three vowel contexts [a_a], [i_i], and [u_u].[5] The tokens were produced by a native Mandarin speaking trained phonetician. The speaker recorded multiple examples of the stimuli with high tone on both syllables. One instance of each VCV was selected as the test item. In order to control the amplitude across tokens, the amplitude was scaled to 65 dB, the rough average of the amplitudes of all the tokens, for each of the tokens. All the tokens were approximately matched on intonation and duration.

20 Korean and 20 Mandarin speakers participated in this experiment. Participants in the Mandarin group were recruited in Taiwan. Participants in the Korean groups were all native speakers of Korean from South Korea, and were recruited in Stony Brook

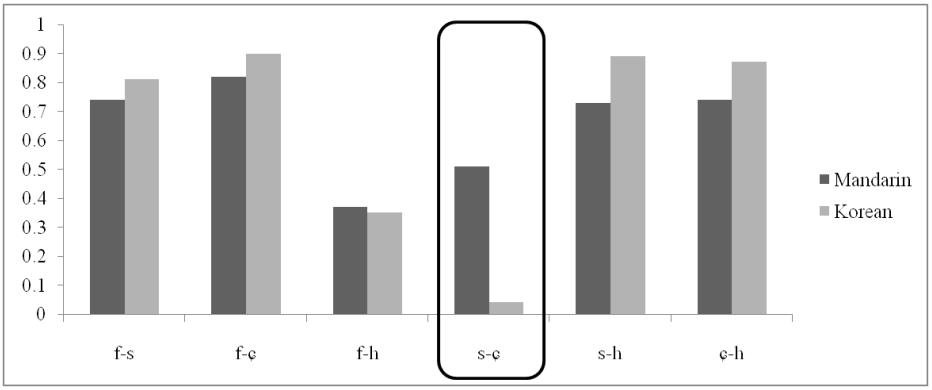
[5] Materials consisted of two tokens of each of the following VCV sequences: [asa][aʲa][afa][aha], [isi][iʲi][ifi][ihi], or [usu][uʲu][ufu][uhu].

University. They all received up to high school education in South Korea before they came to Stony Brook for undergraduate or graduate education.

3.2. Results

To reduce the variability in analyzing the results of this experiment, the rating scores for each participant were standardized to compensate for differences in using the 5-point scale (Boomershine et al. 2008). The standardized scores were centered around zero, with scores above zero indicating 'more different' and scores below zero indicating 'more similar.' The results are shown in (4).

(4) SIMILARITY RATING NORMALIZED RESULTS



From the figure in (4), we can see that, except from the target pair [s-ɕ], the ratings were very similar for the two languages.

A repeated measure analysis (LANGUAGE: Mandarin, Korean; PAIR: [f-s, f-ɕ, f-h, s-ɕ, s-h, ɕ-h]) was performed to interpret the results. The analysis showed that there was a main effect of PAIR ($F(5,38)=73.545$, $p<.001$). In other words, the pairs were not all rated the same. There was also a significant PAIR by LANGUAGE interaction ($F(5,190)=15.077$, $p<.001$), meaning that a participant's response to a given pair was dependent on the language group he/she was in. Simple effect of LANGUAGE in [s-ɕ] pair was significant ($F(1,38)=36.692$, $p<.001$), meaning that the ratings of [s-ɕ] pair from Mandarin and Korean groups were statistically different.

We found that Mandarin listeners rated [s-ɕ] significantly more different to each other than did Korean listeners. This suggests that Mandarin listeners perceive [s] and [ɕ] as different categories.

4. Experiment III – Semantic Priming

Previous research has found priming effects between variant pronunciations of a category, but not between sounds belonging to different categories (Ernestus & Baayen 2007; Ranbom & Connine 2007; Sumner & Samuel 2005). In a series of experiments using semantic priming and lexical decision, Sumner & Samuel (2005) found that the target word *music* was primed by the word *flute* articulated with any of the three variants of final [t] (canonical [t], coarticulated [ʔtˤ] and glottalized [ʔ]). However, when the subjects were presented with a contrastive phoneme [flus], no priming effect was shown.

4.1. Methodology

Following up on research showing a priming effect between allophonic variants but not between contrastive sounds, this experiment was designed to investigate the extent to which [s] primed [ɕ], or vice versa in Mandarin. The results were compared with the priming effects when [s] and [ɕ] were changed into a contrastive sound [f]. We expect facilitation of lexical decision to a semantically related target to a [s]-prime, or to a [ɕ]-prime (e.g., [**s̻i**-jaŋ]*'breed'* primes [toŋ-wu] *'animal'*). We should find no/less facilitation when [s/ɕ] are changed into a contrastive sound (e.g., *[**fi**-jaŋ] should not prime [toŋ-wu]). If we find facilitation when [s] is changed into [ɕ] or vice versa, then the two fricatives should be variants of the same category (e.g., *[**ɕi**-jaŋ] primes [toŋ-wu]). On the contrary, if we do not find facilitation, then [s] and [ɕ] should belong to different categories (e.g., *[**ɕi**-jaŋ] does not prime [toŋ-wu]).

A set of examples is listed in (5), and the complete wordlist can be found in the appendix. Notice that the stimuli for the swapping and contrastive conditions are illegal sequences in Mandarin because of the vowel contexts: [ɕ] does not occur before non-high-front vowels, and [s] does not occur before high-front vowels.

(5) Stimuli for semantic priming

SAME	[s̻-jaŋ] 'breed' [ɕi-jan] 'banquet'	[toŋ-wu] 'animal' [tɕje-hun] 'wedding'
SWAPPING	*[ɕ̻-jaŋ] *[si-jan]	[toŋ-wu] 'animal' [tɕje-hun] 'wedding'
CONTRASTIVE	*[f̻-jaŋ] *[fi-jan]	[toŋ-wu] 'animal' [tɕje-hun] 'wedding'

60 Mandarin speaking participants were recruited in Taiwan and were randomly assigned to the three experimental conditions, SAME, SWAPPING, and CONTRASTIVE. In the SAME conditions, [s/ɕ] were kept unchanged. In the SWAPPING condition, [s] and [ɕ] were swapped, and in the CONTRASTIVE condition, [s/ɕ] were changed into a contrastive sound [f]. Among the 72 primes, 36 were connected with related targets, and the other 36 were connected with unrelated targets.[6] The priming effects were calculated by subtracting the unrelated RTs from the related RTs.

Participants completed the experiment individually or in groups of up to four in a sound-treated booth. Each participant received one experimental list (SAME condition, SWAPPING condition, or CONTRASTIVE condition). Therefore, each participant heard each prime and target only once. All stimuli were presented in a different random order for each participant using E-Prime software. On each trial, participants were presented with an auditory prime, followed by a 500 ms ISI, followed by an auditory target. Participants were instructed to make a lexical decision for the target. Example stimuli were provided and each participant completed a practice session with 8 trials.

[6] A norming pretest was done to select semantically related word pairs. Three lists of disyllabic [s] and [ɕ] onset words were put together. These lists were presented to 10 Taiwanese Mandarin speakers. They were instructed to write down a related word for each item. 72 [s] and [ɕ] onset words were selected from each list as primes (36 [s] onset words and 36 [ɕ] onset words). The average response of the participants for the related prime-target pairs was 39%.

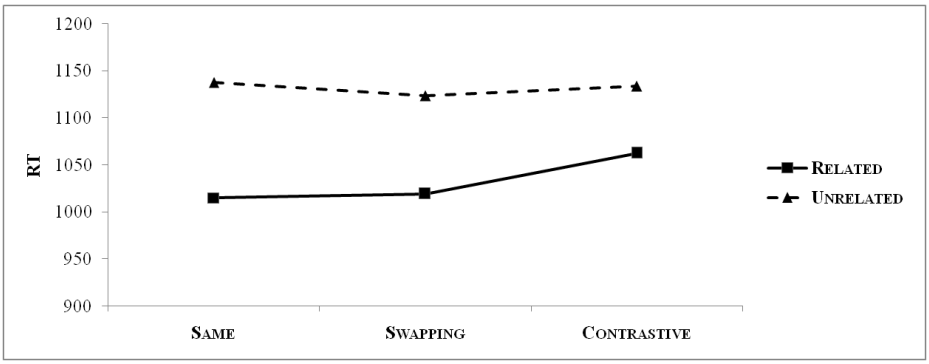
4.2. Results

The mean RTs and the priming effects (the difference between RELATED and UNRELATED) for the three experimental conditions are shown in (6) with standard deviations in parentheses, and are illustrated in (7).

(6) SEMANTIC PRIMING RTS AND STANDARD DEVIATIONS

CONDITION / RELATION	SAME	SWAPPING	CONTRASTIVE
RELATED	1014.94 (110.34)	1019.19 (106.21)	1062.26 (135.16)
UNRELATED	1137.34 (116.27)	1123.48 (107.22)	1133.46 (139.57)
PRIMING EFFECT	122.4	104.29	71.2

(7) SEMANTIC PRIMING RESULTS



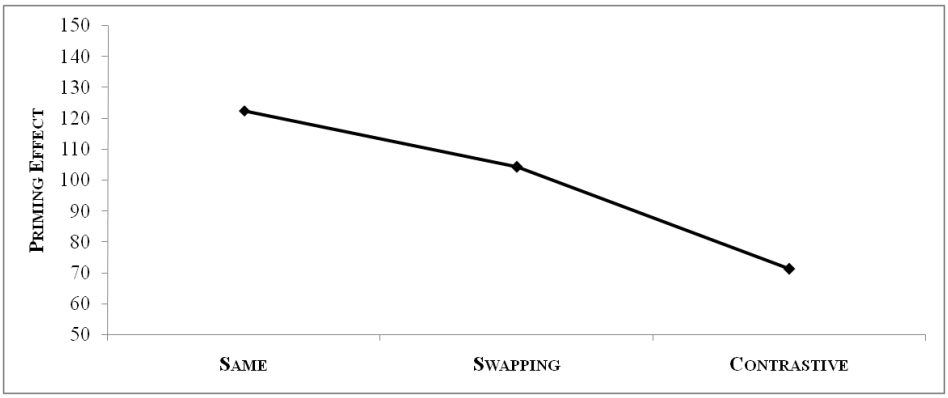
Two-way ANOVAs (**CONDITION**: SAME, SWAPPING, CONTRASTIVE **X RELATION**: RELATED or UNRELATED) were performed for subject ($F1$) and item ($F2$).[7] Overall, reaction times were significantly faster for related targets than for unrelated targets ($F1(1, 57) = 171.660$, $p<.001$; $F2(1, 210) = 47.836$, $p<.001$). Planned comparisons showed that targets preceded by related primes were identified more quickly than unrelated primes in all three conditions (SAME $F1(1, 19)=85.445$, $p<.001$, $F2(1, 70)=23.178$, $p<.001$; SWAPPING $F1(1, 19)=44.004$, $p<.001$, $F2(1, 70)=19.767$, $p<.001$; CONTRASTIVE $F1(1, 19)=53.678$, $p<.001$, $F2(1, 70)=7.699$, $p<.01$). Simple effect of condition in RELATED was not significant ($F1(2, 57)=.985$, $p=.380$, $F2(2, 105)=2.815$, $p=.064$) nor does the simple effect of condition in UNRELATED ($F1(2, 57)=.069$, $p=.933$, $F2(2, 105)=.137$, $p=.873$).

The factor CONDITION yielded a significant effect in an analysis on priming effects (difference of the RTs in RELATED and UNRELATED in each condition), as illustrated in (8) ($F(2, 117)=4.356$, $p<.05$). Pairwise comparisons showed that only the priming effects in

[7] The results reported here are based on the unscreened data. The screened data (excluding RTs when the lexical decisions were wrong; 253 cases were tossed out), though produced lower standard deviations, yielded the same statistical results.

the SAME & CONTRASTIVE conditions were statistically different ($p<.05$); the other two pairwise comparisons (SAME & SWAPPING, SWAPPING & CONTRASTIVE) were not different (both $p>.1$).

(8) PRIMING EFFECTS



If [s] and [ɕ] are variants of the same phoneme, we should expect a significant difference between SWAPPING and CONTRASTIVE conditions, but not between SAME and SWAPPING conditions. If [s] and [ɕ] are contrastive, we should expect a significant difference between SAME and SWAPPING conditions, but not between SWAPPING and CONTRASTIVE. However, the results do not show a three-way difference in RT corresponding to same, allophonic, or contrastive sounds.

4.3. Discussion

The results from semantic priming do not seem to conform to the previous two experiments in which [s] and [ɕ] are shown to belong to separate categories. A possible explanation for the results is the illegal stimuli in the SWAPPING and CONTRASTIVE conditions. Mandarin listeners might repair the sounds [s], [ɕ], and [f] in these illegal sequences to a phonetically similar sound that leads to legal sequences. In other words, the priming effects might be due to a repair strategy from the perception.

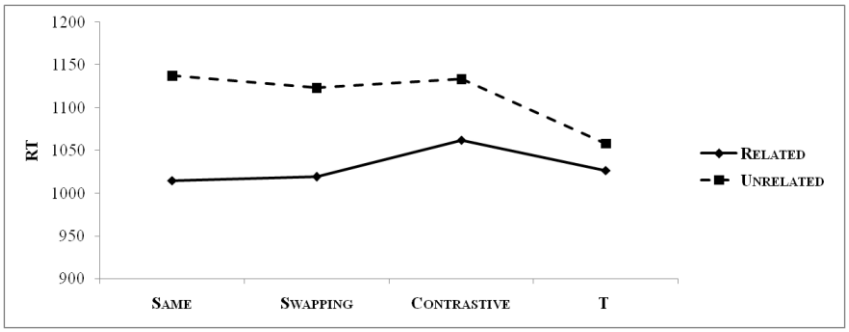
I conducted a follow-up experiment to test this possibility. A fourth condition was added with a contrastive sound that has less phonetic similarity (e.g., [t^h], T condition). Among the stimuli, half of them were illegal sequences, and the other half were legal ones. If the explanation is correct, we should expect an even less priming (or no priming) for the T condition, and we should only find priming effects for the illegal stimuli since Mandarin listeners would repair the illegal sequences, but not the legal ones. The fourth condition, together with the previous three, is listed in (9).

(9) T CONDITION

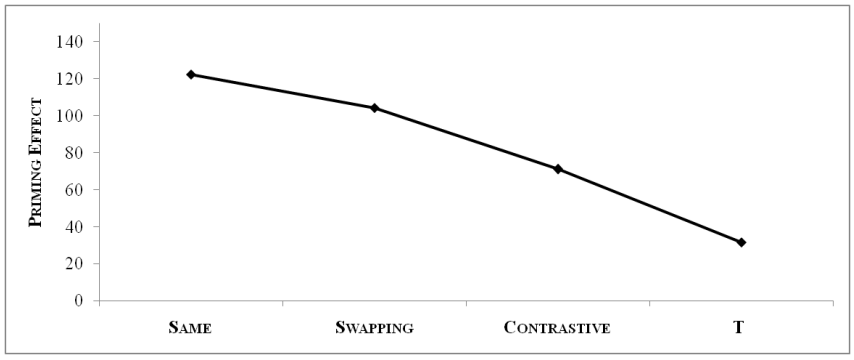
CONDITION		Prime	Target
SAME		[**s**\-jaŋ] ‘breed’ [**ɕ**i-jan] ‘banquet’	[toŋ-wu] ‘animal’ [tɕje-hun] ‘wedding’
SWAPPING		*[**ɕ**\-jaŋ] *[**s**i-jan]	[toŋ-wu] ‘animal’ [tɕje-hun] ‘wedding’
CONTRASTIVE		*[**f**\-jaŋ] *[**f**i-jan]	[toŋ-wu] ‘animal’ [tɕje-hun] ‘wedding’
T CONDITION	(illegal) (legal)	*[**t**^{h}\-jaŋ] [**t**^{h}i-jan]	[toŋ-wu] ‘animal’ [tɕje-hun] ‘wedding’

The results are illustrated in (10). Simple effect of relation in T condition was significant ($F(1, 39) = 9.211$, $p<.005$). In other words, there is still priming in [t] condition. However, the priming effect was significantly less than the other three conditions (all pairwise comparisons $p<.05$), as illustration in 0.

(10) [T] CONDITION RESULTS



(11) [T] PRIMING EFFECTS



The less priming of the fourth condition suggests that Mandarin listeners do perceptually look for a phonetically similar sound to map onto, and that is the reason that

the priming effect of T condition has the least priming effects. If we break the fourth condition into legal and illegal sequences, we see that only the illegal ones have priming (significant simple effect of relation in T-illegal, $F(1,29)=9.173$, $p<.01$) while the legal ones do not ($F(1,19)=2.587$, $p=.124$). This suggests that Mandarin listeners only perceptually repair the illegal sequences.

To summarize this section, at the first sight, the results from semantic priming did not conform to the findings from the previous two experiments. However, after a closer look, the different results reflect a different level of processing in which Mandarin listeners perceptually look for a phonetically similar sound to repair an illegal sequence.

5. Conclusion

This study investigates the psychological reality of the phonological representations of two Mandarin fricatives [s] and [ɕ] by comparing these sounds with a contrastive sound, and with the same sounds in another language. Taken together, the categorical perception on a [s]-[ɕ] continuum, and the phonemic-like judgment on the similarity rating task suggest that the relationship between [s] and [ɕ] are more phonemic than allophonic. The different results from the semantic priming task are due to a different level of processing. The results also shed light on the definition of phonological relationships. Sounds in complementary distribution, like [s] and [ɕ] in Mandarin, need not map onto the same underlying representation, as defined by the traditional structuralist approach. Factors other than distribution need to be taken into account, such as morphological alternation, or phonetic similarity. Future research on how different factors play a role in defining phonological relationships is needed.

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APPENDIX

	ɕ word			**s word**			
1	xiguan 習慣	19	xiwang 希望	1	sewe 四維	19	sekau 思考
2	xigua 西瓜	20	xiyin 吸引	2	sehu 似乎	20	sewang 死亡
3	xiyou 稀有	21	xicao 洗澡	3	seliao 飼料	21	sefa 司法
4	xixiau 嘻笑	22	xishue 溪水	4	seli 私立	22	seji 司機
5	xiguan1 吸管	23	xire 昔日	5	sepiao 撕票	23	senien 思念
6	xinu 息怒	24	xifong 隙縫	6	seliang 思量	24	segei 賜給
7	xifang 西方	25	xinwen 新聞	7	sefong 祀奉	25	sechu 四處
8	xifu 媳婦	26	xinku 辛苦	8	sechuan 四川	26	sefu 賜福
9	xiyan 喜宴	27	xinren 信任	9	sepuo 撕破	27	sexia 私下
10	xinchu 新竹	28	xingtsuo 星座	10	seyang 飼養	28	sejin 絲巾
11	xinshuei 薪水	29	xingxiang 性向	11	semiao 寺廟	29	segue 絲瓜
12	xinguang 星光	30	xinshe 心事	12	sewen 斯文	30	seling 司令
13	xinyang 信仰	31	xintse 刑責	13	sechou 四周	31	sejiao 私交
14	xiyang 夕陽	32	xingyun 幸運	14	seyou 私有	32	seren 私人
15	xihuo 熄火	33	xingmin 姓名	15	sesing 私心	33	sehue 撕毀
16	xinqing 心情	34	xinren1 杏仁	16	senue 肆虐	34	sesin 死心
17	xinshang 欣賞	35	xinxing 新興	17	sezhi 四肢	35	sejiao1 死角
18	xingwei 行為	36	xingwu 省悟	18	semian 四面	36	sesha 廝殺