Post-Lexical Tone 3 Sandhi Domain-Building in Huai'an Mandarin: Multiple Domain Types and Free Application

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1 Introduction

This paper examines the production and acceptability data of the syntactic level tone sandhi patterns in the Huai'an dialect of Jianghuai Mandarin (Huai'an, hereafter), and argues that (i) both disyllabic and trisyllabic tone sandhi domains are basic domains in Huai'an, which differs from the traditional analysis where only disyllabic domain exists in Mandarin languages and trisyllabic domain is derived, and (ii) as a consequence, both types of domains can be built freely at the post-lexical level as long as all the syllables are exhaustively incorporated.

Huai'an has four phonemic tones, labelled as Tone 1, Tone 2, Tone 3 and Tone 4. Following the tradition of tone description in Chinese languages, in Table 1, the four tones are given in tone letters (Chao 1930) on a scale of 1 to 5, where 1 is the lowest pitch and 5 is the highest pitch, and followed by a contour description. Tone 3 is a low-register tone and the rest are high-register tones. For the rest of the paper, I will only use number in examples to refer to tones but not to tone letters; for example, "3" refers to Tone 3.

Phonemic Tone	Tone Letter	Contour Description
Tone 1	42	high falling
Tone 2	24	high rising
Tone 3	212	low/low rising
Tone 4	55	high level

Table 1: Descriptions of phonemic tones in Huai'an.

Huai'an has 6 tone sandhi rules as stated in Error! Reference source not found.:

(1) Low-Register Tone Sandhi (Tone 3 Sandhi) $3+3 \rightarrow 2+3$

High-Register Tone Sandhi $1+1 \rightarrow 3+1$ $1+2 \rightarrow 3+2$ $1+4 \rightarrow 3+4$ $4+4 \rightarrow 3+4$ $4+2 \rightarrow 3+2$

The focus of this paper is Tone 3 Sandhi, which is highly similar to Tone 3 Sandhi in Standard Mandarin for two reasons. First, the phonemes involved in this phonological process are highly similar. Both Tone 3 in Huai'an and Tone 3 in Standard Mandarin are low-register tones, and are realized phonetically as low tones at non-final positions and low tones plus final rising at final positions. Both Tone 2 in Huai'an and Tone 2 in Standard Mandarin are high-register rising tones. Second, both phonological processes obey right-headedness (Duanmu 1995), which means a Tone 3 undergoes tone sandhi with reference to another tone to the right as shown in (1).

However, unlike Standard Mandarin where only disyllabic tone sandhi domain is the basic domain type (Chen 2000, Shih 1997), both disyllabic and trisyllabic tone sandhi domains are basic domains in Huai'an. A tone sandhi domain is a prosodic domain within which tone sandhi applies.

In Standard Mandarin, according to Chen (2000) and Shih (1997), a trisyllabic sandhi domain only exists at sentence-final position through incorporation of a final stranded syllable after left-to-right binary parsing, as shown in (2):

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(2) $3 3 3 3 3 3 3 \rightarrow (2 3)(2 3)(2 3)3 \rightarrow (2 3)(2 3)(2 2 3)$

In Huai'an, however, a trisyllabic domain can appear at sentence-initial, sentence-medial and sentence-final positions. Furthermore, all the logical combinations of disyllabic and trisyllabic domains are attested for 5-syllable, 6-syllable and 7-syllable utterances consisting only of monosyllabic words, as shown in (3), which suggests that both disyllabic and trisyllabic domains function as basic domain in Huai'an (UR = underlying representation and SR = surface representation).

(3) a. li ciã ciã o teisu you want grab me wine "You want to rob me of wine." UR 3 3 3 3 3 3 $(2 \ 3)(2 \ 2 \ 3)$ SR1 SR2 $(2 \ 2 \ 3)(2 \ 3)$ b. li tsuŋ ciã ciã o tciəu you always want grab me wine "You always want to rob me of wine." UR 3 3 3 3 3 3 SR1 (2 3)(2 3)(2 3) SR2 $(2 \ 2 \ 3)(2 \ 2 \ 3)$ li kã ciã ciã o c. tsuŋ tciəu you always dare want grab me wine "You always seek to rob me of wine." 3 3 3 3 3 3 3 3 UR $(2\ 2\ 3)(2\ 3)(2\ 3)$ SR1 (23)(223)(23)SR2 SR3 (23)(23)(223)

2 The Experiments

To confirm the patterns presented in Section 1, we conducted two experiments. Experiment I was a production task through PsychoPy2 (Peirce et al. 2019) where 10 native speakers of Huai'an (6 male, 4 female, age 22 to 56) pronounced a list of 5-syllable to 7-syllable utterances similar to (3), namely consisting only of monosyllabic words. All the stimuli were included in the Appendix. Although all the participants were native speakers of both Huai'an and Standard Mandarin, they were explicitly asked to read only in Huai'an for the experiment. A native speaker of Huai'an (first author) checked all the recordings to ensure only Huai'an was used. All the participants were born and raised in Huai'an city.

The data of the production task was impressionistically annotated and counted by a native speaker of Huai'an (first author). The accuracy was checked by a match rate of 94% with a second native speaker annotator on 100 tokens that were randomly picked. The results are shown in Table 2 (next page).

As shown in Table 2, all logically possible combinations exist in natural speech, which confirms our analysis that both disyllabic and trisyllabic tone sandhi domains are basic domains in Huai'an. It is worth noting that not all combinations are equally preferred. For example, for 5-syllable stimuli, " $(2 \ 3)(2 \ 2 \ 3)$ " is preferred over " $(2 \ 2 \ 3)(2 \ 3)$ " based on higher count. The preference issue is not the focus of this paper. We will leave it to future research.

Stimulus	Surface Representation	Count
5-syllable	(2 2 3)(2 3)	83
	(23)(223)	182
6-syllable	(2 2 3)(2 2 3)	65
	(23)(23)(23)	77
7-syllable	(2 2 3)(2 3)(2 3)	27
	(23)(223)(23)	5
	$(2\ 3)(2\ 3)(2\ 2\ 3)$	6

Table 2: Experiment I results: Counts for each combination of 5-syllable, 6-syllable and 7-syllable stimuli, each combination given by multiple participants.

It is also worth noting that not all the examples collected in Experiment I are reported in Table 2. The example condition is summarized in Table 3. The main reason why some examples do not fit into the patterns reported in Table 2 is that the boundary between subject and predicate can optionally block the application of Tone 3 Sandhi in Huai'an, resulting in monosyllabic subjects in the stimuli to stay outside of a tone sandhi domain, e.g. "3 (23) (223)" when the first tone is a monosyllabic subject. These cases are reported in the rightmost column in Table 3. There are a small number of ambiguous data points that the annotator cannot tell the exact lexical tones. These cases are reported in the second to the right column in Table 3. Any potential influence of syntactic constituents is also not the focus of this paper, and is still under investigation.

Stimulus	Examples reported in Table 1	All examples collected from Experiment I	Ambiguous examples	Examples undergoing other rules not focused in this study
5-syllable	265	49x10=490	4	221
6-syllable	142	32x10=320	6	172
7-syllable	38	12x10=120	2	80

Table 3: Experiment I: Numbers of 5-syllable, 6-syllable and 7-syllable stimuli.

Experiment II was an acceptability judgement task where all logically possible domain combinations were compared with the obviously ungrammatical surface representation where no Tone 3 Sandhi was involved. By this logic, for example, for the utterance in (3a), the expected grammatical surface representations of " $(2 \ 3)(2 \ 2 \ 3)$ " and " $(2 \ 2 \ 3)(2 \ 3)$ " should be compared with the ungrammatical surface representation of " $3 \ 3 \ 3 \ 3$ " where no syllables underwent Tone 3 Sandhi. The prediction was that native speakers of Huai'an should judge all logically possible combinations to be significantly better than the ungrammatical surface representation where no syllables underwent Tone 3 Sandhi. In this experiment, instead of using utterances at the post-lexical level as in (3), 6syllable and 7-syllable flat-structure loanwords were employed to avoid potential influence of syntactic structures. Since T3 sandhi domain-building processes for flat-structure loanwords and the post-lexical utterances are identical (Chen 2000), the tone sandhi patterns of both types of utterances are expected to be the same. The two stimuli are shown in (4):

(4) Two Novel Foreign Names6-syllable word: mi ka ma ua li er7-syllable word: mi ka ma ua li po er

The two words were created to avoid any combination of adjacent syllables resulting in real meaningful words in Huai'an. Therefore, there was no internal morphological structures, which could also have an influence on the Tone 3 Sandhi domain-building process.

The participants were 6 native speakers of Huai'an (1 male, 5 female, age 22 to 51). 5 of them had participated in Experiment I. The interval of the two experiments was about two months, so

these speakers were unlikely to be influenced by their participation of Experiment I. In addition, all participants of Experiment I had been interviewed about what they thought the research question was after they completed the experiment, and none of them gave the right answer including the five speakers who later participated in Experiment II. The five speakers were not told the right answer until they finished Experiment II so the results of Experiment II should be considered to be reliable.

Judgement of acceptability was given on a scale of 1 to 7 with 1 being completely unacceptable and 7 being completely acceptable. The results are shown in Table 4.

Stimulus	Pairs compared	Wilcoxon test result
6-syllable	(2 2 3)(2 2 3) ~ *333333	V = 21, p = 0.03
	(2 3)(2 3)(2 3) ~ *333333	V = 15, p = 0.06
7-syllable	(2 2 3)(2 3)(2 3)~*3333333	V = 21, p = 0.04
	(2 3)(2 2 3)(2 3) ~*3333333	V = 21, p = 0.04
	(2 3)(2 3)(2 2 3) ~*3333333	V = 17.5, p = 0.17

Table 4: Experiment II results: Wilcoxon test results for pairs of expected grammatical combinations and ungrammatical surface representations for a 6-syllable and a 7-syllable loanwords.

As confirmed by a Wilcoxon test, all logically possible combinations are significantly better than ungrammatical surface representations, which supports our analysis that all logically possible combinations are grammatical.

3 Other Evidence

Another piece of evidence comes from phonology. In Standard Mandarin, the disyllabification process (Chen 2000) is taken to reject treating a trisyllabic domain as a possible basic tone sandhi domain type. An example (Chen 2000:367) is shown in (5):

(5) foreign nation language foreign language uai kuo y → uai y
"foreign language"

The argument is that since a trisyllabic word is usually abbreviated as a disyllabic version for common use as in (5), a trisyllabic prosodic unit is not preferred by native speakers of Standard Mandarin. Therefore, only the disyllabic tone sandhi domain can be a basic domain in Standard Mandarin. However, there is no such process in Huai'an, indicating that a trisyllabic tone sandhi domain can also be a basic sandhi domain of Huai'an. An example comes from a local high school name. Although the school name contains the trisyllabic version of "foreign language", the abbreviated disyllabic version is not acceptable for native speakers of Huai'an.

(6) Chuzhou foreign nation language *Chuzhou foreign language $s^{h}u$ -tsəu u ε ko y \rightarrow *ts ^{h}u -tsəu u ε y "Chuzhou Foreign Language High School (a high school in Huai'an City)"

4 Conclusion

By positing both disyllabic and trisyllabic domains, the current proposal gives a succinct analysis of Tone 3 Sandhi in Huai'an, and removes the parameter of directionality. Disyllabic and trisyllabic tone sandhi domains can be built freely when all the syllables are exhaustively parsed. Furthermore, a lapse-based analysis (Elenbaas and Kager 1999) involving a binary tone sandhi domain with an unparsed syllable is unlikely because it cannot produce the surface representation "(2 2 3)" where all three syllables must be included into one tone sandhi domain to generate the correct surface form in Huai'an. This study suggests more generally that ternary prosodic units, including ternary stress feet (Prince 1980), can be independent domains in phonology.

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Appendix

Tone 3 Sandhi at the Post-Lexical Level			
Syntactic Category of Each Syllable	Character	IPA	
5-syllable			
DP/AdvP/AUX/V/DP	你总敢抢酒	li tsuŋ kã ciã tciəu	
	姐总敢抢酒	tei tsuŋ kã ciã teisui	
DP/AdvP/AUX/P/DP(/VP)	你总敢与我(唱歌)	li tsuŋ kễ y o (tsʰaŋ ku)	
	你总敢与姐(唱歌)	li tsuŋ kã y ter (tshaŋ ku)	
	姐总敢与你(唱歌)	teı tsuŋ kã y li (tshaŋ ku)	
	沈总敢与姐(唱歌)	sən tsuŋ kã y tcı (tshaŋ ku)	
DP/AUX/V/DP/DP	你敢抢我酒	li kữ ciữ o tciəu	
	你敢抢姐酒	li kữ ciữ tơi tơi	
	姐敢抢你酒	tei kæ eiæ li teisu	
	沈敢抢姐酒	sən kữ ciữ tcı tciəu	
DP/AUX/V/V/DP	你敢想抢酒	li kữ ciữ ciữ tciəm	
	姐敢想抢酒	tcı kữ ciữ ciữ tciəm	
DP/AdvP/V/DP/DP	你总抢我酒	li tsuŋ ciæ o tciəu	
	你总抢姐酒	li tsuŋ ciæ tcı tciəu	
	姐总抢你酒	tei tsuŋ eiæ li teiəm	
	沈总抢姐酒	sən tsuŋ ciã tcı tciəm	
DP/V/V/DP/DP	你想抢我酒	li ciã ciã o tcieu	
	你想抢姐酒	li ciã ciã ter teisur	
	姐想抢你酒	tei ciã ciã li teisui	
	沈想抢姐酒	sən ciæ ciæ tei teiəm	
DP/AdvP/P/DP/V(/DP)	你总与我抢(钱)	li tsuŋ y o ciã tciəu	

	你总与姐抢(钱)	li tsuŋ y tei ciữ teiəm
	姐总与你抢(钱)	tei tsuŋ y li ciã teiəui
	沈总与姐抢(钱)	sən tsuŋ y tei ciæ teiəui
DP/AUX/P/DP/V(/DP)	你敢与我抢(钱)	li kữ y o ciữ triəu
	你敢与姐抢(钱)	li kữ y tei ciữ teisui
	姐敢与你抢(钱)	teı kæ y li ciæ teiəu
	沈敢与姐抢(钱)	sən kã y tei eiã teiəui
AdvP/AUX/V/V/DP	总敢想抢酒	tsuŋ kữ ciữ ciữ tciəui
AdvP/AUX/V/DP/DP	总敢抢你酒	tsuŋ kữ ciữ li tciəu
	总敢抢姐酒	tsuŋ kã ciã tei teiəui
AdvP/AUX/P/DP/V(/DP)	总敢与你抢(钱)	tsuŋ kã y li ciã (tchiĩ)
	总敢与姐抢(钱)	tsuŋ kã y tei ciã (tchiĩ)
AdvP/V/V/DP/DP	总想抢你酒	tsuŋ ciã ciã li tciəm
	总想抢姐酒	tsuŋ ciã ciã tci tciəm
AdvP/P/DP/V/DP	总与你抢酒	tsuŋ y li ciữ tciəm
	总与姐抢酒	tsuŋ y tcı ciữ tciəm
AUX/V/V/DP/DP	敢想抢你酒	kữ ciữ ciữ li tciou
	敢想抢姐酒	kã ciã ciã ter teisu
AUX/P/DP/V/DP	敢与你抢酒	kữ y li ciữ tciəu
	敢与姐抢酒	kã y tei ciã teisu
DP/V/DP/V/DP	你想我抢酒	li ciã o ciã tciou
	你想姐抢酒	li ciẽ tei ciẽ teiou
	姐想你抢酒	ter ciæ li ciæ teisu
	沈想姐抢酒	sən ciữ tci ciữ tciəui
DP/V/DP/P/DP(/V/DP)	你想我与你(唱歌)	li ciã o y li (tshaŋ ku)
	你想姐与你(唱歌)	li ciữ tơi y li (tshaŋ ku)
	姐想你与姐(唱歌)	ter ciæ li y ter (tshan ku)
	沈想姐与沈(唱歌)	sən ciã tei y sən (tshaŋ ku)
6-syllable		•
DP/AdvP/AUX/V/DP/DP	你总敢抢我酒	li tsuŋ kã ciã o tciəu
	你总敢抢姐酒	li tsuŋ kã ciã tcı tciəu
	姐总敢抢你酒	tei tsuŋ kã ciã li teiəu
	沈总敢抢姐酒	sən tsuŋ kã ciã tcı tciəm
DP/AdvP/AUX/P/DP/V(/DP)	你总敢与我抢(钱)	li tsuŋ kã y o ciã (tchiĩ)

	你总敢与姐抢(钱)	li tsuŋ kã y tei ciã (tchiĩ)	
	姐总敢与你抢(钱)	tei tsuŋ kã y li ciã (tchiĩ)	
	沈总敢与姐抢(钱)	sən tsuŋ kã y tcı ciã (tchiĩ)	
DP/AUX/V/V/DP/DP	你敢想抢我酒	li kữ ciữ ciữ o tciəui	
	你敢想抢姐酒	li kã ciã ciã ter teisur	
	姐敢想抢你酒	tcı kã ciã ciã li tciəm	
	沈敢想抢姐酒	sən kữ ciữ ciữ tci tciəui	
DP/AdvP/P/DP/V/DP	你总与我抢酒	li tsuŋ y o ciã tciəu	
	你总与姐抢酒	li tsuŋ y ter ciã teiou	
	姐总与你抢酒	teı tsuŋ y li ciữ teiəu	
	沈总与姐抢酒	sən tsuŋ y tei ciæ teiəui	
DP/AUX/P/DP/V/DP	你敢与我抢酒	li kữ y o ciữ tciəm	
	你敢与姐抢酒	li kữ y tei ciữ teioui	
	姐敢与你抢酒	tei kã y li ciã teisu	
	沈敢与姐抢酒	sən kã y tei eiã teiəui	
AdvP/AUX/V/V/DP/DP	总敢想抢你酒	tsuŋ kữ ciữ ciữ li tciəm	
	总敢想抢姐酒	tsuŋ kã ciã ciã tci tciəm	
AdvP/AUX/P/DP/V/DP	总敢与你抢酒	tsuŋ kã y li ciã tciəm	
	总敢与姐抢酒	tsuŋ kã y tei eiã teiau	
DP/V/DP/V/DP/DP	你想我抢你酒	li ciã o ciã li teisu	
	你想姐抢你酒	li ciẽ ter ciẽ li teisu	
	姐想你抢姐酒	tei ciæ li ciæ tei teiou	
	沈想姐抢沈酒	sən ciæ tei ciæ sən teiəu	
DP/V/DP/P/DP/V(/DP)	你想我与你抢(钱)	li ciã o y li (tsʰaŋ ku)	
	你想姐与你抢(钱)	li ciã ter y li (tshaŋ ku)	
	姐想你与姐抢(钱)	teı ciæ li y teı (tshaŋ ku)	
	沈想姐与沈抢(钱)	sən ciæ tcı y sən (tshaŋ ku)	
7-syllable			
DP/AdvP/AUX/V/V/DP/DP	你总敢想抢我酒	li tsuŋ kữ ciữ ciữ o tciətu	
	你总敢想抢姐酒	li tsuŋ kữ ciữ ciữ tci tciəui	
	姐总敢想抢你酒	ter tsuŋ kã ciã ciã li teiəu	
	沈总敢想抢姐酒	sən tsuŋ kã ciã ciã tcı tciəu	
DP/AdvP/AUX/P/DP/V/DP	你总敢与我抢酒	li tsuŋ kã y o ciã tciəm	
	你总敢与姐抢酒	li tsuŋ kã y tei ciã teiəm	

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	姐总敢与你抢酒	tei tsuŋ kã y li ciã teiəm
	沈总敢与姐抢酒	sən tsuŋ kữ y teı ciữ teiəm
8-syllable		
DP/AdvP/AUX/V/P/DP/V/DP	你总敢想与我抢酒	li tsuŋ kã ciã y o ciã tciəu
	你总敢想与姐抢酒	li tsuŋ kữ ciữ y tcı ciữ tciəu
	姐总敢想与你抢酒	tei tsuŋ kữ ciữ y li ciữ teiəu
	沈总敢想与姐抢酒	sən tsuŋ kữ ciữ y tcı ciữ tciəu

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