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The Qualitative Difference among Tones: Evidence from an Acceptability Judgement of Taiwanese Tone Sandhi

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Taiwanese

- ...> Sinitic >...> Min > Taiwanese
 Southern Min
- Tones are distinctive
- Seven **base** tones, in which two of them are tones for close syllables







Base tone → Sandhi tone

 If another tone follows, the preceding tone obligatorily changes into another tone in <u>all non-final positions</u> according to the rule below:

Example :
$$H \rightarrow M$$

車 [H]
'car'
車庫 H + ML \rightarrow [M ML]
'garage'
車身 H + H \rightarrow [M H]
'car body'



Two Questions:

Is tone sandhi a rule or lexicalization?

Do different tones show different behavior in tone sandhi?



Rule or Lexicalization?

Yes, it is a rule:

• Rule Hypothesis (Chuang et al. 2011)

No, it is memorized:

- Lexicalization (Hsieh 1970, Zhang et al. 2006)
 - Allomorph Selection Hypothesis (Tsay and Myers 1996)
 - Word Retrieval Hypothesis





• 車 [H] + 庫 [ML] → 車庫 [M ML] 'garage'





Procedures

- 1. Instruction: participants pronounce the word when seeing a picture and a word
- 2. ERP study (towards sound stimuli)
- 3. Six-scaled naturalness rating (towards sound stimuli)









Word-Final

Word-Initial

電車 M+H→[MLH] 'train'	車庫 <u>H</u> +ML→[<u>M</u> ML] 'garage'			
a. Congruent	e. Congruent			
$M + H \rightarrow ML H$	$H + ML \rightarrow M ML$			
b. Sandhi Violation(over-generalized)	f. Sandhi Violation (sandhi unapplied)			
$M + H \rightarrow ML M$	$H + ML \rightarrow H M$			
c. Lexical Violation	g. Lexical Violation			
$M + H \rightarrow ML HL$	$H + ML \rightarrow HL ML$			
d. Non-existent Base Tone	h. Non-existent Sandhi			
$M + H \rightarrow ML MHL$	$H + ML \rightarrow MH ML$			



Prediction: What the Lexicon Has in Each Hypothesis

Congruent 車庫 [M ML]
 Sandhi Violation 車庫 [H ML] _{Different? The same?}
 Lexical Violation 車庫 [HL ML]





Allomorph selection hypothesis





Analysis

- Participants: As a total, 25 Taiwanese speakers (age=20~69, SD = 17.4). The data of one participant were excluded
- Stimuli presented with E-prime 2.0 Standard
- Statistics :
 - R 3.4.0
 - Linear Mixed Model, LME
 - LME does not inflate type one errors as expected in analyzing Likert-scale data (Kizach 2014)
 - backward selection
 - *p* value : ImerTest (Welch-Satterhwaite) (Kuznetsova 2015)

Results: The Congruent Conditions are higher



- The First Model: Predictors were dummy-coded with the congruent conditions (a) and (e) as the baseline Fixed Factors: violation type x syllable position, Random factors: items, subjects
- Taiwanese native speakers rated <u>congruent conditions</u> higher than all other conditions (p < .001***)



The First Model

a. congruent

- b. Sandhi Violation (over-generalization)
- c. lexical violation
- d. non-existent base tone

e. congruent

- f. Sandhi Violation (non-application)
- g. lexical violation
- h. non-existent sandhi

Comparison of Lexical Violation and Sandhi 😚

The Second Model: Predictors were dummy-coded with the <u>lexical</u> <u>violation</u> conditions as the baseline



The Second Model

- a. congruent
- b. Sandhi Violation (over-generalization)
- c. lexical violation
- d. non-existent tone

e. congruent

- f. Sandhi Violation (non-application)
- g. lexical violation
- h. initial/non-existent sandhi

Results: Sandhi Violation > Lexical Violation

- Main effect of violation type: β=0.83, SE=0.56, p<.001***
- Interaction with the syllable position: β =-0.64, *SE*=0.08, *p*<.001***
- The sandhi violation group was rated more acceptable than the lexical violation group, both in the word-initial and the word-final positions (the extent is different in word-final and word-initial)



b. final/Sandhi Violation (over-generalization) c. final/lexical violation

f. initial/Sandhi Violation (non-application) g. initial/lexical violation



Result: Word Retrieval Hypothesis Fails









• Are all tonal changes equally obligatory (i.e. is there any difference among the tones)?



Oifference of Tonal Changes in Productivity



- Zhang et al. (2006) production wug-test
- (highest productivity) $M \rightarrow ML > H \rightarrow M = ML \rightarrow HL > HL \rightarrow H$ (lowest productivity)







- If the acceptability is the same as the productivity:
- M \rightarrow ML > H \rightarrow M = ML \rightarrow HL > HL \rightarrow H (lowest productivity)



• Prediction on acceptability of failure of sandhi application: HL \rightarrow H > H \rightarrow M = ML \rightarrow HL > M \rightarrow ML

Results of Tone Difference

- failure of sandhiapplication)/ Word-Initial
- LME (dependent variable: rating score, fixed factor: tone type, random factor: items, subjects)



 $M \rightarrow ML, H \rightarrow M > HL \rightarrow H >? ML \rightarrow HL$





- The acceptability result of this study:
- M \rightarrow ML, H \rightarrow M > HL \rightarrow H > ML \rightarrow HL (lowest acceptability when unapplied)
- cf. The prediction according to the productivity result in Zhang et al. (2006)
- $HL \rightarrow H > H \rightarrow M = ML \rightarrow HL > M \rightarrow ML$

Why different?

- 1. Production vs. perception
- 2. Wug test vs. real words





Sandhi Violation / final condition

- $H \rightarrow M$ as the baseline
- 1. $H \rightarrow M > ML \rightarrow HL (\beta = -0.67, SE = 0.21, p = .002 **)$
- 2. $H \rightarrow M > HL \rightarrow H \ (\beta = -0.94, SE = 0.17, p < .001^{***})$
- 3. $H \rightarrow M = M \rightarrow ML (\beta = -0.02, SE = 0.185, p = .91)$
- $\ensuremath{\text{ML}}\xspace \rightarrow \ensuremath{\text{HL}}\xspace$ as the baseline
- 1. $ML \rightarrow HL = H \rightarrow M \ (\beta = -0.27, SE = 0.22, p = 0.21)$

Rating result in ruleoverapplied condition



$\mathsf{M} \to \mathsf{ML} = \mathsf{H} \to \mathsf{M} > \mathsf{HL} \to \mathsf{H} = \mathsf{ML} \to \mathsf{HL}$

A Possible Account: Markedness Difference

- What is "marked"?
 - High tones are more marked than low tones (Pulleyblank 1986)
 - Tones with longer duration are more marked than tones with shorter duration. Falling tones are shorter. (Zhang 2004, Zhang et al. 2006)

Markedness Standard	$M \rightarrow ML$	$H \rightarrow M$	$HL \rightarrow H$	$ML \rightarrow HL$
Getting a high tone 1				~
Become longer 1			 ✓ 	
Losing a high tone		~		
Become shorter	~			



Asymmetry in Each Tone Rule

- The acceptability result in sandhi position when the rule is unapplied (Sandhi Violation, initial):
 - $\begin{array}{c} M \rightarrow ML = H \rightarrow M > HL \rightarrow H = ? ML \rightarrow HL \\ \text{Becoming unmarked} & \text{Becoming marked} \\ \text{after sandhi} & \text{after sandhi} \end{array}$
- More unacceptable when rules involving a rise of markedness are not correctly applied (perception)
- Speakers might expect a markedness rise in perception, which makes a word more distinguishable.

Explain Production with Markedness



- Production and perception are different processes
- Production: Principle of Least Effort (e.g. Tatham and Morton 2016: 23)
 - more marked = requires more effort
 - less marked = requires less effort
- Rules involving a fall of markedness are more productive.
 - $MH \rightarrow M > M \rightarrow ML > H \rightarrow M = ML \rightarrow HL > HL \rightarrow H$

Markedness Standa	rd	MH→M	$M \rightarrow ML$	$H \rightarrow M$	$ML \rightarrow HL$	$HL \rightarrow H$
Losing a high tone	Ļ	~		~		
Become shorter	↓	~	~			



Conclusion

- 1. The acceptability rating results show that Taiwanese native speakers do evaluate different violation types differently
- 2. <u>The sandhi violation group</u> was rated more acceptable than <u>the lexical violation group</u>, both in the word-initial and the word-final positions, which is compatible with both the allomorph selection hypothesis and the rule hypothesis, but not with the word retrieval hypothesis



Conclusion

- 3. The results also show a difference among tones.
- 4. The results can be accounted for by the markedness hierarchy, based on the following assumptions:
 - Tones that have longer duration are more marked than other tones
 - Tones containing H tone are more marked
- 5. Tone rules involving a markedness rise have a lower acceptability rate when unapplied.
- 6. Markedness can also account for the production result.



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Appendix (1): Results: Main Effect of Violation Type ***

- Main effect of violation type: significant in all groups ($p < .001^{***}$)
- Interaction with the syllable position:
 - 1 congruent vs. Sandhi Violation (β=0.26, SE=0.08, p=.01**)
 - 2. congruent vs. lexical violation (β =0.04, SE=0.08, p=.60)
 - 3. congruent vs. non-existent violation (β=-0.60, SE=0.08, p<.001***)



Appendix (3): Result of Tone Difference in Rule Unapplied Condition

- Sandhi Violation / initial condition
- $HL \rightarrow H$ as the baseline
- 1. $HL \rightarrow H > ML \rightarrow HL (\beta = -0.32, SE = 0.19, \rho = 0.098.)$
- 2. $HL \rightarrow H < H \rightarrow M (\beta = 0.68, SE = 0.15, p < 0.001^{***})$
- 3. $HL \rightarrow H < M \rightarrow ML \ (\beta = 0.91, SE = 0.17, p < 0.001^{***})$
- $M \rightarrow ML$ as the baseline
- 1. $M \rightarrow ML > ML \rightarrow HL (\beta = -1.23, SE = 0.20, p < 0.001^{***})$
- 2. $M \rightarrow ML = H \rightarrow M \ (\beta = -0.24, SE = 0.16, p = 0.15)$



Appendix (3): Result of Tone Difference in Rule Over-Generalization



Sandhi Violation / final condition

- $H \rightarrow M$ as the baseline
- 1. $H \rightarrow M > ML \rightarrow HL (\beta = -0.67, SE = 0.21, p = 0.002 **)$
- 2. $H \rightarrow M > HL \rightarrow H (\beta = -0.94, SE = 0.17, p < 0.001^{***})$
- 3. $H \rightarrow M = M \rightarrow ML (\beta = -0.02, SE = 0.185, p = 0.91)$
- $\ensuremath{\mathsf{ML}}\xspace \to \ensuremath{\mathsf{HL}}\xspace$ as the baseline
- 1. $ML \rightarrow HL = H \rightarrow M \ (\beta = -0.27, SE = 0.22, p = 0.21)$

Rating result in ruleoverapplied condition

