

## The Emergence of the Unmarked in an Analogical Change

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### 1. Introduction

#### (1) Explaining phonetic naturalness

- Phonology is largely phonetically natural. Why?
- Three approaches (cf. Albright 2004)
  - i) Diachronic approach (Blevins 2004, Hyman 2001, Barnes 2002, Ohala various)
    - Phonetic naturalness is only an epiphenomenon of historical changes.
    - Historical changes are constrained by the physical reality of speech and the resulting sound patterns are phonetically reasonable.
    - Learners simply acquire the extant patterns, regardless of phonetic naturalness.
    - Phonetic naturalness does not have a cognitive status in synchronic grammar.
  - ii) Synchronic approach (Prince and Smolensky 1993)
    - Grammatical constraints directly encode the phonetic naturalness in the form of markedness.
    - All constraints are universal.
    - Patterns that violate universal markedness generalizations (=phonetically unnatural patterns) cannot be handled.
    - Given the existence of “crazy” processes, this view is likely to be too constricted.
  - iii) Moderated synchronic approach (Hayes 1997; Wilson 2003; Albright 2004)
    - Grammar is powerful enough to accommodate both phonetically natural and unnatural patterns, but has a built-in bias toward phonetic naturalness.

#### (2) Empirical evidence?

- Just looking at synchronic data is not very helpful because both “diachronic approach” and “moderated synchronic approach” expect synchronic sound patterns to be largely phonetically natural and at the same time allow the possibility of “crazy” rules.
- We need to look at the patterns that couldn’t have arisen from phonetically motivated historical changes and see whether we still find phonetic naturalness bias or not.
  - Artificial learning experiments (Wilson 2003)
  - Loanword adaptation (Comrie 1979)
  - Historical changes of non-phonetic origin (Anttila 1997, Garrett 2003)

## (3) Phonetic vs. morpho-phonological change

## i) Phonetic sound change

- Change in the phonetic content with subsequent change in phonological categorization of the phonetic content
- An example: assibilation before a high vowel (H. Kim 2001)
  - Cross-linguistically, coronal stop assibilation tends to be confined to high vowel contexts.
  - Stop release is noisier before a high vowel than before a non-high vowel.
  - The turbulent release of stop before a high vowel is reinterpreted as [+strident] and the coronal stop is reinterpreted as a sibilant.

## ii) Morpho-phonological change (analogical change)

- The mapping between the phonetic content and the phonological category remains stable but the change occurs in the mapping between a morpheme and a phonological category.
- An example: Paradigm leveling in Korean nouns

UNSUFFIXED	LOC.
A: mulɪp	mulɪp <sup>h</sup> -e
B: mulɪp	mulɪp-e

- Learners are not *misperceiving* [p<sup>h</sup>] as [p].

## (4) Phonetic naturalness bias in morpho-phonological change

- According to the diachronic view of phonetic naturalness, phonetic naturalness effect can arise only through changes of the first type (i) but not through the second type (ii).
- According to the moderated synchronic view of phonetic naturalness, phonetic naturalness bias may emerge even in the change of second type (ii).

## (5) Today's talk

- Examine a morpho-phonological change in progress that affect /t<sup>h</sup>/ and /t<sup>h</sup>/-final nouns.
- Although the change is morpho-phonological in nature, the distribution of the novel form shows an apparent phonetic naturalness effect.
- Can this be a case of the emergence of phonetic naturalness in a morpho-phonological change?
- An alternative explanation based on “frequency of use effect” is possible.

## 2. Background

(6) Korean phoneme inventory (cf. H. Kim 1999)

p, p <sup>h</sup> , p'	t, t <sup>h</sup> , t'	k, k <sup>h</sup> , k'	i	ɨ	u
	ts̄, ts̄ <sup>h</sup> , ts̄'		e	ə	o
	s, s'	h	(æ)	ɑ	
m	n	j			
	L <sup>1</sup>				

(7) Coda neutralization: /t<sup>h</sup>, t, t<sup>s</sup>, t<sup>sh</sup>, s, s'/ → [t]/\_]coda<sup>2</sup>

STEM-DECL.	STEM-and	
[kat <sup>h</sup> -a]	[kat-k'o]	'same'
[pat-a]	[pat-k'o]	'to receive'
[ts̄'ots̄ <sup>h</sup> -a]	[ts̄'ot-k'o]	'to chase'
[ts̄ats̄-a]	[ts̄at-k'o]	'frequent'
[is'-ə]	[it-k'o]	'to exist'
[pəs-ə]	[pət-k'o]	'to take off'

(8) Affrication: /t, t<sup>h</sup>/ → [ts̄, ts̄<sup>h</sup>]/\_]stem(h){i, j}

/i/:	/t <sup>h</sup> ək-pat-i/	[t <sup>h</sup> ək'p'ats̄i]	'bib'
	/kat <sup>h</sup> -i/	[kats̄ <sup>h</sup> i]	'together'
/i/:	/pat-ini/	[patini] *[pats̄ini]	'receive-therefore'
	/kat <sup>h</sup> -ini/	[kat <sup>h</sup> ini] *[kats̄ <sup>h</sup> ini]	'same-therefore'
/a/:	/pat-a/	[pata] *[pats̄a]	'receive-IMPERATIVE'
	/kat <sup>h</sup> -a/	[kat <sup>h</sup> a] *[kats̄ <sup>h</sup> a]	'same-IMPERATIVE'
/ə/:	/kət-ə /	[kətə] *[kət̄s̄ə]	'gather-IMPERATIVE'
	/put <sup>h</sup> -ə/	[put <sup>h</sup> ə] *[put̄s̄ <sup>h</sup> ə]	'stick-IMPERATIVE'

(9) Neutralization of underlying contrast in noun paradigm (expected)

	Unsuffixed	NOM. (-i)	ACC. (-il)	LOC. (-e)
/ts̄ <sup>h</sup> /	-t	-ts̄ <sup>h</sup>	-ts̄ <sup>h</sup>	-ts̄ <sup>h</sup>
/t <sup>h</sup> /	-t	-ts̄ <sup>h</sup>	-t <sup>h</sup>	-t <sup>h</sup>
	:Coda	:Affrication		
	Neutralization			

<sup>1</sup> /L/ represents a liquid phoneme, which is realized as [r] or [l] depending on the syllable position (Cho 1997, Lee 2001, Seo 2002).

<sup>2</sup> There is no verbal stem that ends in /t'/ or /t<sup>s</sup>'/.

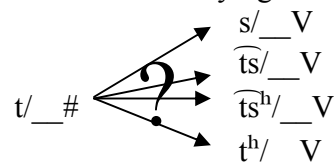
### 3. Overview

(10) Actual pattern (a rough sketch, to be refined below)

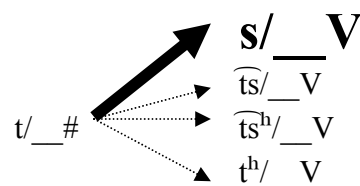
	Unaffixed	NOM. (-i)	ACC. (-il)	LOC. (-e)
/-t <sup>h</sup> /	-t	-ts <sup>h</sup> ~ -s	-t <sup>h</sup> ~ -ts <sup>h</sup> ~ -s	-t <sup>h</sup> ~ -ts <sup>h</sup> ~ -s
/-ts <sup>h</sup> /	-t	-ts <sup>h</sup> ~ -s	-ts <sup>h</sup> ~ -t <sup>h</sup> ~ -s	-ts <sup>h</sup> ~ -t <sup>h</sup> ~ -s
	Unaffixed	Nom. (-i)	Acc. (-il)	Loc. (-e)
e.g., /p <sup>h</sup> at <sup>h</sup> / ‘red bean’	p <sup>h</sup> at	p <sup>h</sup> ats <sup>h</sup> -i ~ pas-i	p <sup>h</sup> at <sup>h</sup> -il ~ p <sup>h</sup> ats <sup>h</sup> -il ~ p <sup>h</sup> as-il	p <sup>h</sup> at <sup>h</sup> -e ~ p <sup>h</sup> ats <sup>h</sup> -e ~ p <sup>h</sup> as-e
/sut <sup>h</sup> / ‘charcoal’	sut	suts <sup>h</sup> -i ~ sus-i	suts <sup>h</sup> -il ~ sut <sup>h</sup> -il ~ sus-il	suts <sup>h</sup> -e ~ sut <sup>h</sup> -e ~ sus-e

(11) [s]-final variant (Ko 1989; Y. Kang 2003; Albright 2002, 2005)

- Found in all coronal obstruent-final nouns ( $/\widehat{ts}/$ ,  $/\widehat{ts}^h/$  and  $/t^h/$ )<sup>3</sup> in Seoul and South-Western dialects.
- An **analogy** to the dominant class of /s/-final nouns.
  - Choice of base: The unaffixed form serves as the base of paradigm in Korean from which other forms in the paradigm are projected, due to its high frequency of occurrence (despite its uninformativeness in predicting the correct UR).
  - In the unaffixed form, all coronal obstruents neutralize. Therefore, the learners are presented with the unaffixed form and have to “guess” what the underlying consonant should be.

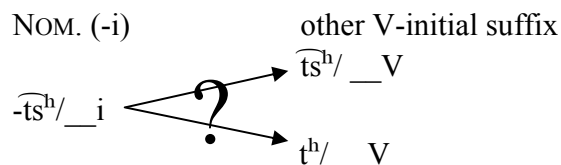


- They opt for the most common /s/-final nouns (i.e., the nouns that show alternation between final [t] in the unaffixed form and [s] before a vowel-initial suffix.), which gives them the best chance at being correct.



(12)  $[\widehat{ts}^h]$  or  $[t^h]$ -final variants in  $/t^h/$  and  $/\widehat{ts}^h/$ -final nouns

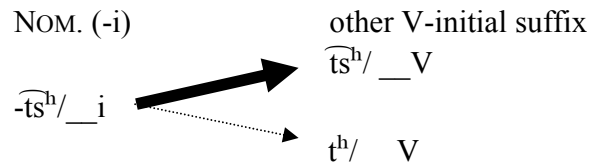
- Given the  $[\widehat{ts}^h]$ -final form in the nominative, learners cannot be sure whether the noun is  $[\widehat{ts}^h]$ -final or  $/t^h/$ -final.



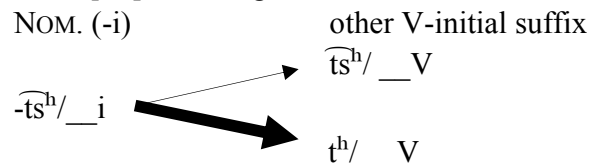
<sup>3</sup> There is no nominal stem that ends in  $/t/$ ,  $/s^h/$ ,  $/t^h/$  or  $/t^s^h/$ .

- Another base?: Taking into account the frequency of occurrence and the predictability of the UR, the nominative form ranks second to the unsuffixed form in its overall informativeness rating (Albright 2005).
- In terms of type frequency,  $t^h$ -final nouns have a slight majority over the  $\widehat{ts^h}$ -final nouns but the difference is not striking.

- Central dialects: the change is mainly toward  $\widehat{ts^h}$  and the change toward  $t^h$  is marginal.



- Eastern dialects: the change is mainly toward  $t^h$  and the change toward  $\widehat{ts^h}$  is marginal.



### (13) Not a phonetic sound change

- Morphological condition
  - The change/variation is confined to noun-final position only and does not apply to verbs, as shown below.
 

$\widehat{ts}$ ' $\widehat{ots^h}$ -ini/	$[\widehat{ts}'\widehat{ots^h}ini]$	* $[\widehat{ts}'\widehat{ot^h}ini]$	* $[\widehat{ts}'\widehat{osini}]$	'chase-therefore'
/kat <sup>h</sup> -ini/	$[\widehat{kat^h}ini]$	* $[\widehat{kats^h}ini]$	* $[\widehat{kasini}]$	'same-therefore'
cf. /mats <sup>h</sup> -ini/	$[\widehat{matsini}]$	* $[\widehat{matini}]$	* $[\widehat{masini}]$	'match-therefore'
/pat <sup>h</sup> -ini/	$[\widehat{patini}]$	* $[\widehat{patsini}]$	* $[\widehat{pasini}]$	'receive-therefore'
- The change could not have arisen from a misperception of  $/t^h/$ ,  $\widehat{ts^h}/$  and  $/s/$ .
- Frequency of use effect: high frequency words tend to resist the innovative  $[s]$ -final pronunciation (Y. Kang 2003). This is a typical characteristic of an analogically motivated change not of a phonetically motivated change (Hooper 1976, Phillips 1984 etc.)

(14) Dialects examined based on Y. Kang(2003), NAKL(2004), and AKS(1990~1995)

	Central		South-Western		Eastern	
	Seoul	Kyenggi	Chungnam <sup>4</sup>	Cennam	Kangwon	Kyengnam
/t <sup>h</sup> /, /ts <sup>h</sup> / > [s]	Yes	Yes	Yes	Yes	No	No
/t <sup>h</sup> / > [ts <sup>h</sup> ]	<b>Yes</b>	<b>Yes</b>	No	Marginal	<b>Marginal</b>	<b>Marginal</b>
/ts <sup>h</sup> / > [t <sup>h</sup> ]	<b>No</b>	<b>Yes</b>	No	No	<b>Yes</b>	<b>Yes</b>

#### 4. Central dialects

(15) Vowel height effect in the Seoul and Kyenggi dialects

- For /t<sup>h</sup>/ final nouns, the innovative [ts<sup>h</sup>] pronunciation is more acceptable before a high vowel suffix (i-) than before a non-high vowel suffix (e).
- For /ts<sup>h</sup>/ final nouns, the innovative [t<sup>h</sup>] pronunciation is attested only before a non-high vowel suffix (e) but not before a high vowel suffix (i-).

##### 4.1. Y. Kang (2003)

(16) Seoul speakers; well-formedness rating

- written questionnaire format
- 8 Seoul speakers
- 8 commonly used /t<sup>h</sup>/-final nouns
  - *pyət<sup>h</sup>* ‘sunlight’, *mit<sup>h</sup>* ‘bottom’, *pat<sup>h</sup>* ‘field’, *k’it<sup>h</sup>* ‘end’, *p<sup>h</sup>at<sup>h</sup>* ‘red bean’, *sot<sup>h</sup>* ‘pot’, *kət<sup>h</sup>* ‘outside’ *kyət<sup>h</sup>* ‘side’
- 5 commonly used /ts<sup>h</sup>/-final nouns
  - *pits<sup>h</sup>* ‘light’, *nats<sup>h</sup>* ‘face’, *k’ots<sup>h</sup>* ‘flower’, *təts<sup>h</sup>* ‘trap’, *suts<sup>h</sup>* ‘coal’
- 7 vowel-initial suffixes
  - e-:        **-e** Locative/Dative/Goal
  - ij~e:     **-ij** (formal)~ **e** (informal) Genitive
  - i- :       **-il** Accusative, **-ilo** Directional/Instrument, **-in** Topic
  - i- :       **-i** Nominative, **-i(-ta)** Copula
- Rating: between 1 (bad) and 4 (good).

<sup>4</sup> In Chungnam dialects, the locative suffix is frequently realized as /i/ (a high vowel) while the accusative suffix is frequently realized as /əl/ (a non-high vowel). But, the dialect does not show the relevant variants of interest ([ts<sup>h</sup>] or [t<sup>h</sup>]-final forms). J. Choi (2001) states that the locative /i/ suffix is a more general phenomenon of Cenla dialects.

(17)  $[ts^h]$  pronunciation of  $/t^h/$  nouns

- $[ts^h]$  pronunciation of a  $/t^h/$ -final noun is judged to be more acceptable before a high vowel ( $/i/$ ,  $/ij/$ ) than before a non-high vowel ( $/e/$ ).
- The genitive suffix behaves like a high vowel. This seems to be due to the fact that the data was presented in a written form, prompting a more formal pronunciation ( $ij$ ) of the suffix.

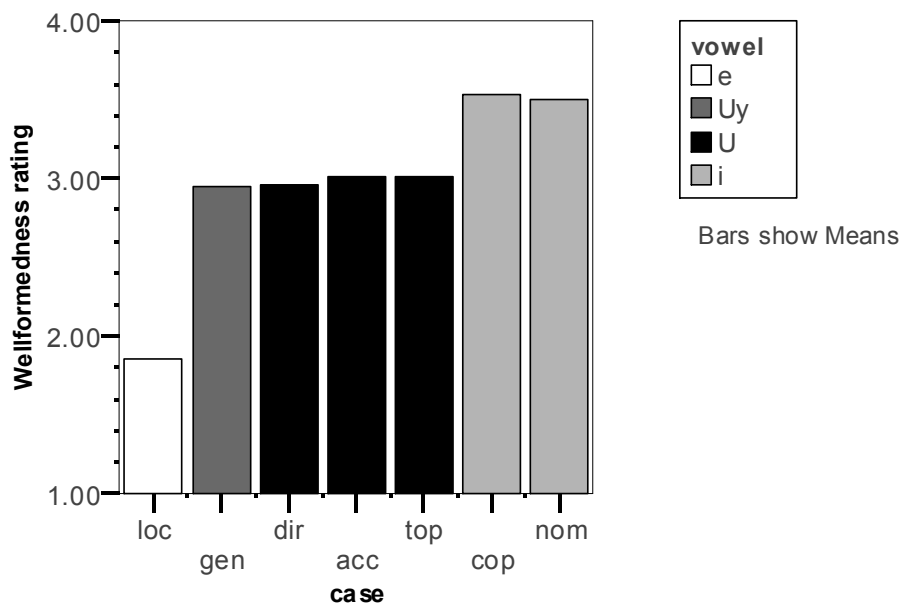


Figure 1: Mean well-formedness rating for  $[ts^h]$  pronunciation of  $/t^h/$ -final nouns: averaged over 8 speakers and 8 nouns (based on Y. Kang 2003)

- The same pattern holds true when the data is examined for individual speakers (Figure 2).
- Except for speaker #6, for whom the  $[ts^h]$ -final pronunciation is simply unavailable in contexts other than /i/, all speakers show a statistically significant difference in ratings between /e/ suffix forms and /i/- or /ij/- suffix forms.

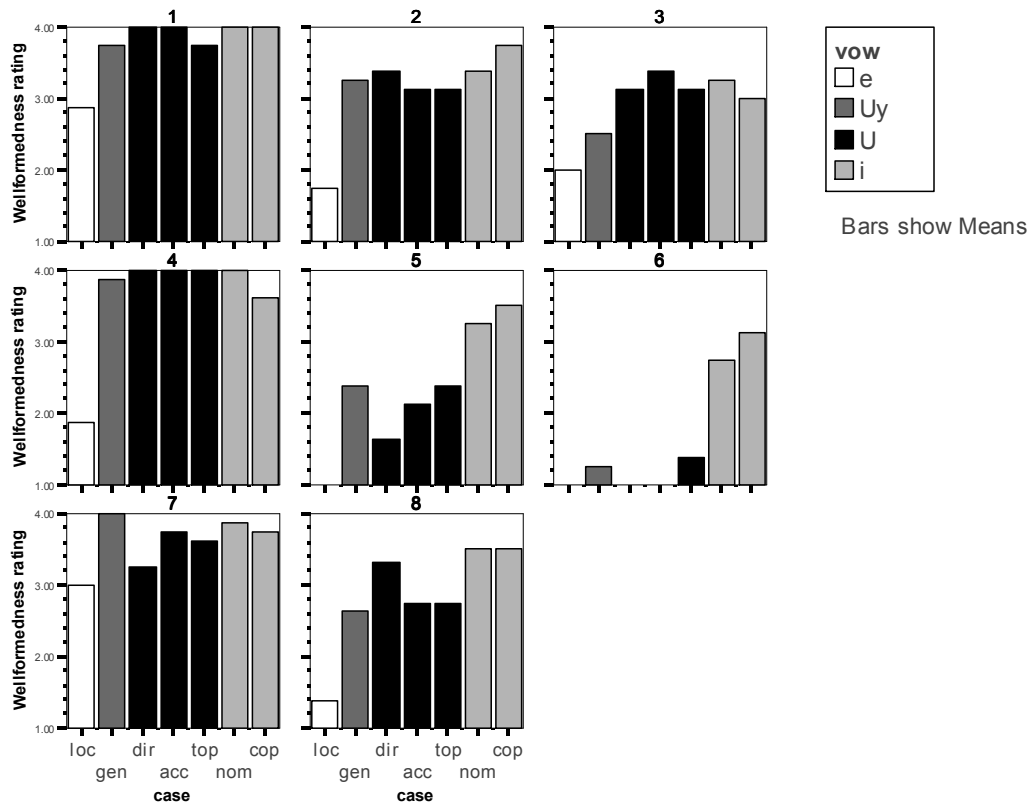


Figure 2. Mean wellformedness rating for  $[ts^h]$  pronunciation of /t<sup>h</sup>-final nouns: averaged over 8 nouns (Based on Y. Kang 2003)

- The same pattern holds true when the data is examined for individual nouns (Figure 3).

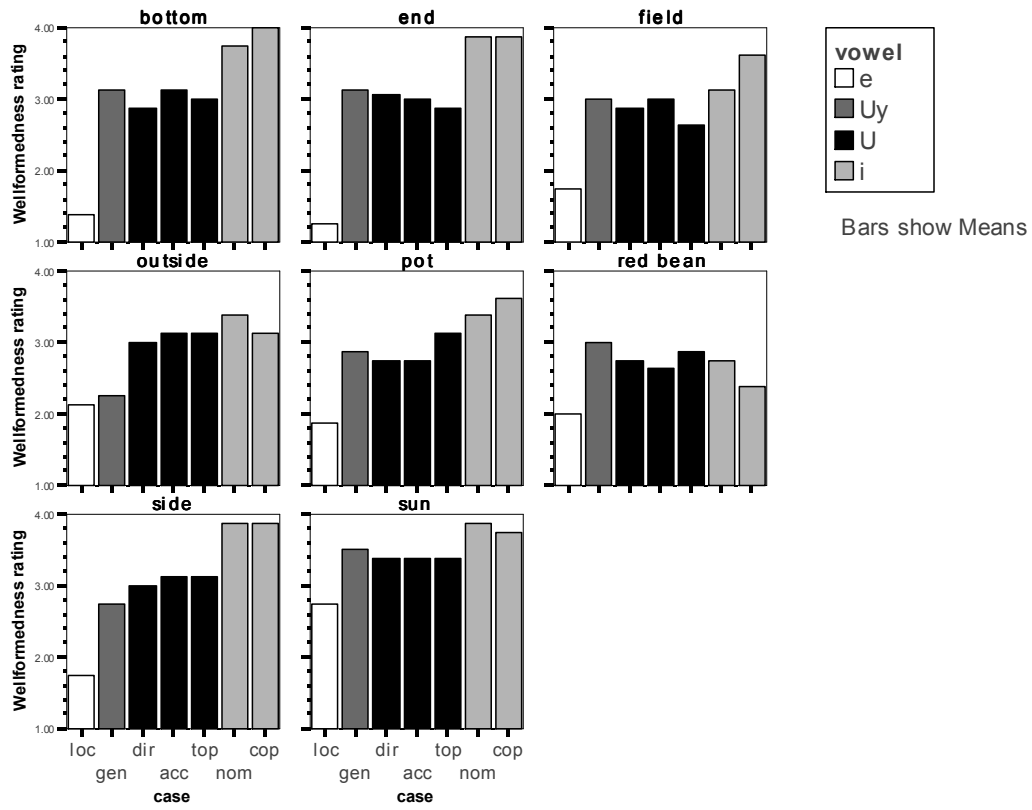


Figure 3. Mean wellformedness rating for  $[ts^h]$  pronunciation of /t<sup>h</sup>-final nouns: averaged over 8 speakers (Based on Y. Kang 2003)

(18) Y. Kang (2003): [t<sup>h</sup>] pronunciation of /tʰs<sup>h</sup>/-final nouns

- The rating is overall very low.

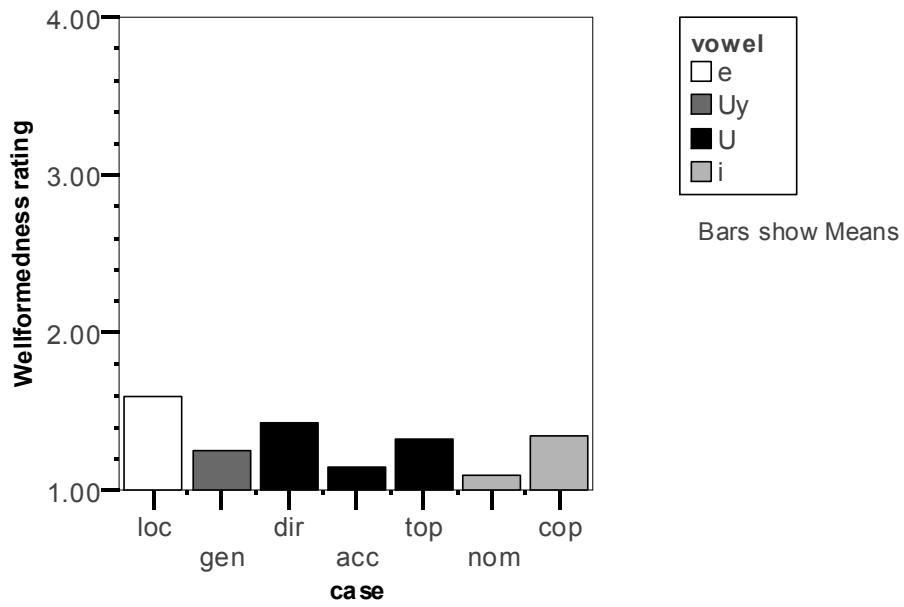


Figure 4: Mean wellformedness rating for [t<sup>h</sup>] pronunciation of /tʰs<sup>h</sup>/-final nouns: averaged over 8 speakers and 8 nouns (Based on Y. Kang 2003)

## 4.2. NAKL (2004)

(19) Seoul-Incheon-Keynggi speakers: multiple choice questionnaire

- The National Academy of Korean Language  
(Hye-Won Choi, Min-Kyeng Suh, Yen-Sin Hwang, Mi-Yeng Kwen)
- Multiple choice questionnaire
- 1174 speakers
- 15 /t<sup>h</sup>/-final nouns
  - *pyət<sup>h</sup>* ‘sunlight’, *mit<sup>h</sup>* ‘bottom’, *pat<sup>h</sup>* ‘field’, *k’it<sup>h</sup>* ‘end’, *p<sup>h</sup>at<sup>h</sup>* ‘red bean’, *sot<sup>h</sup>* ‘pot’, *kət<sup>h</sup>* ‘outside’ *kyət<sup>h</sup>* ‘side’ *nat<sup>h</sup>* ‘a unit’, *twik’jət<sup>h</sup>* ‘backyard’, *məlimat<sup>h</sup>* ‘bedside’, *mut<sup>h</sup>* ‘land’, *pak’at<sup>h</sup>* ‘outside’, *sat<sup>h</sup>* ‘crotch’ and *sut<sup>h</sup>* ‘thickness (of hair)’
- 11 /ts<sup>h</sup>/-final nouns
  - *pits<sup>h</sup>* ‘light’, *nats<sup>h</sup>* ‘face’, *k’ots<sup>h</sup>* ‘flower’, *təts<sup>h</sup>* ‘trap’, *suts<sup>h</sup>* ‘coal’, *tats<sup>h</sup>* ‘anchor’, *tots<sup>h</sup>* ‘sail’, *mjəts<sup>h</sup>* ‘some’, *salkats<sup>h</sup>* ‘skin’, *ots<sup>h</sup>* ‘lacquer’, *juts<sup>h</sup>* ‘stick game’
- 5 vocalic suffix condition
  - only one suffix from each vowel category per noun
  - e-:     –**e** Locative/Dative/Goal, –**esə** Locative
  - ij~e:   –**ij** ~ **e** Genitive
  - i- :     –**il** Accusative, –**ilo** Directional/Instrument, –**in** Topic
  - i- :     –**i** Nominative, –**i(-ta)** Copula, –**ilang** Connective
  - a:       –**a** Vocative [not discussed here]

(20)  $[ts^h]$  pronunciation of /t<sup>h</sup>-final nouns

- More likely before a high vowel than before a non-high vowel.
- The genitive suffix is presented as [ij] along with an [e] pronunciation in parenthesis in the questionnaire. The genitive suffix behaves ambiguously, sometimes patterning with the locative ([e]) and other times with the accusative/topic/directive ([i-]).

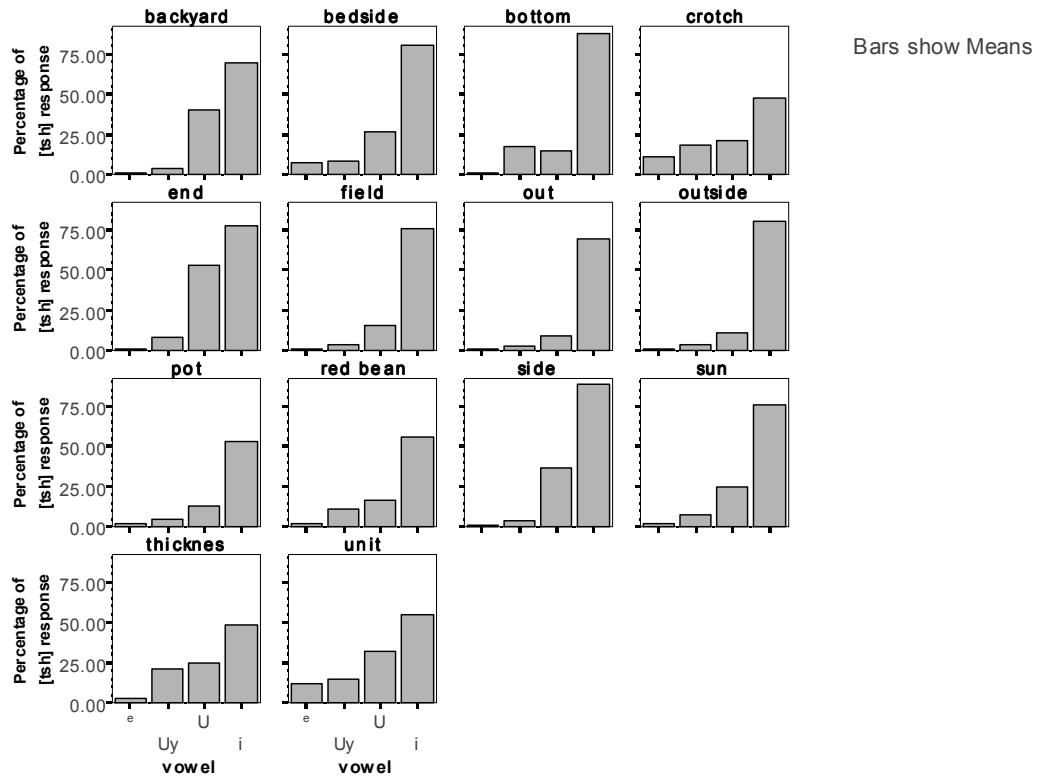


Figure 5: Percentage of  $[ts^h]$  pronunciation response for /t<sup>h</sup>-final nouns (Based on NAKL 2004)

(21) [t<sup>h</sup>] pronunciation of /tʰ/-final nouns

- In general, very few responses.
- A sizable proportion of [t<sup>h</sup>] responses for the locative form ([e]) of some nouns.

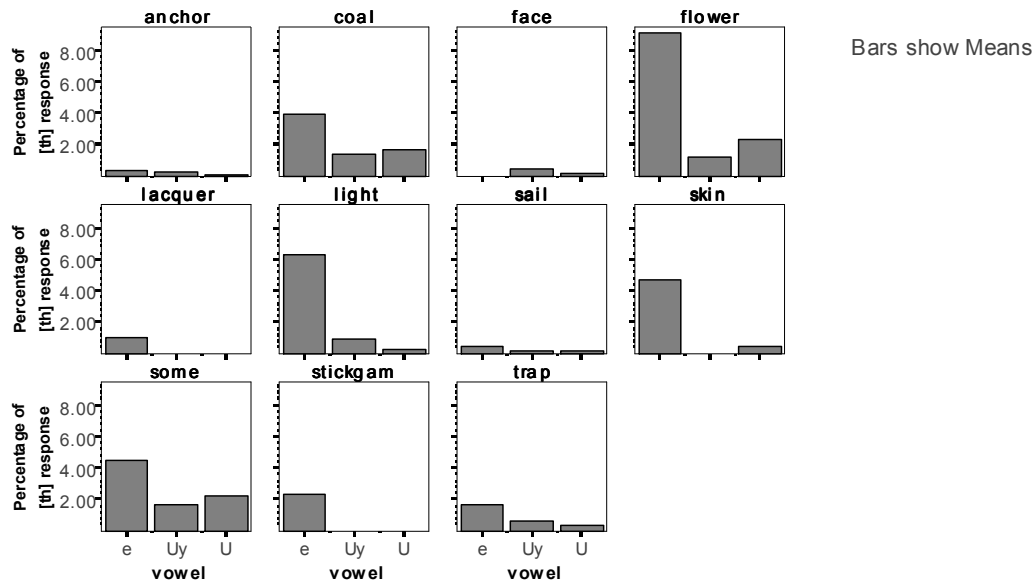


Figure 6: Percentage of [t<sup>h</sup>] response for /tʰ/-final nouns (Based on NAKL 2004)

### 4.3. AKS (1995)

(22) AKS (1990-1995)

- The Academy of Korean Studies
- Elicited production data
- One speaker per *kwun* (town)
- Of the /tʰ/ and /tʰ/-final nouns included in the study, only a few show the relevant range of suffixal forms in relevant vowel contexts.
  - /tʰ/: pat<sup>h</sup> ‘field’, sot<sup>h</sup> ‘pot’, silumit<sup>h</sup> ‘under the stove’
  - /tʰ/: k’ots<sup>h</sup> ‘flower’, tʰats<sup>h</sup> ‘trap’, sut<sup>h</sup> ‘coal’

(23) Seoul-Kyenggi dialects (AKS 1995)			
	Nom./i/	Acc./Dir. /i/	Loc. /e/
/t <sup>h</sup> /-final nouns	$\widehat{ts^h}(\sim s)$	<b><math>\widehat{ts^h}</math></b> (~s)	t <sup>h</sup> (~s)
$\widehat{ts^h}$ /-final nouns	$\widehat{ts^h}(\sim s)$	$\widehat{ts^h}$ (~s)	$\widehat{ts^h} \sim \mathbf{t^h}(\sim s)$

(24) /t<sup>h</sup>/ nouns: Kyenggi dialects (AKS 1995)

□ : the forms where the [s] variant is not dominant.

bold face: the crucial forms with the asymmetry

- [ $\widehat{ts^h}$ ] before a high vowel

- [t<sup>h</sup>] before a non-high vowel.

■ : an exception to the generalization (asymmetry in the opposite direction)

	Nom./i/	Acc. /i/ <sup>5</sup>	Loc. /e/	(N=19)
/pat <sup>h</sup> / ‘field’	$\widehat{ts^h}(\sim s)$	<b><math>\widehat{ts^h}</math></b>	<b>t<sup>h</sup></b>	12
	$\widehat{ts^h}$	t <sup>h</sup>	t <sup>h</sup> ~ $\widehat{ts^h}$ ~s	1
	s	s	t <sup>h</sup>	4
	s	s	s	2
/silumit <sup>h</sup> / ‘under the steamer’	$\widehat{ts^h}$	<b><math>\widehat{ts^h}</math></b>	<b>t<sup>h</sup></b>	6
		$\widehat{ts^h}$	$\widehat{ts^h}$	2
		t <sup>h</sup>	t <sup>h</sup>	1
	(s)	s	s	5
		s	t <sup>h</sup>	3
	different lexical choices			2
/sot <sup>h</sup> / ‘pot’	$\widehat{ts^h}(\sim s)$	<b><math>\widehat{ts^h}</math></b>	<b>t<sup>h</sup></b>	8
		<b><math>\widehat{ts^h} \sim s</math></b>	<b>t<sup>h</sup></b>	2
	$\widehat{ts^h}$		t <sup>h</sup>	1
	$(\widehat{ts^h} \sim)s$	s	t <sup>h</sup>	6
	s	s	t <sup>h</sup> ~s	1
	s	s	s	1

<sup>5</sup> For many speakers, the vowel of the accusative suffix /i/ is often realized with lowering as [ə]. The likelihood of affricate realization and the [ə] vs. [i] realization of the accusative suffix does not seem correlated. If the vowel height generalization were to be maintained, one should assume an opaque derivation, where the affricate variant is chosen based on the “underlying” vowel quality /i/ and then the vowel is lowered in the surface realization.

(25) /ts<sup>h</sup>/ nouns: Kyenggi dialects (AKS 1995)

	Nom./i/	Acc. /il/ (~/əl/)	Loc. /e/	(N=19)
/suts <sup>h</sup> / ‘charcoal’	ts <sup>h</sup>	ts <sup>h</sup>	t <sup>h</sup>	5
	ts <sup>h</sup>		t <sup>h</sup>	1
	ts <sup>h</sup>	ts <sup>h</sup>	ts <sup>h</sup>	3
	s	s	s	6
	ts <sup>h</sup>	s	s	1
	ts <sup>h</sup>	s	ts <sup>h</sup>	1
	s	s	t <sup>h</sup>	1
/k’ots <sup>h</sup> / ‘flower’	(ts <sup>h</sup> )	ts <sup>h</sup>	t <sup>h</sup>	4
	ts <sup>h</sup>	ts <sup>h</sup>	ts <sup>h</sup>	5
	ts <sup>h</sup>	ts <sup>h</sup>	ts <sup>h</sup> ~s	1
	(s)	s	s	8
		s	t <sup>h</sup>	1
/təts <sup>h</sup> / ‘trap’	ts <sup>h</sup>	ts <sup>h</sup>	ts <sup>h</sup>	2
	ts <sup>h</sup> ~s	ts <sup>h</sup>	ts <sup>h</sup>	1
	s	s	s	10
	s	ts <sup>h</sup>	s	1
		different lexical choices		5

### 5. Eastern dialects

(26) Kangwon: AKS (1990)			
	Nom./i/	Acc. /il/ (~/əl/)	Loc. /e/
/t <sup>h</sup> /-final nouns	ts <sup>h</sup>	t <sup>h</sup> ~ ts <sup>h</sup>	t <sup>h</sup>
/ts <sup>h</sup> /-final nouns	ts <sup>h</sup>	ts <sup>h</sup>	ts <sup>h</sup> ~ t <sup>h</sup>

(27) /t<sup>h</sup>/-final nouns: Kangwon dialect (AKS 1990)

	Nom./i/	Acc. /il/	Loc. /e/	(N=15)
/pat <sup>h</sup> / ‘field’	$\widehat{ts}^h$	t <sup>h</sup>	t <sup>h</sup>	8
	$\widehat{ts}^h$	$\widehat{ts}^h$	<b>t<sup>h</sup></b>	4
	$\widehat{ts}^h$	t <sup>h</sup> ~s	t <sup>h</sup>	1
			t <sup>h</sup>	1
/silumit <sup>h</sup> / ‘under the steamer’		t <sup>h</sup>	t <sup>h</sup>	7
		$\widehat{ts}^h$	<b>t<sup>h</sup></b>	3
		different lexical choice		5
/sot <sup>h</sup> / ‘pot’	$\widehat{ts}^h$	t <sup>h</sup>	t <sup>h</sup>	6
	$\widehat{ts}^h$		t <sup>h</sup>	5
	$\widehat{ts}^h$	$\widehat{ts}^h$	<b>t<sup>h</sup></b>	3
	$\widehat{ts}^h$	t <sup>h</sup> ~s	t <sup>h</sup>	1

(28) /ts<sup>h</sup>/-final nouns: Kangwon dialect (AKS 1990)

	Nom./i/	Acc. /il/	Loc. /e/	(N=15)
/suts <sup>h</sup> / ‘charcoal’	$\widehat{ts}^h$	t <sup>h</sup>	t <sup>h</sup>	7
	$\widehat{ts}^h$	$\widehat{ts}^h$	$\widehat{ts}^h$	4
	$\widehat{ts}^h$	$\widehat{ts}^h$	<b>t<sup>h</sup></b>	1
	$\widehat{ts}^h$	t <sup>h</sup>	$\widehat{ts}^h$	1
/k’ots <sup>h</sup> / ‘flower’	$\widehat{ts}^h$	t <sup>h</sup>	t <sup>h</sup>	8
	$\widehat{ts}^h$	$\widehat{ts}^h$	<b>t<sup>h</sup></b>	1
	$\widehat{ts}^h$	$\widehat{ts}^h$	$\widehat{ts}^h$	1
	( $\widehat{ts}^h$ )	$\widehat{ts}^h$		2
			t <sup>h</sup>	1
	$\widehat{ts}^h$ ~s	t <sup>h</sup>		1
s	s	s	1	
/təts <sup>h</sup> / ‘trap’	$\widehat{ts}^h$	$\widehat{ts}^h$	$\widehat{ts}^h$	5
	$\widehat{ts}^h$		$\widehat{ts}^h$	1
	$\widehat{ts}^h$	$\widehat{ts}^h$	<b>t<sup>h</sup></b>	1
	$\widehat{ts}^h$			1
	$\widehat{ts}^h$		t <sup>h</sup>	1
	$\widehat{ts}^h$	t <sup>h</sup>	t <sup>h</sup>	5
	s	s	s	1

(29) Southern Kyengsang: AKS (1993)			
	Nom./i/	Acc. /il/(~/əl/)	Loc. /e/
/t <sup>h</sup> -final nouns	ts <sup>h</sup>	t <sup>h</sup> (~ts <sup>h</sup> )	t <sup>h</sup>
/ts <sup>h</sup> -final nouns	ts <sup>h</sup>	ts <sup>h</sup> ~t <sup>h</sup>	<b>t<sup>h</sup></b>

(30) /t<sup>h</sup>-final nouns: Southern Kyengsang dialect (AKS 1993)

	Nom./i/	Acc. /il/	Loc. /e/	(N=19)
/pat <sup>h</sup> / ‘field’	ts <sup>h</sup>	t <sup>h</sup>	t <sup>h</sup>	19
/silumit <sup>h</sup> / ‘under the steamer’	different lexical choices			9
/sot <sup>h</sup> / ‘pot’	ts <sup>h</sup>	t <sup>h</sup>	t <sup>h</sup>	17
	ts <sup>h</sup>	<b>ts<sup>h</sup></b>	<b>t<sup>h</sup></b>	2

(31) /ts<sup>h</sup>-final nouns: Southern Kyengsang dialect (AKS 1993)

	Nom./i/	Acc. /il/	Loc. /e/	(N=15)
/suts <sup>h</sup> / ‘charcoal’	ts <sup>h</sup>	t <sup>h</sup>	t <sup>h</sup>	17
	ts <sup>h</sup>	<b>ts<sup>h</sup></b>	<b>t<sup>h</sup></b>	1
	ts <sup>h</sup>	t <sup>h</sup>	ts <sup>h</sup>	1
/k’ots <sup>h</sup> / ‘flower’	ts <sup>h</sup>	t <sup>h</sup>	t <sup>h</sup>	15
	ts <sup>h</sup>	<b>ts<sup>h</sup></b>	<b>t<sup>h</sup></b>	5

(32) Summary of vowel height effect

- The change to [ts<sup>h</sup>] mainly affects the high vowel context.
- The change to [t<sup>h</sup>] mainly affects the non-high vowel context.

**6. Vowel height effect and markedness: a grammatical account**

(33) Markedness constraints

- \*tV<sup>high front</sup>: no coronal stop before a high front vowel
- \*tV<sup>high</sup>: no coronal stop before a high vowel
- \*tV: no coronal stop before a vowel
- BASE-IDENTITY: if stem ends in [ts<sup>h</sup>] in the nominative, the stem should end in [ts<sup>h</sup>].
- ANTI-CORRESPONDENCE.: if stem ends in [ts<sup>h</sup>] in the nominative, the stem should end in [t<sup>h</sup>]. (cf. Hayes 1997)

(34) Verbal stems

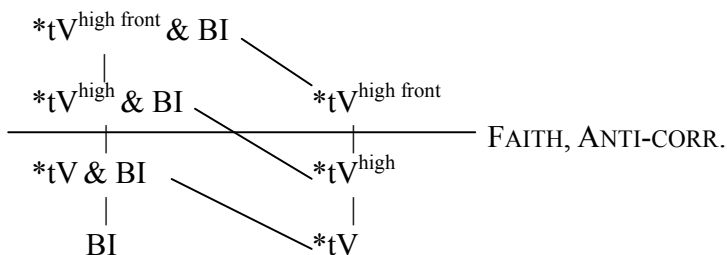
t <sup>h</sup> - i	*tV <sup>high front</sup>	FAITH	*tV <sup>high</sup>	*tV
→ ts <sup>h</sup> i		*		
t <sup>h</sup> i	*!		*	*
t <sup>h</sup> - ə	*tV <sup>high front</sup>	FAITH	*tV <sup>high</sup>	*tV
ts <sup>h</sup> ə		*!		
→ t <sup>h</sup> i			*	*
t <sup>h</sup> - ə	*tV <sup>high front</sup>	FAITH	*tV <sup>high</sup>	*tV
ts <sup>h</sup> ə		*!		
→ t <sup>h</sup> ə				*

- No evidence of tV<sup>high</sup>.

(35) Seoul-Kyenggi dialects (AKS 1995)			
	Nom./i/	Acc./Dir. /i/	Loc. /e/
/t <sup>h</sup> /-final nouns	ts <sup>h</sup> (~s)	ts <sup>h</sup> (~s)	t <sup>h</sup> (~s)
/ts <sup>h</sup> /-final nouns	ts <sup>h</sup> (~s)	ts <sup>h</sup> (~s)	ts <sup>h</sup> ~t <sup>h</sup> (~s)

(36) Local conjunction

- The effect of \*tV<sup>high</sup> constraint emerges when forced by Base-Identity constraints.
- The Base-Identity constraint respects the markedness scale (\*tV<sup>high front</sup> >> \*tV<sup>high</sup> >> \*tV) → local conjunction of BI and the markedness scale.



(37) /t<sup>h</sup>/-final nouns (Nominative: [ts<sup>h</sup>])

t <sup>h</sup> - i	BI&*tV <sup>high front</sup>	BI&*tV <sup>high</sup>	FAITH	BI&*tV
→ ts <sup>h</sup> i			*	
t <sup>h</sup> i	*!	*		*
t <sup>h</sup> - i	BI&*tV <sup>high front</sup>	BI&*tV <sup>high</sup>	FAITH	BI&*tV
→ ts <sup>h</sup> i			*	
t <sup>h</sup> i		*!		*
t <sup>h</sup> - e	BI&*tV <sup>high front</sup>	BI&*tV <sup>high</sup>	FAITH	BI&*tV
ts <sup>h</sup> e			*!	
→ t <sup>h</sup> e				*

(38) /ts<sup>h</sup>/-final nouns (Nominative: [ts<sup>h</sup>])

ts <sup>h</sup> - i	BI&*tV <sup>high front</sup>	BI&*tV <sup>high</sup>	ANTI CORR.	FAITH	BI&*tV
→ ts <sup>h</sup> i			*		
t <sup>h</sup> i	*!	*		*	*
ts <sup>h</sup> - i	BI&*tV <sup>high front</sup>	BI&*tV <sup>high</sup>	ANTI CORR.	FAITH	BI&*tV
→ ts <sup>h</sup> i			*		
t <sup>h</sup> i		*!		*	*
ts <sup>h</sup> - e	BI&*tV <sup>high front</sup>	BI&*tV <sup>high</sup>	ANTI CORR.	FAITH	BI&*tV
→ ts <sup>h</sup> e			*!		
→ t <sup>h</sup> e				*	*

## 7. Frequency of use and resistance to an analogical change

(39) An alternative account

- Is there an account of the vowel height asymmetry that can do without the universal markedness constraint \*tV<sup>high</sup>?
- Is it possible that the vowel height asymmetry could have been **learned**?

(40) Lexical diffusion and frequency of use

- Analogically motivated changes affect low-frequency words first.
- High-frequency words form strong mental representations and resist change motivated by analogy to other forms.
- ♣ Schuchardt 1885, Phillips 1983, 1984, 2001, Bybee 1985, 2001, Bybee and Hopper 2001

(41) Frequency of use: /t<sup>h</sup>/-final nouns

- Most of the existing /t<sup>h</sup>/-final nouns have a meaning of “location” and tends to be used very frequently with the locative suffix (/e/).

(B. Lee 1975, T. Choi 1977, J. Choi 1986, K. Lee 1986, K. Ko 1989, H. Kang 1993)

- Frequency count (<http://morph.kaist.ac.kr/kcp/>): 13.6 million words

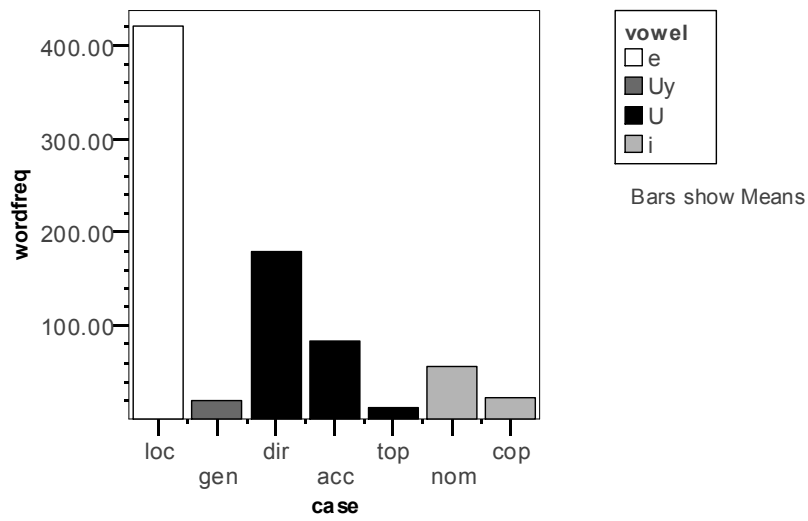


Figure 7: Mean word frequency of /tʰ/-final nouns in KAIST corpus: averaged over 8 nouns studied in Y. Kang (2003)

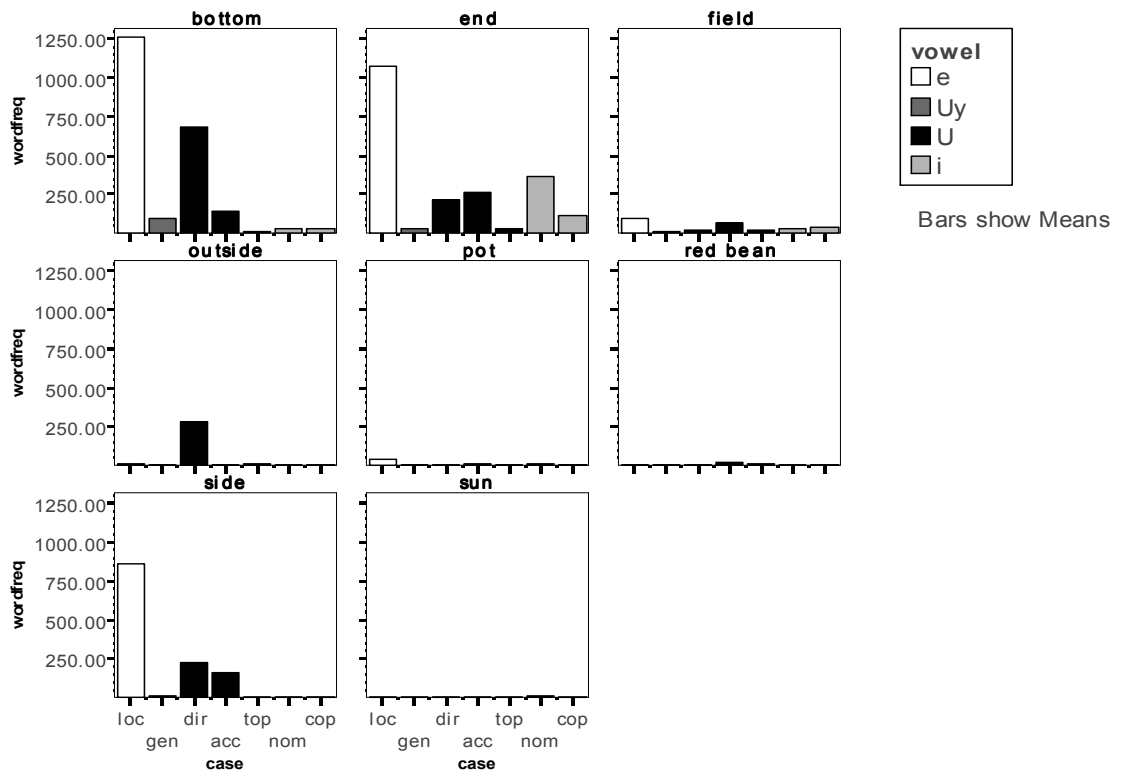


Figure 8: Word frequency of /tʰ/-final nouns in KAIST corpus: for the 8 nouns studied in Y. Kang (2003)

(42) Frequency of use alone is not quite enough

- Not all nouns show the frequency asymmetry between locative vs. other forms but the locative form consistently show the lowest acceptability rating for  $[ts^h]$  for all /t<sup>h</sup>-final nouns (Figure 3, 5).
- Words of comparable frequency still show different acceptability conditioned by the vowel height.

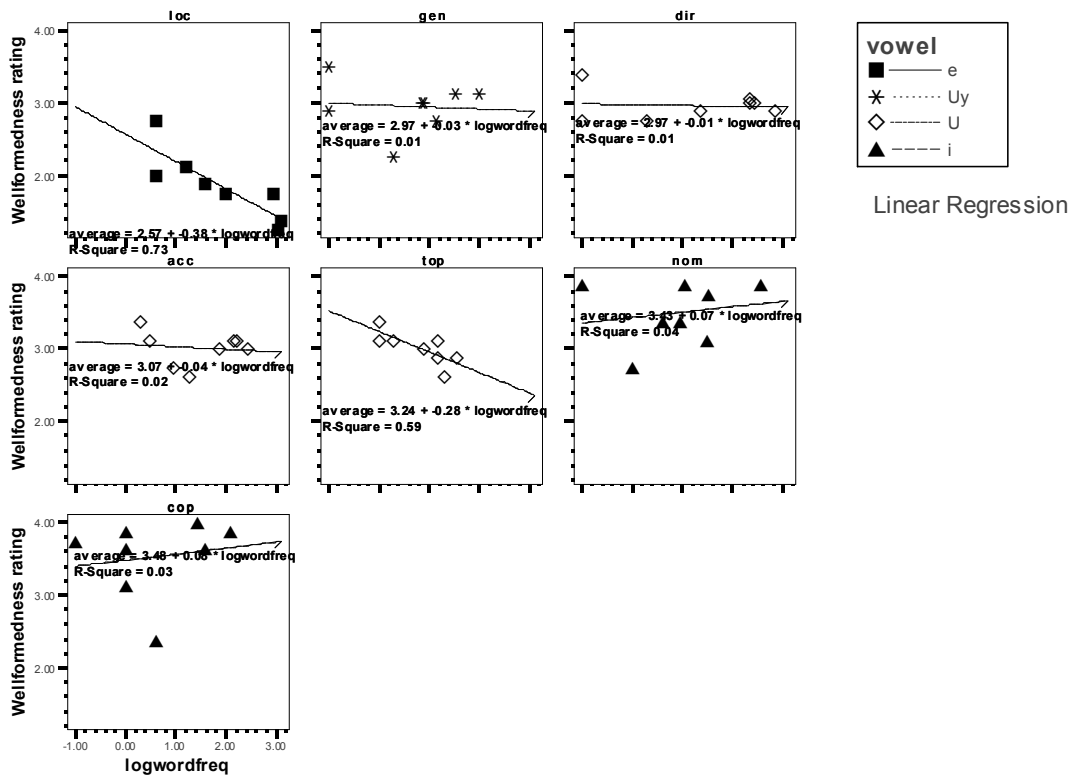


Figure 9: Scatterplot of mean wellformedness rating of  $[ts^h]$  pronunciation of /t<sup>h</sup>-final nouns (averaged over 8 speakers and 8 nouns) plotted against the frequency of occurrence in the KAIST corpus.

(43) Frequency of use effect and reanalysis

- An asymmetry in distribution initially created as an epiphenomenon of frequency effect is reinterpreted as a vowel height effect by the learners.

	Acc (i)	Loc (e)
Stage A:	$t^h t^h t^h t^h t^h t^h$	$t^h t^h t^h t^h t^h t^h$
Stage B:	$\widehat{ts^h} t^h \widehat{ts^h} \widehat{ts^h} \widehat{ts^h} t^h$	$t^h t^h \widehat{ts^h} t^h t^h t^h$
Stage C:	$\widehat{ts^h} \widehat{ts^h} \widehat{ts^h} \widehat{ts^h} \widehat{ts^h} \widehat{ts^h}$	$t^h t^h t^h t^h t^h t^h$

- Stage B: The change to  $\widehat{ts^h}$  in the  $/t^h/$ -final nouns affects infrequently used words more readily than frequently used words. Overall, most locative forms are produced with  $[t^h]$ , while most accusative forms are produced with  $\widehat{ts^h}$ .
- Stage C: The learners reinterpret the distribution of  $\widehat{ts^h}$  and  $[t^h]$  as one conditioned by vowel quality.

(44) Frequency of use:  $\widehat{ts^h}$ -final nouns

- The frequency count from <http://morph.kaist.ac.kr/kcp/> shows a high frequency for the accusative form in a couple of  $\widehat{ts^h}$  final nouns.
- This is consistent with the fact that the change to  $[t^h]$  affects  $[e]$  suffix forms more readily.

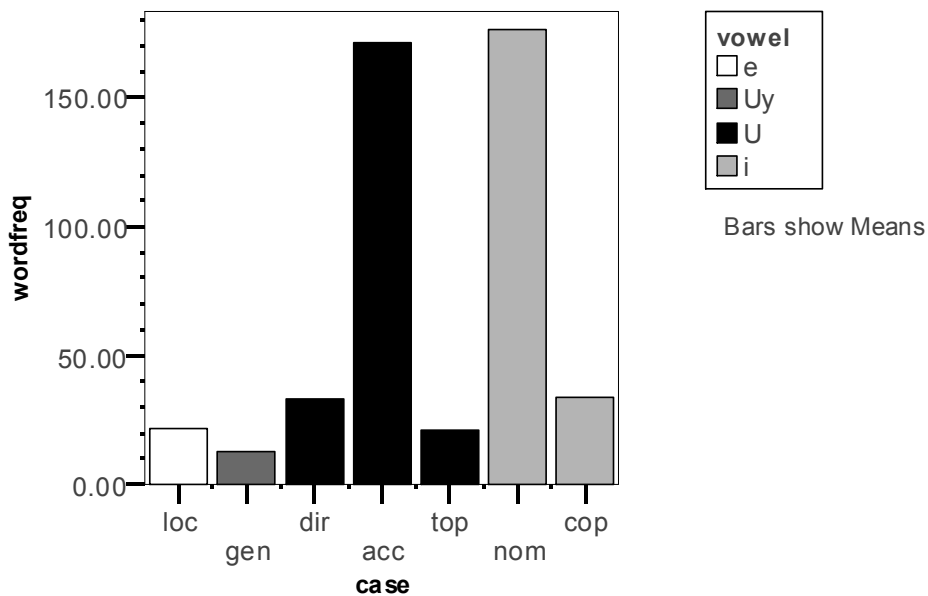


Figure 10: Mean word frequency of  $\widehat{ts^h}$ -final nouns in KAIST corpus: averaged over 5 nouns studied in Y. Kang (2003)

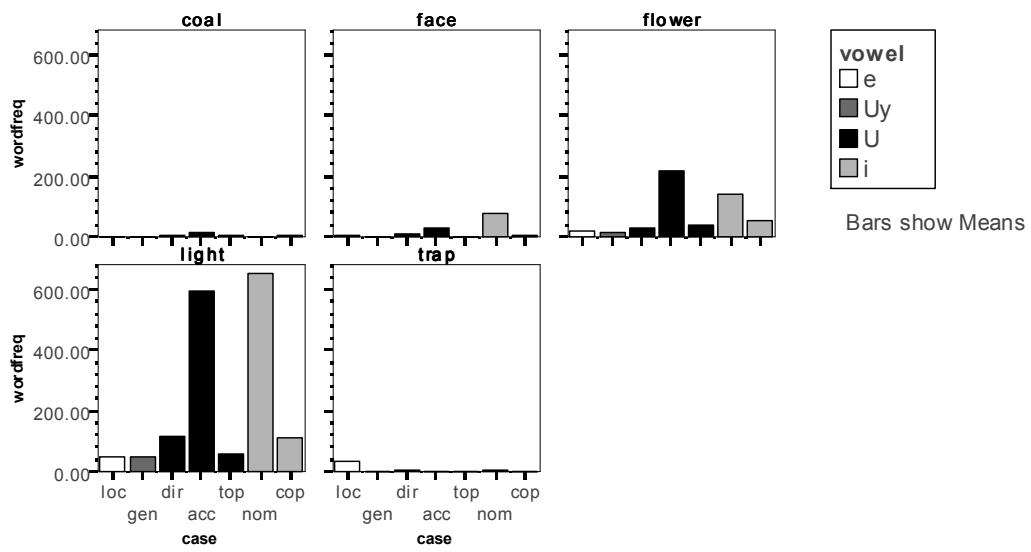


Figure 11: Word frequency of /t<sup>h</sup>-final nouns in KAIST corpus: for the 5 nouns studied in Y. Kang (2003)

(45) The directive forms

- H. Kang (1992): Kwangcwu and Kwangyang dialects (Cennam)
- 32 speakers each
- Elicited production
- Directive forms (ilo) pattern with locative (e) and show very low rate of  $[ts^h]$  response, while the accusative forms (il) show a rate of  $[ts^h]$  response comparable to that of nominative (i).

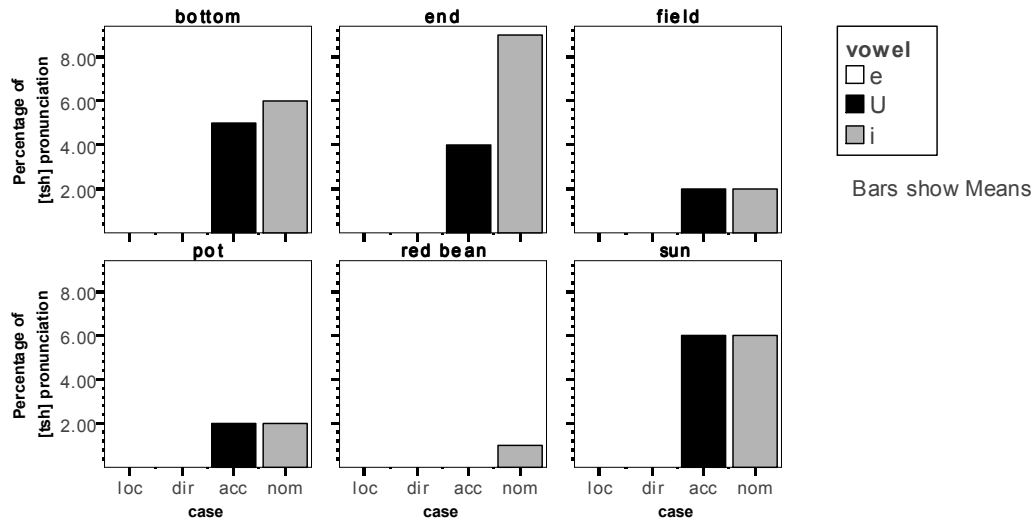


Figure 12: Percentage of  $[ts^h]$  pronunciation for  $/t^h/$ -final nouns in 32 Kwangcwu speakers

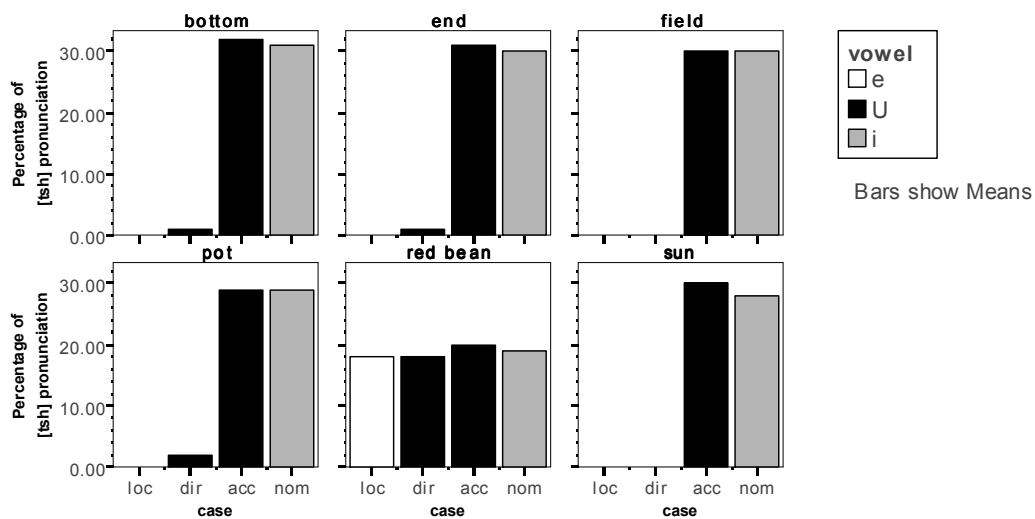


Figure 13: Percentage of  $[ts^h]$  pronunciation for  $/t^h/$ -final nouns in 32 Kwangyang speakers

- Why the special behavior of directive forms?
  - Many of the /t<sup>h</sup>/ final nouns have a meaning of ‘location’ and they are likely used frequently with the directive suffix (Figure 7.). This creates an initial three-way asymmetry:
    - locative (e): most conservative
    - directive (ilo): intermediate
    - accusative (il): least conservative
  - Some speakers make sense of the pattern by analyzing it as a phonologically conditioned alternation (Central, Eastern dialects), grouping directive and accusative together, while others analyze it as a morphologically conditioned alternation (Kwangcwu and Kwangyang dialects).<sup>6</sup>

## 8. Conclusion

- An apparent phonetic naturalness effect emerges in a morpho-phonological change.
- A markedness constraint-based account is considered.
- An account based on frequency effect is suggested as a possible alternative.
- The data do not lend a positive support for a grammatical bias toward phonetic naturalness.
- Speakers seem to posit a generalization that utilizes natural class (high vs. non-high vowel) and morphological case (directive, locative vs. accusative) even in the face of a number of exceptions and a significant variability.

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<sup>6</sup> An alternative possibility is that the directive suffix is sometimes pronounced as /elo/, which can be analyzed as a concatenation of locative suffix /e/ and a directive suffix /lo/.

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