

STEM-FINAL OBSTRUENT VARIATIONS IN KOREAN ARE PRODUCT-ORIENTED

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0. Overview

- Topic: Free variation of stem-final obstruents in Korean
- Variation in nouns
- Frequency of nouns
- Variation in bound stems
- A product-oriented analysis

BACKGROUND: STEM-FINAL ALTERNATIONS IN NOUNS

1. Three-way laryngeal distinction among obstruents in Korean

	<i>Labial</i>	<i>Coronal</i>			<i>Velar</i>
	Stop	Stop	Fricative	Affricate	Stop
Lenis	p	t	s	c	k
Aspirated	p ^h	t ^h		c ^h	k ^h
Tense	p'	t'	s'	c'	k'

2. Phonological changes involving obstruents.

- a. **Coda neutralization:** Aspirated/tense obstruents → lenis stop in the coda
- b. **Palatalization:** /t, t^h/ → [c, c^h] /__ + [i]

3. Alternations of stem-final obstruents in nouns.

stem-final C	<i>(i) Locative (-e)</i>	<i>(ii) Isolation form</i>	<i>(iii) Nominative (-i)</i>	<i>gloss</i>
<u>Coronal</u>	os-e pat ^h -e nac-e pic ^h -e	ot ^ɿ pat ^ɿ nat ^ɿ pit ^ɿ	oɟ-i pac^h-i nac-i pic ^h -i	'clothes' 'field' 'day' 'light'
<u>Labial</u>	pap-e ip ^h -e	pap ^ɿ ip ^ɿ	pap-i ip ^h -i	'rice' 'leaf'
<u>Velar</u>	kuk-e pak'-e puək ^h -e	kuk ^ɿ pak ^ɿ puək ^ɿ	kuk-i pak'-i puək ^h -i	'soup' 'outside' 'kitchen'

4. Standard rule-based analysis of the alternations: UR = pre-V form.

	<i>locative</i>	<i>isolation</i>	<i>nominative</i>
<u>UR</u>	/pat ^h +e/	/pat ^h /	/pat ^h +i/
<u>coda neutralization</u>		t	
<u>palatalization</u>			c ^h
<u>SR</u>	[pat ^h e]	[pat]	[pac ^h i]

VARIATION IN NOUNS

5. Free variation of noun stem-final obstruents before V-initial suffixes (Ko 1989; Martin 1992; Albright 2005a,b; Y. Kang 2003a,b)

- Coronal C ~ [s] (less frequently, [c^h]) e.g. /pat^h-il/ [pat^hil] ~ [pasil] ‘field, accusative’
- Noncoronal C ~ **lenis** [p, k] e.g. /ip^h-e/ [ip^h-e] ~ [ipe] ‘leaf, locative’

6. Recent survey studies (Kim 2003; Choe 2004; E. Kang et al. 2004)

- Patterns involved are more complicated: e.g. a wider set of coronal variants [s, t^h, c^h, c, t].

7. Stem-final obstruent = coronal (Selected from Kim (2003), Choe (2004), E. Kang et al. (2004))

<u>Stem-final C</u>	<u>UR</u>	<u>Standard</u>	<u>Variants</u>	<u>gloss</u>	<u>Source</u>
a. /t ^h /	(i) /pat ^h -i/	pac ^h -i	pas-i [paʃi]	‘field’	Choe
	(ii) /pat ^h -ilo/	pat ^h -ilo	pas-ilo ~ pac ^h -ilo	‘field’	Choe
	(iii) /sot ^h -e/	sot ^h -e	sos-e ~ soc ^h -e ~ sot-e	‘pot’	Kang
	(iv) /mit ^h -il/	mit ^h -il	mis-il ~ mic ^h -il ~ mit-il	‘bottom’	Kang
b. /c ^h /	(i) /k’oc ^h -ilo/	k’oc ^h -ilo	k’os-ilo ~ k’ot ^h -ilo	‘flower’	Choe
	(ii) /k’oc ^h -a/	k’oc ^h -a	k’os-a ~ k’ot ^h -a ~ k’oc-a ~ k’ot-a	‘flower’	Kim, Choe
	(iii) /nac ^h -ilo/	nac ^h -ilo	nas-ilo ~ nat ^h -ilo	‘face’	Choe
	(iv) /tac ^h -il/	tac ^h -il	tas-il ~ tat ^h -il ~ tac-il	‘anchor’	Choe
	(v) /toc ^h -e/	toc ^h -e	tos-e ~ tot ^h -e ~ toc-e ~ tot-e	‘sail’	Choe
	(vi) /pic ^h -il/	pic ^h -il	pis-il ~ pit ^h -il	‘light’	Choe
c. /c/	(i) /nac-ilo/	nac-ilo	nas-ilo ~ nac ^h -ilo	‘daytime’	Kang
	(ii) /pic-in/	pic-in	pis-in ~ pic ^h -in	‘debt’	Kang
	(iii) /mokcæc-e/	mokcæc-e	mokcæs-e ~ mokcæc ^h -e	‘uvula’	Kang

(Suffixes: /-i/ = nominative, /-il/ = accusative, /-ilo/ = locative/instrumental, /-in/ = topic, /-e/ = dative/locative, /-a/ = vocative)

8. The relative preference among the variants differs depending on the stem and the suffix.

9. Tendencies with stem-final coronal obstruents

- a. [s] is, in general, the most favored variant.
- b. [c^h] is favored when the stem combines with /i/-initial suffixes such as -il, -in and -ilo (E. Kang et al. (2004: 12) and Choe (2004: 21)).
- c. [t^h] is favored when the stem combines with /e/-initial suffixes such as -e and -esə. (Ko 1989; Y. Kang 2003a, b; Choe 2004; E. Kang et al. 2004)
- d. [c] and [t] are, in general, rarely adopted.

10. Stem-final obstruents = Noncoronal (Choe 2004; E. Kang et al. 2004 among many others)

<u>Stem-final C</u>	<u>UR (= standard)</u>	<u>Variants</u>	<u>gloss</u>
/p ^h /	ip ^h -e	ip-e	‘leaf’
	sup ^h -i	sup-i	‘woods’
/k ^h /	puæk ^h -e	puæk-e	‘kitchen’
	sɛpjækɲjæk ^h -e	sɛpjækɲjæk-e	‘dawn’

11. A summary of observations about stem-final obstruent variation in nouns

- a. Five obstruents [s, t^h, c^h, c, t] are involved in free variation of stem-final coronal obstruents.
- b. [s] is, in general, the most favored variant.
- c. [c^h] is favored before /i/-initial suffixes.
- d. [t^h] is favored before /e/-initial suffixes.
- e. [c] and [t] are least favored variants.
- f. Noncoronal aspirated/tense obstruents are in free variation with their lenis counterparts.

FREQUENCY FACTS

12. All the observations about free variation in nouns are consistent with frequency facts in Korean.

13. Distribution of final obstruents of nouns

- Based on Kang & Kim (2004) employing the 5.5 million word text corpus of Sejong Project

Labial		Coronal		Velars	
p	2488	t	7	k	7437
p ^h	82	t ^h	141	k ^h	22
p'	0	t'	0	k'	9
		c	19		
		c ^h	227		
		c'	0		
		s	557		
		s'	0		

14. Frequency hierarchies among final obstruents

a. Coronal: s >> c^h >> t^h >> c, t, (t', c', s')

b. Noncoronal: k >> k^h, k' p >> p^h

- These frequency facts are consistent with the observations summarized above except for (11c, d).
- Indication: The relative frequency of final obstruents in the lexicon determines their relative preference in the choice of final variants in free variation. (cf. Albright 2005a)
- What about the suffix-specific difference in the preference between [c^h] and [t^h]?

15. Distribution of final coronal obstruents of **suffixed** nouns

- The 5.5 million word text corpus of Sejong Project (1999 ~ 2001)

Final C (↓) vs. suffix (→)	il	in	e	esə
s	149	77	57	28
t ^h	42	19	56	32
c ^h	67	36	21	8
c	7	7	6	1
t	1	0	0	0

✓ before [il, in]: s >> c^h >> t^h >> c >> t

✓ before [e, esə]: s, t^h >> c^h > c > t

- Indication. The observed suffix-specific difference in the preference between [c^h] and [t^h] → the suffix-specific asymmetry in the frequency of relevant suffixed nouns.

16. Distribution of final **noncoronal** obstruents of suffixed nouns

Final C (↓) vs. suffix (→)	il	in	e	esə
p	757	441	538	231
p ^h	36	16	24	15
k	2515	1392	1512	697
k ^h	3	4	11	8
k'	2	2	6	3

✓ Lenis >> Aspirated

17. Main findings

- The relative frequency of nouns ending in a certain obstruent determines the degree of its preference in the choice of the stem-final variant of nouns. (cf. Albright 2005a)
- **Type frequency of suffixed forms**, not bare stems, is the determining factor in the preference of variants.

VARIATION IN BOUND STEMS

18. Compound verbs

a. Noun stem + *ha* = verb stem (Sohn 2001) cf. *ha* 'do'

- (i) *il* 'work, noun'
- (ii) *il-ha-ta* 'work, verb, infinitive'
- (iii) *il-ha-ko* 'work, verb, connective'

b. loanword + *ha* = verb stem

- (i) *keim* 'game, noun'
- (ii) *keim-ha-ta* 'play a game, infinitive'
- (iii) *keim-ha-ko* 'play a game and, connective'

19. Compound verbs: Bound stem + *ha* = verb stem

- (i) *p^hokin-ha-ta* 'warm, infinitive' *p^hokin-ha-ko* 'warm, connective'
- (ii) *pisish-ha-ta* 'similar, infinitive' *pisish-ha-ko* 'similar, connective'
- (iii) *taptap-ha-ta* 'stuffy, infinitive' *taptap-ha-ko* 'stuffy, connective'
- (vi) *t'okt'ok-ha-ta* 'clever, infinitive' *t'okt'ok-ha-ko* 'clever, infinitive'
- (v) *t'akt'ak-ha-ta* 'hard, infinitive' *t'akt'ak-ha-ko* 'hard, infinitive'

20. Bound stems

a. Isolation forms of the stems are rarely, if ever, attested.

b. Normal occurrence: combination with ...

- *-ha* e.g. *p^hokin-ha-(ta)* 'warm, infinitive'
- *-i*, an adverbializing suffix (for some stems) e.g. *p^hokin-i* 'warmly'

c. Mostly, mimetic vocabulary. Often, reduplication. They **cannot be classified as nouns**.

d. In principle, topic marker *-in* may be inserted between the bound stem and *ha*.

21. Topic formation of bound stems: [stem + *in* + *ha*]

- (i) p^hokin-in-ha-ta 'warm, topicalized, infinitive'
- (ii) pisis-in-ha-ta 'similar, topicalized, infinitive'
- (iii) taptap-in-ha-ta 'stuffy, topicalized, infinitive'
- (vi) t'okt'ok-in-ha-ta 'clever, topicalized, infinitive'
- (v) t'akt'ak-in-ha-ta 'hard, topicalized, infinitive'

- This formation is completely acceptable to native Korean speakers, but **rarely** used.
- A probable location for variation of stem-final obstruents.

JUDGMENT SURVEY

22. Test stems

<i>Stem-final C</i>	<i>Stems (transcribed based on the Korean orthography)</i>
Coronal	pisis, k'ek'is, t'at'is, t'ət'əs, himus, nikis, iicəs, ɛthis, p'utis, c'alis, pantis (11stems)
Labial	pokcap, takip, səŋkip, pikəp, cokip, mihip, taptap, səpsəp, k'amucăpcăp, kapkap, c'ipc'ip (11 stems)
Velar	simkak, palamcik, solcik, nəknək, t'akt'ak, t'okt'ok, k'imcik, kipkjək, makmak, t'ətɪls'ək, katik, s'iks'ik (12 stems)

23. Design

- a. Target words: **bound stem + in + ha**
- b. The test words are put in a sentential context. Experimental sentences are written in Korean orthography.
- c. Subjects were presented with possible phonetic forms of each test word which differ only in the stem-final obstruent.
- d. Subjects: 30 native speakers of the Seoul Korean, aged 20s - 40s.
- e. For each form, the subjects were asked to rate 1 through 4 in the order of acceptability: 4 (good), 3 (O.K.), 2 (not impossible), 1 (impossible).

24. Example experimental sentences

- a. Final obstruent = coronal

wancənhi kat^hci-nin anh-təlato **pisis-in** hɛ-jaci. (ha + əjaci → hejaci)

[pisisin] ()

[pisi^hin] ()

[pisi^hc'in] ()

[pisi^cin] ()

[pisi^tin] ()

'completely' 'same-Top' 'not-although' 'similar-Top' 'do-should'

'Even if (they) are not completely identical, they should be similar.'

- b. Final obstruent = labial

ki salam səŋkjək-i **səŋkip-in** ha-nte, kileto c^hakhe.

[səŋkipin] ()

[səŋkip^hin] ()

'the' 'person' 'personality-Nom' 'impatient-Top' 'do-though' 'nonetheless' 'nice'

‘Although his personality is impatient, he is nice.’

RESULTS

25. Degree of Acceptability

- ** At least half the subjects (i.e. 15) choose 4 or 3 (meaning at least “O.K.”)
- * At least half the subjects (i.e. 15) choose 4 or 3 or 2 (meaning at least “not impossible”)
- x otherwise (meaning “impossible”)

26. Acceptability of variant forms of /pisis-in/ ‘similar’

[pisi__in]	4	3	2	1	4+3	4+3+2	Acceptability	Mean
s	21	7	1	1	28	29	**	3.60
t ^h	1	8	11	10	9	20	*	2.00
c ^h	2	6	13	9	8	21	*	2.03
č	1	7	6	16	8	14	x	1.77
t	6	8	10	6	14	24	*	2.47

27. Acceptability of variants (Stem-final C = Coronal)

a. Degree of Acceptability: $s \gg c^h \gg t^h > c > t$

	s	t ^h	c ^h	c	t
1. pisis	**	*	*	x	*
2. k'ek'is	**	*	**	*	*
3. t'at'is	**	*	**	*	*
4. t'əst'əs	**	*	**	*	*
5. himus	**	*	*	*	x
6. nikis	**	*	*	*	x
7. iičəs	**	*	*	*	x
8. et ^h is	**	x	*	*	*
9. p'utis	**	x	*	x	*
10. č'alīs	**	*	*	x	x
11. pantīs	**	*	*	*	*

b. Mean acceptability scores: $s > c^h > t^h > c > t$

stem-final obstruent	s	t ^h	c ^h	c	t
Mean	3.78	2.03	2.39	1.92	1.90
standard deviation	0.35	0.57	0.59	0.72	0.61

28. ANOVA test (stem-final C = coronal): A significant main effect of variant types (true for all target stems).

29. Post-hoc test (Tukey-Kramer HSD)

Words	significant differences (indicated by >)
1. pisis	$s > t, t^h, c^h, c; t > c$
2. k'ek'is	$s > c^h > t^h, c, t$

3. t'at'is	s > c ^h , t ^h , t, c; c ^h > c
4. t'əst'əs	s > c ^h > t ^h , t, c
5. himus	s > c ^h , t ^h , c, t; c ^h > t
6. nikis	s > c ^h > t ^h , c, t
7. iicəs	s > t ^h , c, c ^h , t
8. ɛt ^h is	s > c ^h , c, t, t ^h
9. p'utis	s > c ^h , t, c, t ^h
10. c'alis	s > c ^h , t ^h , c, t; ch > c, t
11. pantis	s > c ^h , c, t, t ^h ; ch > t ^h

- [s]-final forms show significantly larger scores than those ending in the other obstruents in all 11 words.
- [c^h]-final forms show significantly larger scores than those ending in [t^h, c, t] in 3 words and those ending in some of [t^h, c, t] in 4 words.
- [t]-final forms show significantly larger scores than [c]-final forms only in one word.
- In summary, [s] >> [c^h] > [t^h], [c], [t]

30. A summary of results of tests with target stems ending with the coronal obstruent.

a. Degree of acceptability	s > c ^h > t ^h > c > t
b. Mean acceptability score	s > c ^h > t ^h > c > t
c. ANOVA & Post-hoc test	s > c ^h > t ^h , c, t

- Multiple forms are acceptable. In all cases, more than one form are at least “not impossible”.
- Different variants show different degrees of acceptability.
- [s]-final forms: the most favored.
- [c^h]-final forms: the 2nd best option.
- The overall order of acceptability: s > c^h > t^h > c > t.
- ≈ the frequency of nouns, combined with a topic marker –in, repeated below.

31. Distribution of final obstruents of topicalized noun stems ending in coronals (topic marker = in)

stem-final obstruent	s	c ^h	t ^h	c	t
type frequency	77	36	19	7	0

32. Acceptability of variants (stem-final C = Noncoronal)

- Degree of Acceptability

Labial	p	p ^h	Velar	k	k ^h
pokcap	**	*	simkak	**	x
takip	**	*	palamcik	**	*
səŋkip	**	*	solcik	**	*

pikəp	**	*	nəknək	**	*
cokip	**	*	t'akt'ak	**	x
mihip	**	*	t'okt'ok	**	*
taptap	**	*	k'imc'ik	**	x
səpsəp	**	*	kipkjək	**	*
k'amucapcap	**	*	makmak	**	*
kapkap	**	*	t'ətɨls'ək	**	x
c'ipc'ip	**	*	katik	**	*
			s'iks'ik	**	x

- Mean acceptability score

stem-final obstruent	p	p ^h	k	k ^h
Mean	3.76	2.14	3.85	1.79
Standard Deviation	0.35	0.77	0.34	0.69

- Often, more than one form are at least “not impossible”.
- Lenis >> Aspirated
- ≈ the frequency of nouns, combined with a topic marker –in, repeated below.

33. Distribution of final obstruents of topicalized noun stems ending with noncoronals

stem-final obstruent	p	p ^h	k	k ^h
type frequency	441	16	1392	4

34. Important observations

- Speakers’ judgments of acceptability of topicalized bound stems show the same type of variation as can be seen with nouns.
- Strikingly, the relative **frequency of nouns** ending in a certain obstruent determines the relative **acceptability of topicalized bound stems** ending in this obstruent.

ANALYSIS

35. A summary of findings

- Nouns: Variation patterns are determined by the **distribution of final obstruents of nouns**.
- The distribution must be based on the number of **suffixed forms**, not bare stems.
- Bound stems: show **similar stem-final variation** before a topic marker *-in*.
- Bound** stem variations are also determined by the distribution of final obstruents of **nouns**.

36. Source-oriented vs. Product-oriented (in Bybee’s (2001) terminology)

- Source-oriented: the form of a certain (inflectional) category is determined by forms of different categories.
 - ✓ Most previous analyses of variation patterns of Korean nouns.
 - ✓ rule (Ko 1989, Albright 2002, 2005), anti-correspondence constraints (Hayes 1999, Y. Kang 2003b), Paradigm Uniformity (or Optimal Paradigms) constraint (Kenstowicz 1995, Park 2006)

- ✓ Anticorrespondence constraint: $t/ _]_{\text{noun}} \# \rightarrow s/ _]_{\text{noun}} V (t \rightarrow s)$ (Kang 2003b)
 “If a noun ends in [t] in isolation form, change it to [s] before a vowel initial suffix.”

- b. Product-oriented: a certain lexical item’s output form of a category is determined by other lexical items’ output forms of the same category.
- To explain the stem-final variation in Korean: **Product-oriented** >> **Source-oriented** since similar variation patterns are observed in two different morphological categories, nouns and bound stems, which have totally different paradigm systems.

37. Proposal

- a. Formalized in Optimality Theory (Prince and Smolensky 2004)
- b. Assumption: suffixed forms are listed in the lexicon (Bybee 2001; cf. Zuraw 2002).
- c. Speakers know patterns of the listed suffixed forms, and the knowledge may include phonotactic generalizations on the positioning of segments within words, projecting language-specific constraints (cf. Hayes 1999).

38. Some suffix-specific markedness constraints

a. pre-[in] constraints

- (i) $s/ _ \text{in}$: stem-final coronal obstruent is [s] before a topic marker [in].
- (ii) $t^h/ _ \text{in}$: stem-final coronal obstruent is [t^h] before a topic marker [in].
- (iii) $c^h/ _ \text{in}$: stem-final coronal obstruent is [c^h] before a topic marker [in].
- ...

b. pre-[il] constraints

- (i) $s/ _ \text{il}$: stem-final coronal obstruent is [s] before an accusative marker [il].
- (ii) $t^h/ _ \text{il}$: stem-final coronal obstruent is [t^h] before an accusative marker [il].
- ...

c. pre-[e] constraints

- (i) $s/ _ \text{e}$: stem-final coronal obstruent is [s] before a locative marker [e].
- (ii) $t^h/ _ \text{e}$: stem-final coronal obstruent is [t^h] before a locative marker [e].
- ...

d. pre-[esə] constraints

- (i) $s/ _ \text{esə}$: stem-final coronal obstruent is [s] before a locative marker [esə].
- (ii) $t^h/ _ \text{esə}$: stem-final coronal obstruent is [t^h] before a locative marker [esə].
- ...

- These constraints apply regardless of the morphological category of the base, thus capturing the similarity between nouns and bound stems.
- These constraints are internally ranked, based on the type frequency of relevant suffixed forms in the lexicon.

39. Rankings of suffix-specific markedness constraints

a. pre-[in] constraints:

- (i) $s/ _ \text{in} \gg c^h/ _ \text{in} \gg t^h/ _ \text{in} \gg t/ _ \text{in}$

(ii) $p/_\text{in} \gg p^h/_\text{in}$

(iii) $k/_\text{in} \gg k^h/_\text{in}$

b. pre-[il] constraints: $s/_\text{il} \gg c^h/_\text{il} \gg t^h/_\text{il} \gg c/_\text{il} \gg t/_\text{il}$

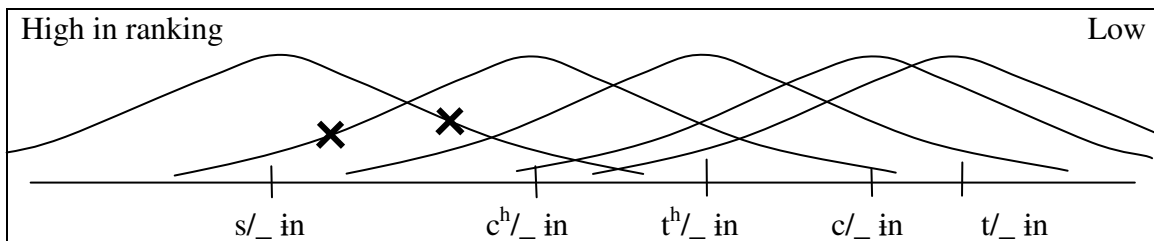
c. pre-[e] constraints: $s/_\text{e}, t^h/_\text{e} \gg c^h/_\text{e} \gg c/_\text{e} \gg t/_\text{e}$

d. pre-[esə] constraints: $s/_\text{esə}, t^h/_\text{esə} \gg c^h/_\text{esə} \gg c/_\text{esə} \gg t/_\text{esə}$

40. Probabilistic ranking model (Boersma 1998; Boersma and Hayes 2001; Zuraw 2005)

- A continuous ranking scale
- Stochastic OT grammar: Each constraint is associated with a range where its position in the ranking scale may vary.
- At evaluation time, the position of each constraint in the ranking scale is randomly selected with probabilities which can be described with a normal (= Gaussian) distribution.

41. Stochastic ranking of pre-[in] constraints



- Constraints with higher ranking values are more frequently, but not always, ranked above those with lower values.
- For instance, $s/_\text{in}$ would be top-ranked most often, thus producing [s]-final forms most frequently.
- But, it is less often the case that $s/_\text{in}$ is ranked low within its range and, at the same time, some other constraint, say $c^h/_\text{in}$, is ranked high (marked with x's in the above figure), reversing their usual relative ranking. Then some other variants like [c^h]-final forms would occur.
- Consequently, the variable ranking model adopted may explain not only the relative preference/acceptability of variants but also free variation.

42. The proposed analysis is very similar to Albright's analysis of variation in Korean nouns.

- The important role of type frequency.
- One crucial difference: product-oriented (Bybee 2001) cf. Paradigm Learning Model: source-oriented.

CONCLUSIONS

- Mainly based on recent survey studies, I have shown that patterns involved in free variation of noun stem-final obstruents are more complicated than previously thought.
- Several different coronal obstruents are in variation with one another, and their usage preferences are different, mainly depending on the suffix. Stems ending in noncoronal obstruents also show free variation between lenis and laryngeally marked stops.

- c. I have claimed that the relative (suffix-specific) preference of the variants is determined by the distribution of stem-final obstruents of nouns, crucially suffixed forms.
- d. I have performed a judgment survey with bound stems, which cannot be classified as nouns. The same type of variation patterns as with nouns is observed with stem-final obstruents of the bound stems.
- e. To explain the finding that the same type of variation patterns occurs in two totally different morphological categories, I have provided an product-oriented analysis.
- f. Specifically, I have proposed multiple suffix-specific phonotactic constraints, ranked in a probabilistic way in line with stochastic OT theory (Boersma and Hayes 2001).

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