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Rendaku I: Constraint Conjunction and the OCP

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(1) **Central theses:**
OCP effects are markedness effects.
Within local domains, multiple violations of markedness constraints interact strongly.

I.A Interactions between constraint violations

(2) Local Conjunction of Constraints (Smolensky 1995):

a. Derived constraint generation:

[P,Q ∈ CON] ⊃ [P&$_{\ell}$Q ∈ CON] ("...&$_{\ell}$..." =$_{def}$ "...locally conjoined with ...")

If P and Q are members of the constraint set CON, so is the derived constraint P&$_{\ell}$Q (read: "P locally conjoined with Q").

Interpretation: P&$_{\ell}$Q is violated if and only if there is some domain D in which both P and Q are violated.

b. Ranking (universal): P&$_{\ell}$Q » {P, Q}

(3) Example:

Derived constraint: NoCoda &$_{\ell}$ *[+voi, -son] "No voiced obstruents in codas"

⇑

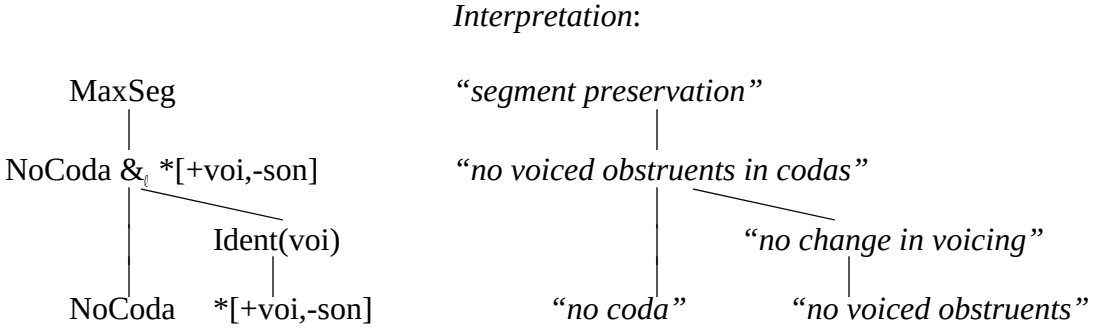
(c)
(a) (b)

Basic constraints: NoCoda *[+voi, -son] "No voiced obstruents"

(4) German syllable-final devoicing

/bund/	.bunt.	cf.	.byn.də.
'league'	<Bund>		<Bünde>
	sg.		pl.

(5) Analysis:



(6)

/bund/ 'league'	MaxSeg	NoCoda &₍ *[+voi,-son]	NoCoda	Ident(voi)	*[+voi,-son]
[bund]		*!	**		**
[bun]	*!		*		*
☞ [bunt]			**	*	*
[punt]			**	**!	

(7) Distribution of the Danish stød

Stød (glottal accent) occurs on sonorant second moras of stressed syllables (morphological conditions omitted).

Stød [ˀ] is found on:

a. postnuclear sonorant consonants if followed by another consonant (i.e., never on word-final sonorant consonants):

skilˀt 'sign'
lamˀp 'lamp'

skin 'light' *skinˀ
møl 'moth' *mølˀ

b. second moras of long vowels or diphthongs, irrespective of whether the vowel or diphthong is word-final.

ko:ˀ	‘cow’		
hu:ˀs	‘house’		
skowˀ	‘forest’	orthographic:	<skov>
skowˀl	‘shovel’		<skovl>
sajˀ	‘coalfish’		<sej>
sajˀl	‘sail’		<sejl>

(8) Descriptive summary: The postnuclear stød bearer must be a vowel or a nonfinal sonorant consonant.

(9) Constraints:

Have-Stød†	Stressed σ must have glottal accent on 2nd mora
NonFin	Glottal accent should not be final in PrWd
*Stød/X	Glottal accent should not fall on segments of type X

† A compressed formulation standing in for a complex of constraints and constraint interactions. Glotal accent itself is the phonetic reflex of a falling pitch contour.

Problem: Ranking paradox. There is no way of ranking *Stød/C, NonFin, and Have-Stød correctly with respect to each other:

(10)

	Have-Stød	NonFin	* Stød/C	*Stød/V
ven	*!			
☻ venˀ (wrong winner)		*	*	
kamp	*!			
☞ kamˀp			*	
koo	*!			
☞ kooˀ		*		*
huus	*!			
☞ huuˀs				*

(11) Moving NonFin alone up in the ranking:

	NonFin	Have-Stød	* Stød/C	*Stød/V
☞ ven		*		
ven^{ʔ}	*!		*	
kamp		*!		
☞ kam^{ʔ}p			*	
☻ koo (wrong winner)		*		
koo^{ʔ}	*!			*
huus		*!		
☞ huu^{ʔ}s				*

(12) Moving *Stød/C alone up in the ranking:

	*Stød/C	Have-Stød	NonFin	*Stød/V
☞ ven		*		
ven^{ʔ}	*!		*	
☻ kamp (wrong winner)		*		
kam^{ʔ}p	*!			
koo		*!		
☞ koo^{ʔ}			*	*
huus		*!		
☞ huu^{ʔ}s				*

(13) Conclusion: Neither NonFin nor *Stød/C can be moved up in the ranking. Rather, a derived constraint NonFin & *Stød/C dominates Have-Stød.

	NonFin & *Stød/C	Have-Stød	NonFin	* Stød/C	*Stød/V
☞ ven		*			
ven[ʔ]	*!		*	*	
kamp		*!			
☞ kam[ʔ]p				*	
koo		*!			
☞ koo[ʔ]			*		*
huus		*!			
☞ huu[ʔ]s					*

Remark: Could NonFin alternatively be split into separate constraints for C and V: NonFin<C> ("Glottal accent on C should not be final in PrWd") and NonFin<V> ("Glottal accent on V should not be final in PrWd")? Certainly—but this merely reproduces the effects of constraint conjunction.

I.B The OCP revisited

(14) The Obligatory Contour Principle ("OCP", Leben 1973, McCarthy 1986, etc.): Adjacent identical autosegments are prohibited.

(15) Segmental markedness constraints:
*ϕ "The feature specification ϕ is prohibited."

Examples: *[+spread glottis] "Aspirates are prohibited."
*[-son, +voi] "Voiced obstruents are prohibited."
etc.

(16) OCP-effects in the most general sense result when a *marked type of structure* is present *more than once* within the same local domain.

Prototypical case: The same marked feature specification is found in two adjacent locations. This was geometrized in Autosegmental Theory in terms of adjacency of autosegments.

αF αF
| |
X X

(17) Example: Sanskrit roots (Allen 1951, Borowsky & Mester 1983, Kaye & Lowenstamm 1985, among others)

bud^{h}	'to be awake'	[+] | C V C	[spread glottis] tier
b^{h}id	'to split'	[+] | C V C	
*b^{h}id^{h}		* [+] [+] | | C V C	

Many cases where the feature specification are not strictly speaking adjacent (but still in close proximity) are subsumed under tier adjacency through

- tier (or: planar) separation of feature groups
- morphemically defined tiers
- underspecification

(18) Strategy pursued here:

- Marked features (like [+spread glottis]) and feature combinations constitute violations of markedness constraints.
- Multiple presence → multiple violations
- Multiple violations interact strongly through local constraint conjunction.

(19) Special case of constraint conjunction:
$\text{Constraint}_i \,\&_{\ell}\, \text{Constraint}_j$ with $\text{Constraint}_i = \text{Constraint}_j$ (self-conjunction of constraints)

(20)

$*\phi\phi = *\phi^2$	No cooccurrence of the feature specification ϕ with itself
$*[\text{+spread glottis}]^2$	No cooccurrence of [+sg] with itself (Grassmann's Law in Sanskrit: OCP on [+spread glottis])
$*[\text{+voi, -son}]^2$	No cooccurrence of voiced obstruency with itself (Lyman's Law in Japanese: OCP on [+voi])

(21) Further extensions:

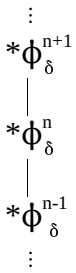
$*\phi^3$ (Ruling out ternary cooccurrence of ϕ with itself: *ϕϕϕ. There is little evidence that this is ever operative separate from ϕ^2.)

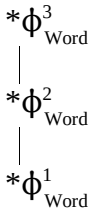
*ϕ² etc. only make sense when tied to a domain, that's where two violations of the anti-voiced-obstruent constraint can locally interact. Besides prosodic categories, the relevant domains include the syntactic-morphological categories "stem" and "word".

The constraint system produces two hierarchies:

(22) Intrinsic ranking in terms of number of locally interacting violations, within a given domain δ ("the more, the merrier"):

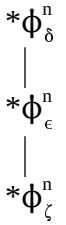
For example:

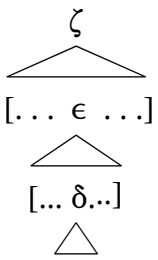


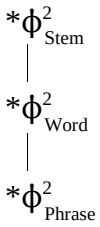


(23) Ranking in terms of the locality of the interaction domain ("the smaller the domain, the stronger the interaction"):

Ranking: Domain hierarchy: For example:







Further Issues

Reducing locality ranking to constraint conjunction?

The locality ranking itself is arguably reducible to local conjunction since the domains in question are in a hierarchical inclusion relation, such as *word* ⊂ *stem*. Whenever F^2 is violated in the domain of some stem, it is necessarily also violated in the domain of some word, but not vice versa. Recursive application of constraint conjunction then yields the following:

(24) $[*\phi^2_{Stem}$ & $*\phi^2_{Word}]_{Phrase}$ i.e.: $[*\phi\&_{Stem}*\phi]\&_{Phrase}[*\phi\&_{Word}*\phi]$

$*\phi^2_{Stem}$ $*\phi^2_{Word}$ $[*\phi\&_{Stem}*\phi]$ $[*\phi\&_{Word}*\phi]$

Such recursive applications of constraint conjunction seems somewhat bizarre. They might be taken to indicate that expressing the strong interaction between violations of (related?) constraints by means of a new higher-ranked constraint might not be the ultimate formal tool for capturing the insight that violation density has an effect on the weight of the violations.

Generalized OCP-effects

Viewed as potentiated markedness effects, there is no reason to expect interactions of the OCP-type to be limited to segmental markedness (a point first made in Yip 1988). The prediction is, then, that similar effects should also be found with other marked phonological properties, like length (vs. shortness) of vowels and consonants. And indeed, there are examples of restrictions excluding combinations of long vowels and geminates. Examples include the "Lex Mamilla" in Latin, and a corresponding generalization in Japanese loanwords (Iwai 1987, Wade 1996).

(25) Degemination in Latin

mamma	'breast'	mami**ll**a	(diminutive)	*ma**mm**i**ll**a
offa	'morsel'	ofe**ll**a	(diminutive)	*o**ff**e**ll**a
saccus	'sack'	sace**ll**us	(diminutive, Vulgar Latin)	*sa**cc**e**ll**us
ob-	'aside'	o-mi**tt**ō	'lay aside'	*o**mm**i**tt**ō

Traditionally often interpreted as geminate dissimilation ("Lex Mamilla", after the prototypical example):

(26) $vc_ic_ivc_kc_kv \rightarrow vc_ivc_kc_kv$

But the Latin phenomenon is more general (Leumann1977, 184; Sihler 1995, 322) since degemination is found not only before another geminate, but also before other kinds of (accented?) heavy syllables:

canna	'reed'	canālis	'channel'	*cannālis
farr- < *fars-	'spelt'	farīna	'meal, flour'	*farrīna
currus	'chariot'	curūlis	'relating to a chariot'	*currūlis
pollen	'fine flour'	polenta	'barley-groats'	*pollenta

If so, the dissimilating marked property is “heavy syllable”, with dissimilation preferentially affecting geminate consonants.

(28) Japanese loans from English show geminates plosives after lax vowels in the source language (Iwai 1989, see also Wade 1996)

jippaa	‘zipper’
rakkii	‘lucky’
purattohoomu	‘(train) platform’

(29) This rule is not followed when there is another geminate later in the same word:

pikunikku	‘picnic’	*pikkunikku	
bisuketto	‘biscuit’	*bisukketto	
poketto	‘pocket’	*pokketto	cf. the clipped form: pokke

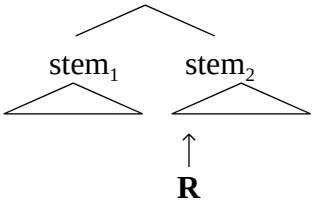
(30) Iwai’s 1989 generalization:
Gemination after a lax vowel affects only the rightmost [-son, -cont] consonant in a word.

(31) Basic analysis of degemination in “double-geminate” words:
$NoGem^2$ » Max-μ » $NoGem^1$

Iwai’s directionality effect (geminates are preferred at the right edge of the word: ...VC_iC_iV#) requires further analysis (cf. Zoll 1996).

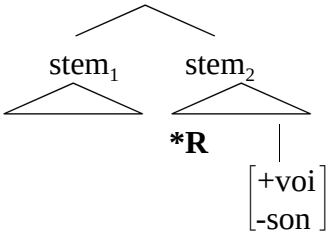
I.C Rendaku revisited

(32) Rendaku (Sequential Voicing), descriptively: “The beginning of second compound members should be voiced.” Or, equivalently: “...should not be voiceless.”



/natsu + sora/	→ natsu +zora	‘summer sky’
/kawa + hata/	→ kawa + bata	‘river bank’
/otome + kokoro/	→ otome + gokoro	‘maiden heart’

(33) Lyman's Law, descriptively: Rendaku is blocked when $stem_2$ contains a voiced obstruent:



(34)	/mori +soba/	→ mori +soba	*mori+zoba	'soba serving'
	/iwa + hada/	→ iwa + hada	*iwa+bada	'rock surface'
	/onna + kotoba/	→ onna + kotoba	*onna+gotoba	'women's speech'

Analysis: Lyman's Law is an OCP effect on obstruent voicing within stems, with the new understanding of the OCP as locally enhanced markedness (instead of tier adjacency coupled with underspecification, as in Itô & Mester 1986).

(35) OCP[voiced obs, stem] ("Lyman's Law")
$*[+voi, -son]^2_{Stem}$ No cooccurrence of voiced obstruency with itself within stems.

OCP[voiced obs, stem] (35) must dominate the constraint SeqVoi responsible for Rendaku (further analysis below): "Lyman's Law *blocks* Rendaku".

(36) $*[+voi, -son]^2_{Stem}$ » SeqVoi

SeqVoi itself must dominate the simple markedness constraint against voiced obstruents (so that Rendaku can take place at all).

(37) OCP[voiced obs, stem] » Sequential Voicing » AntiVoicing[voiced obs]

i.e.: $*[+voi, -son]^2_{Stem}$ » SeqVoi » *[+voi, -son]

(38)

/natsu + sora/	$*[+voi, -son]^2_{Stem}$	SeqVoi	*[+voi, -son]
☞ [natsu + zora]			*
[natsu + sora]		*!	

(39)

/mori +soba/	*[+voi, -son]$^2_{Stem}$	SeqVoi	*[+voi, -son]
[mori + zoba]	*!		**
☞ [mori + soba]		*	*

The word as whole, on the other hand, can contain two voiced obstruents, including the case where one of them is rendaku-induced. I.e., a voiced obstruent in the first compound member does not block Rendaku in the second member (in Modern Japanese; for Old Japanese, see below).

(40) /tabi + hito/ → tabi +bito ‘travelling person’
/hada +samui/ → hada + zamui ‘skincold’
cf. also: /soba + mugi / → soba + mugi ‘buckwheat’

(41) OCP[voiced obs, stem] » Sequential Voicing » OCP[voiced obs, word]

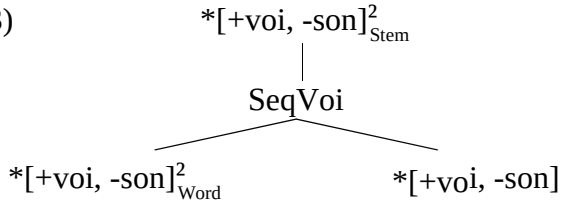
i.e.: *[+voi, -son]$^2_{Stem}$ » SeqVoi » *[+voi, -son]$^2_{Word}$

(42)

/hada +samui/	*[+voi, -son]$^2_{Stem}$	SeqVoi	*[+voi,-son]$^2_{Word}$	*[+voi, -son]
☞ [hada+zamui]			*	**
[hada+samui]		*!		*

Overall ranking so far:

(43)



Sequential Voicing

What is the status of SeqVoi (i.e., Rendaku)? A language-specific constraint?? With antiharmonic effects: commanding voicing of obstruents???

Answer: Rendaku is not a language-specific constraint. Rather, in true OT-style, it is the emergence of universal unmarkedness—in this case, of a member of the "Avoid Effort" family of constraints ruling out changes in glottal state (here, a switch from voicing to voicelessness back to voicing).

(44) Sequential Voicing (SeqVoi):

*$[_{+-+}]$voi i.e., *[+voi]⌒[-voi]⌒[+voi]

SeqVoi is a constraint against word-internal voicing contours of the form $[_{+-+}]$. In functionalist parlance, it is one member of the "AvoidEffort" family of constraints (see Steriade 1995 and work cited there).

Remark: As stated, SeqVoi expresses the idea of intervocalic voicing quite directly, ruling out the switch from [+voi] to [-voi] and back to [+voi] (i.e., [-voi] in a [+voi] domain, yielding an embedded domain, in terms of Smolensky's 1993 conception). It is possible that the constraint should be stated differently: as ruling out any switch of the form $[_{+-}]$voi, or even any switch of voicing whatsoever: *[α⌒−α]voi.

The derived environment effect

SeqVoi is truly emergent—it only has effects when the $[_{+-+}]$ contour is derived through morpheme composition (here, of stems), not when it is input-given within a single lexical item.

(45) Linearity (McCarthy & Prince 1995)
S_1 reflects the precedence structure of S_2, and vice versa.

(S_1 and S_2 refer to input and output strings, and other strings of correspondent segments.)

Linearity is a faithfulness constraint protecting input-given linearity relations. Here we assume an appropriate extension to the featural level, taking up a suggestion in Pater 1995.

(46) Examples of (extended) Linearity violations:

	correspondent strings	precedence relations
a. Input	/ta/	[-voi]⌒a, ...
Output	[da]	[+voi]⌒a, ...
b. Input	/ato/	a⌒[-voi], [-voi]⌒o, ...
Output	[ado]	a⌒[+voi], [+voi]⌒o, ...

Linearity protects stem-internal segments because a change in a stem-internal segment means two changes in precedence structure (with respect to the preceding and the following segment), i.e., two violations of Linearity. The violations interact strongly (in constraint-conjunction theory, they constitute a violation of a higher constraint Linearity^2 (self-conjunction).

(47) Linearity [2-sided] » Sequential Voicing » Linearity [1-sided]

i.e.: Linearity ^{2} » SeqVoi » Linearity^1

(48)

/mato/	Linearity^2	SeqVoi	Linearity^1
☞ [mato]		*	
[mado]	*!		*

(49)

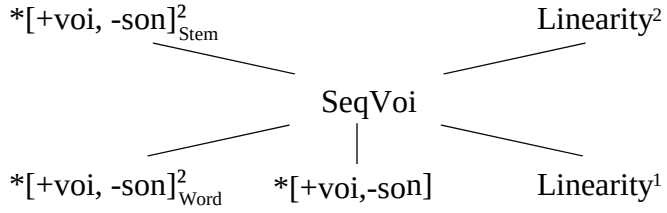
/nama + kome/	Linearity^2	SeqVoi	Linearity^1
[nama + kome]		*!	
☞ [nama + gome]			*

The ranking [Linearity^2 » SeqVoi] also forstalls an alternative way of avoiding Lyman's Law violations, namely, by devoicing the stem-internal voiced obstruent instead of blocking Rendaku (i.e., **mori+zopa* instead of *mori-soba* 'soba serving'). (This result follows also from the ranking [Ident[+voi] » SeqVoi] seen in Part II.)

(50)

/mori +soba/	*[+voi, -son]$^2_{Stem}$	Linearity^2	SeqVoi
☞ [mori + soba]			*
[mori + zoba]	*!		
[mori + zopa]		*!	*
[mori + sopa]		*!	**

(51)

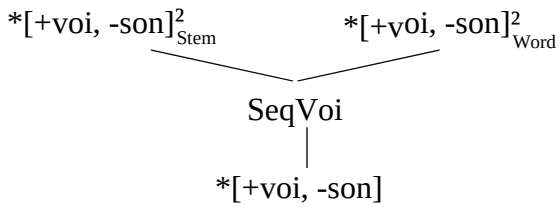


Epilogue: Strong version of Lyman's Law (Old Japanese)

(52) Unger (1975, 8-9) reports the existence of a *strong version of Lyman's Law* in Old Japanese (citing work by Ramsy & Unger 1972 and Miyake 1932, and referring to Ishizura Tatsumaro's *Kogen seidaku kō* (1801) as the original source of the observation):

> "[...] in old Japanese, *rendaku* also did not take place if the first morpheme contained a voiced obstruent."

(53) Analysis of the strong version of Lyman's law (OJ):



(54) Some tendencies about Rendaku avoidance noted by Sato 1988 can be interpreted remaining reflexes of the strong version of Lyman's Law in MJ:

a.	/ichi+tsukeru/	→	ichi+dzukeru	'put into position'	
	/na+tsukeru/	→	na+dzukeru	'give a name to'	
but:	/kizu+tsukeru/	→	kizu+tsukeru	'give a wound to'	*kizu+dzukeru
b.	/taki+hi/	→	taki+bi	'firewood'	
	/morai+hi/	→	morai+bi	'catch fire'	
but:	/tobi-hi/	→	tobi+hi	'flying sparks'	*tobi-bi
c.	/naka+kanna/	→	naka+ganna	'middle plane (tool)'	
	/maru+kanna/	→	maru+ganna	'round plane'	
but:	/shiage+kanna/	→	shiage+kanna	'finishing plane'	*shiage+ganna
	/mizo+kanna/	→	mizo+kanna	'groove plane'	*mizo+ganna

(55) Reflexes in names (Sugito 1965):

	/ima+ta/	→	ima+da
	/yama+ta/	→	yama+da
but:	/shiba+ta/	→	shiba+ta
	/kubo+ta/	→	kubo+ta

But note also the most famous exception to this subgeneralization: the name *Kubo+zono*.

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