Stress and syllabification: Parallel or serial?

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Common sense

Stress is assigned to syllables.

Therefore, syllabification must precede stress assignment.

As is often the case, common sense is wrong.

The Finnish problem

/VV/ can be syllabified in two ways depending on stress:

/au/ → [au] **join** (diphthong, tautosyllabic)
/au/ → [a.u] **split** (heterosyllabic)

The puzzle:

Stress presupposes syllabification.

Syllabification depends on stress.

Optimality Theory vs. Harmonic Serialism

- In CLASSICAL OT (Prince and Smolensky 1993/2004) there is no problem because candidate evaluation happens in **parallel**.

- In HARMONIC SERIALISM (McCarthy 2008, Kimper 2011, Pater 2012, Elfner 2016, Elsman 2016) candidate evaluation is **serial**. Is that a problem?

Finnish syllabification in OT

/paperi/ ‘paper’	*CODA	ONSET
(a) ☞ pá.pe.ri		
(b) *páp.e.ri	1	1

*CODA ‘A syllable must not have a coda.’

ONSET ‘A syllable must have an onset.’

Primary stress: Initial.

Secondary stress: Every odd syllable after that, except final.

Adjacent vowels (/V_1V_2/)

Generalization 1 (Häkkinen 1978:26)

If V_2 is /i/ we have a diphthong

ái.kai.nen ‘early’

(**ái.ka.ì.nen*)

(**á.i.kài.nen*)

(**á.i.kà.i.nen*)

Exception: The lexically stressed suffix /-ìsti/

/ate-ìsti/ → *á.te.ìs.ti* ‘atheist’

/dada-ìsti/ → *dá.da.ìs.ti* ‘dadaist’

Adjacent vowels (/V_1V_2/)

Generalization 2

If V_2 is non-high we get splitting

má.ke.a	(**má.kea*)	‘sweet’
kí.os.ki	(**kíos.ki*)	‘kiosk’
tér.ri.è.ri	(**tér.rie.ri*)	‘terrier’

Exception: Under primary stress /ie, uo, yö/ form a diphthong

tíe	(**tí.e*)	‘road’
túo	(**tú.o*)	‘that’
ýö	(**ý.ö*)	‘night’

Adjacent vowels (/V_1V_2/)

Generalization 3

If V_2 is /u, y/ we have two options

(a) Diphthong under primary stress

háu.ta (**há.u.ta*) ‘grave’

(b) Else variation

rák.ka.ù.den ~ rák.kau.den ‘love-GEN’

láu.ka.ùs.ta ~ láu.kaus.ta ‘shot-PAR’

Problem: *láu.ka.ùs.ta* is harmonically bounded

/laukausta/	*CODA	ONSET
(a) ☞ láu.ka.ùs.ta	1	1
(b) ☞ láu.kaus.ta	1	
(c) *lá.u.ka.ùs.ta	1	2
(d) *lá.u.kaus.ta	1	1

How to get *láu.ka.ùs.ta* ~ *láu.kaus.ta*?

The variants are not equally good

Diphthong is preferred in open syllables

Splitting is preferred in closed syllables

	OPEN	CLOSED
JOIN	rák.kau.den	láu.kaus.ta
SPLIT	rák.ka.ù.den	láu.ka.ùs.ta
	‘love-PL-GEN’	‘shot-PAR’

see, e.g., Häkkinen 1978:26

The explanation is stress

Stressed lights are dispreferred

Unstressed heavies are dispreferred

	OPEN	CLOSED
JOIN	rák.kau.den	láu.**kaus**.ta
SPLIT	rák.ka.**ù**.den	láu.ka.ùs.ta
	‘love-PL-GEN’	‘shot-PAR’

Summary

/VV/-syllabification depends on stress, weight, and vowel quality:

- /VV/ → VV **join**
- /VV/ → V.V **split**
- /VV/ → VV ~ V.V **vary**

Stress feeds syllabification.

This is a problem if syllabification precedes stress assignment.

Evidence for variation from verse

Early 20th century verse written in syllable-counting meters

Juhani Siljo (1910) *Runoja*	gutenberg.org
V. A. Koskenniemi (1917) *Elegioja*	gutenberg.org

- 522 /u, y/-final vowel pairs
  - Not part of longer vowel sequences, e.g., /VVV/
- 481 where the syllabification is unambiguously identifiable
- 55 of the identifiable syllabifications do not appear word-initially
  - **Thus, they may split or join!**

Koskenniemi's hexameter (Leino 2002:163)

- A line-final weak position is monosyllabic.
- The weak position before the last strong position is disyllabic.
- All other weak positions may have one or two syllables.

(s w) (s w) (s w) (s w) (s w) (s w)
míss' ó.vat víi.sa.us, vói.ma ja lém.pe.ys, ói.ke.us ýh.tä
'where wisdom, strength, gentleness, and justice are one'

V. A. Koskenniemi, *Runo Suomen vapaudelle*

Siljo's (1910) *Runoja*

	Open	Closed
Diphthong	6	0
	á.vau.tuu	**rák.kaus*
Splitting	0	14
	**á.va.ù.tuu*	*rák.ka.us*

The disfavored syllabifications are unattested.

Koskenniemi's (1917) *Elegioja*

	Open	Closed
Diphthong	8	1
	káik.keu.den	*lém.peys*
Splitting	6	20
	kor.ke.ù.tees	*vál.ke.us*

The disfavored syllabifications are permitted at a low frequency.

To be explained

Some /VV/ sequences have variant syllabifications, e.g., *au* ~ *a.u*

The choice depends on stress. The variants can be

in complementary distribution by stress

(Siljo, Häkkinen's rule)

in free variation quantitatively influenced by stress

(Koskenniemi)

Analysis: Vowel sonority

- The syllabification of /au, äy, eu, ey, ou, öy, iu, iy/ varies.
- The syllabification of /ai, äi, oi, öi, ei, ui, yi/ does not.
- This suggests that in Finnish /u,y/ make better nuclei than /i/.

Constraints (Kiparsky 1994, de Lacy 2004):

*NUC/i	‘No high unrounded vowel nuclei’
*NUC/iuy	‘No high vowel nuclei’
*NUC/iuyeo	‘No non-low vowel nuclei’
*NUC/iuyeoa (= *NUC/v)	‘No vowel nuclei’

Analysis: Stress and syllable weight

- Diphthong is preferred in open syllables (*rák.kau.den*)
- Splitting is preferred in closed syllables (*láu.ka.ùs.ta*)
- This suggests that weight and stress interact.

Constraints (Prince 1990, Prince and Smolensky 1993/2004)

WEIGHT-TO-STRESS PRINCIPLE (WSP, *H)

‘No unstressed heavy syllables’

PEAK-PROMINENCE (PK-PROM, *Ĺ)

‘No stressed light syllables’

Modeling variation (Anttila 1997, Anttila and Cho 1998)

/Input/	C1	C2	C3
(a) ☞ [Output-1]	1		
(b) ☞ [Output-2]		1	1

C1 >> C2 >> C3 ☞ [Output-2]
C1 >> C3 >> C2 ☞ [Output-2]
} R-volume(Output-2) = 2/6 = 33%

C2 >> C1 >> C3 ☞ [Output-1]
C2 >> C3 >> C1 ☞ [Output-1]
C3 >> C1 >> C2 ☞ [Output-1]
C3 >> C2 >> C1 ☞ [Output-1]
} R-volume(Output-1) = 4/6 = 67%

Our grammar correctly predicts variation

/laukausta/	*Nuc/ i	WSP	*Nuc/ iuy	*Nuc/ iuyeo	*Nuc/ iuyeoa	Pk-Prom
(a) ☞ láu.ka.ùs.ta			1	1	4	
(b) ☞ láu.kaus.ta		1			3	
(c) *lá.u.ka.ùs.ta			2	2	4	
(d) *lá.u.kaus.ta		1	1	1	3	

láu.ka.ùs.ta ~ láu.kaus.ta

It also derives probabilities

A set of 6 constraints can be ordered in 720 possible ways:

- R-volume(*láu.ka.ùs.ta*) = 180/720 = **0.25**
- R-volume(*rák.ka.ù.den*) = 144/720 = **0.20**

The empirical reality: *láu.ka.ùs.ta* > *rák.ka.ù.den.*

How to block variation in *ái.kai.nen*?

/aikainen/	*Nuc/ i	WSP	*Nuc/ iuy	*Nuc/ iuyeo	*Nuc/ iuyeoa	Pk-Prom
(a) ☞ ái.kai.nen		1		1	3	
(b) *ái.ka.ì.nen	1		1	2	4	1
(c) *á.i.kài.nen	1		1	2	4	1
(d) *á.i.kà.i.nen	2		2	3	5	1

How to rank the constraints to rule out (b) and (c)?

130,023 partial orders work. Which one should we pick?

/aikainen/	*Nuc/ i	WSP	*Nuc/ iuy	*Nuc/ iuyeo	*Nuc/ iuyeoa	Pk-Prom
(a) ☞ ái.kai.nen		1		1	3	
(b) *ái.ka.ì.nen	1 **W**	**L**	1 **W**	2 **W**	4 **W**	1 **W**
(c) *á.i.kài.nen	1 **W**	**L**	1 **W**	2 **W**	4 **W**	1 **W**
(d) *á.i.kà.i.nen	2 **W**	**L**	2 **W**	3 **W**	5 **W**	1 **W**

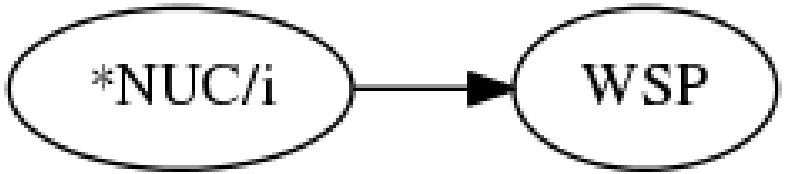
Find the simplest grammar that works

"works" gets the categorical patterns right, i.e.,
rules in all attested variants
rules out all unattested variants

"simplest" a grammar with the largest R-volume
(≈ the fewest ranked constraint pairs)

This grammar can be found with the help of OTORDER
(Djalali and Jeffers 2016, rc-linguistics.stanford.edu)

The simplest grammar



(a) No variation in /aikainen/ → *ái.kai.nen*

(b) Variation in

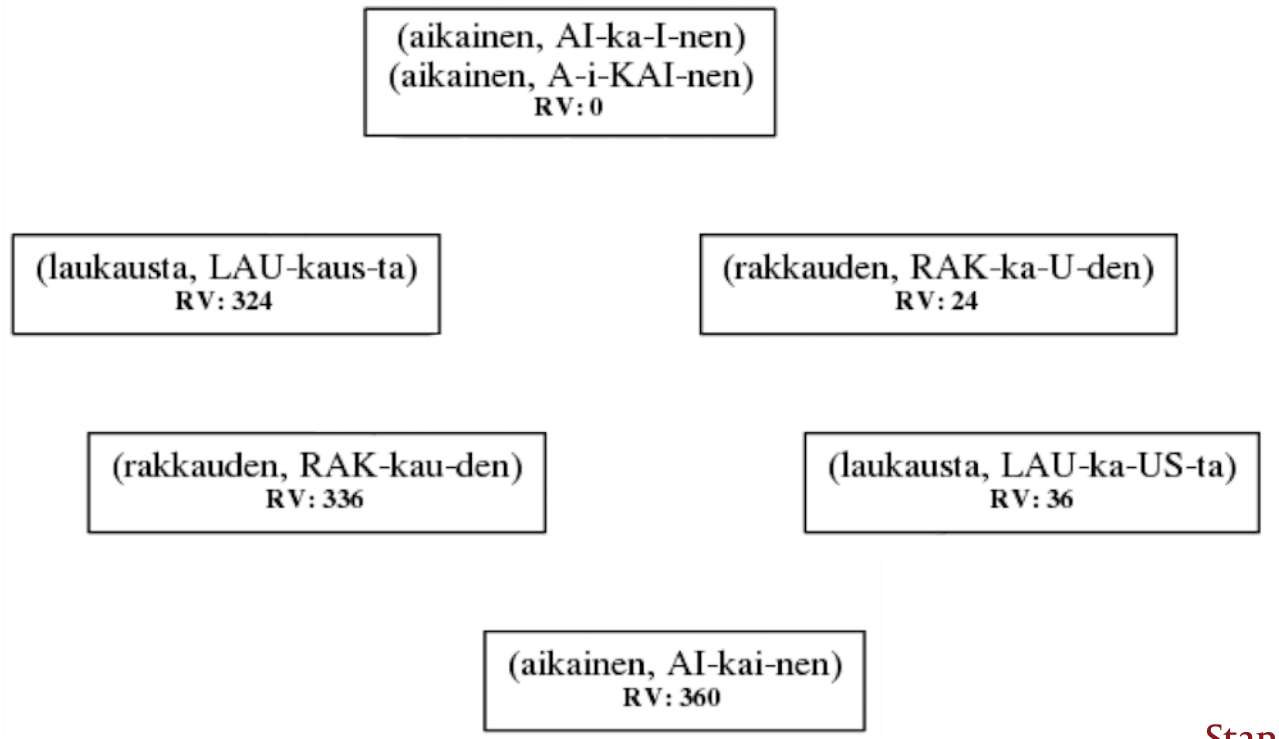
(i) /laukausta/ → *láu.ka.ùs.ta ~ láu.kaus.ta*

(ii) /rakkauden/ → *rák.ka.ù.den ~ rák.kau.den*

Do the quantitative predictions still hold up?

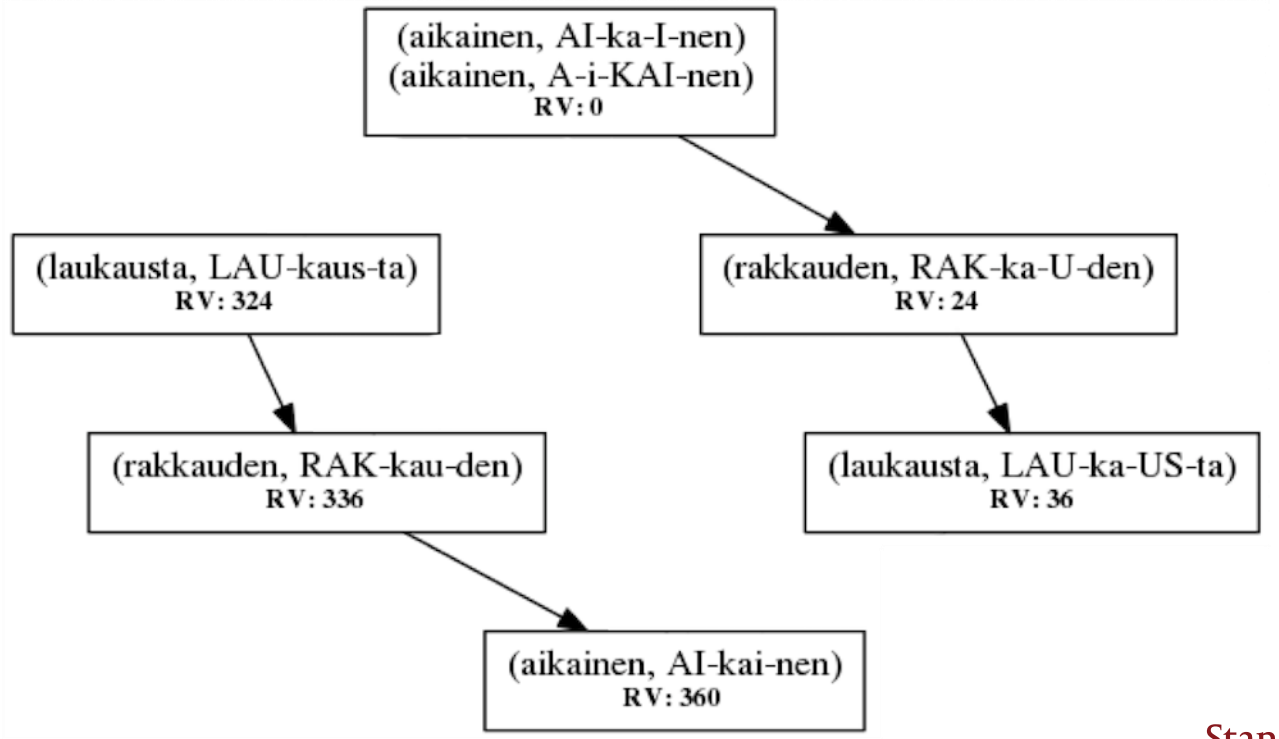
Interpretation of the T-order graph

Each **node** is the set of total grammars that make a candidate optimal.



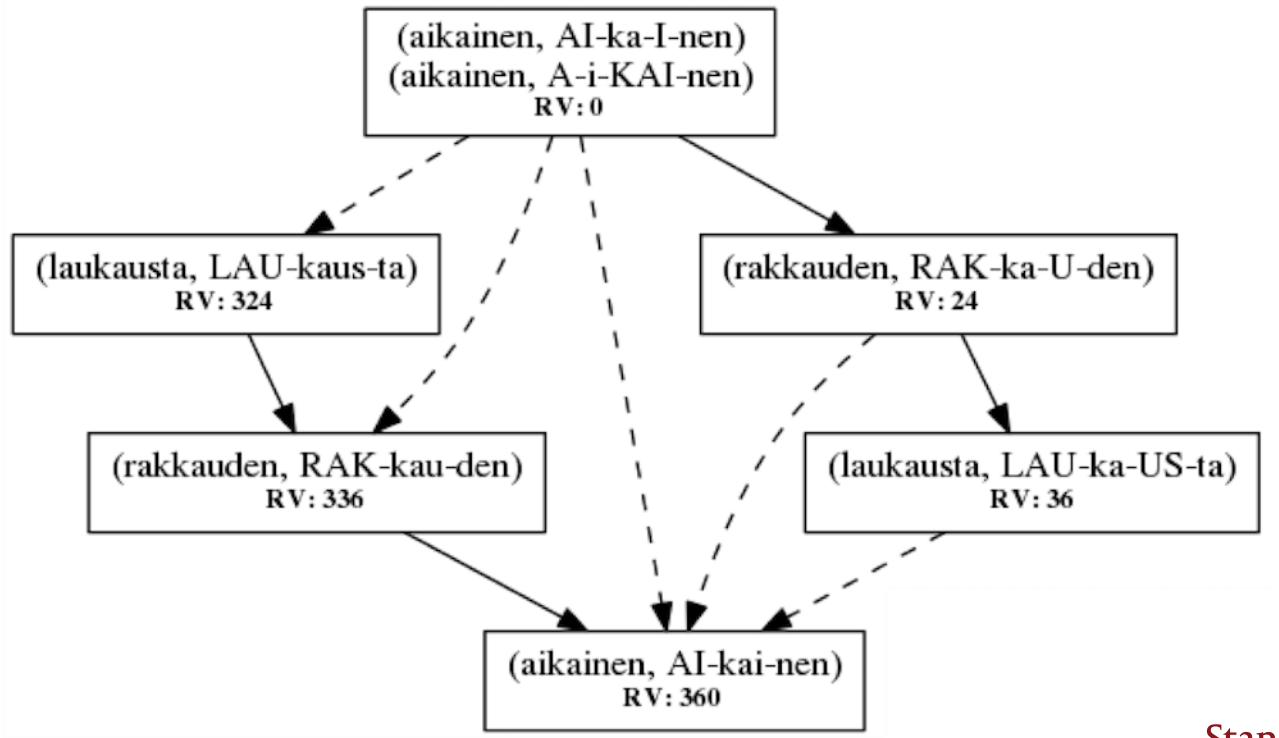
Interpretation of the T-order graph

Solid arrows denote **universal** subset relations.

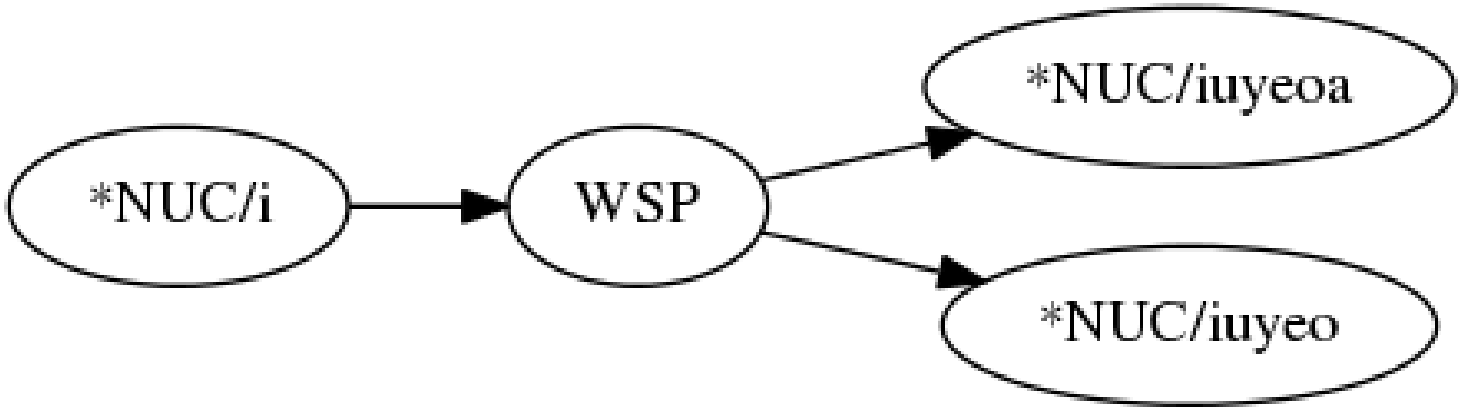


Interpretation of the T-order graph

Dashed arrows denote **ranking-dependent** subset relations.



The complete variable grammar (e.g., Koskenniemi)



Predicted invariant data

- **Invariant diphthongs**

  tíe ‘road’ *té.ra.pèut.ti* ‘therapist’,

  háu.ta ‘grave’ *vá.pai.den* ‘free-PL-GEN’

- **Invariant splitting**

  má.ke.a ‘sweet’ *sól.mi.o* ‘tie’ *lá.si.en* ‘glass-PL-GEN’

Predicted variable data

(a) **Splitting preferred**		R-VOLUMES
vá.pa.ùt.ta ~ vá.paut.ta	‘freedom-PAR’	0.60 ~ 0.40
vá.pa.u.dès.ta ~ vá.pau.dès.ta	‘freedom-ELA’	0.60 ~ 0.40
vá.pa.us ~ vá.paus	‘freedom.NOM’	0.60 ~ 0.40

(b) **Diphthong preferred**		R-VOLUMES
vá.pa.ù.den ~ vá.pau.den	‘freedom-GEN’	0.40 ~ 0.60

A nice minimal pair

nó.peut.ti	~	*nó.pe.ùt.ti*	‘sped up’
té.ra.pèut.ti		**té.ra.pe.ùt.ti, *té.ra.pè.ut.ti*	‘therapist’

- diphthong is **optional** in the second syllable
- diphthong is **obligatory** in the third syllable (secondary stress)

Residual problems

These are incorrectly predicted to be monosyllabic:

Lé.a	‘(the name) Leah’	
Lé.o	‘(the name) Leo’	(cf. the monosyllabic *tuo*)
hí.o	‘smoothen!’	

But they are disyllabic as shown by morphology:

Lé.aa	**Lea.ta*	‘Leah-PAR’
Lé.o.a	**Leo.ta*	‘Leo-PAR’
hí.o.a	**hio.da*	‘smoothen-INF’

Is this because they are nonderived environments?

How would this work in Harmonic Serialism?

In Harmonic Serialism (HS) changes are made one at a time, with a re-evaluation at each step, until there is no improvement.

Stress and syllabification (McCarthy 2008, Elsman 2016):

- First, syllabify
- Then, stress

Analysis (Poser 1985, McCarthy 2008, Kimper 2011, Elsman 2016)

- Syllabification is variable
- The WSP splits /VV/ optionally (following Elsman 2016)

	/rakkauden/	/rakkautta/
Syllabify:	*rak.ka.u.den ~ rak.kau.den*	*rak.ka.ut.ta ~ rak.kaut.ta*
Stress:	*rák.ka.ù.den ~ rák.kau.den*	*rák.ka.ùt.ta ~ rák.kaut.ta*

Problem at the syllabification step

/rakkauden/ /rakkautta/

rak.ka.u.den ~ rak.kau.den *rak.ka.ut.ta ~ rak.kaut.ta*

…

Both *rak.ka.ut.ta ~ rak.kaut.ta* violate the WSP

rak.ka.ut.ta is ruled out as harmonically bounded

Under parallel evaluation there is no problem because *rák.ka.ùt.ta* is rescued by stress!

Harmonic Serialism: The syllabification step

/nopeutti/	*Nuc/ i	WSP	*Nuc/ iuy	*Nuc/ iuyeo	*Nuc/ iuyeoa	Pk-Prom
(a) ☞ no.pe.ut.ti	1	1	2	4	4	
(b) ☞ no.peut.ti	1	1	1	3	3	
/vapautta/	*Nuc/ i	WSP	*Nuc/ iuy	*Nuc/ iuyeo	*Nuc/ iuyeoa	Pk-Prom
(a) ☞ va.pa.ut.ta		1	1	1	4	
(b) ☞ va.paut.ta		1			3	

R-volumes under Harmonic Serialism

(a) No variation				R-VOLUMES
va.pa.ut.ta	~	*va.paut.ta*	‘freedom-PAR’	0.00 ~ 1.00

Problem 1: Ruled out by harmonic bounding

(b) Variation				R-VOLUMES
va.pa.us	~	*va.paus*	‘freedom.NOM’	0.25 ~ 0.75
va.pa.u.den	~	*va.pau.den*	‘freedom-GEN’	0.25 ~ 0.75

Problem 2: No quantitative difference predicted

Harmonic Serialism: The stress step

/no.peut.ti/	Stress	*Nuc/i	WSP	*Nuc/ iuy	*Nuc/ iuyeo	*Nuc/ iuyeoa	Pk-Prom
(a) ☞ nó.peut.ti		1	1	1	3	3	1
(b) *nó.pèut.ti	1!	1		1	3	3	1
(c) *nó.peut.tì		1	1	1	3	3	2
(d) *no.péut.tì	2!	1		1	3	3	

Stress = Align(Word, L, Foot, L) ‘Main stress initial’

*Clash ‘No adjacent stresses’

R-volumes under Harmonic Serialism

Syllabification uniquely determines the stress pattern.

Syllabification:	*rak.ka.u.den ~*	*rak.kau.den*	*rak.kaut.ta*
Stress:	*rák.ka.ù.den ~*	*rák.kau.den*	*rák.kaut.ta*
R-volume:	720	720	720

→ There can be no quantitative differences in the outcomes.

Conclusion

- Harmonic Serialism precludes the modeling of both categorical and quantitative interactions between stress and syllabification, at least under this constraint set.

- **Stress and syllabification interact in parallel, not serially.**

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