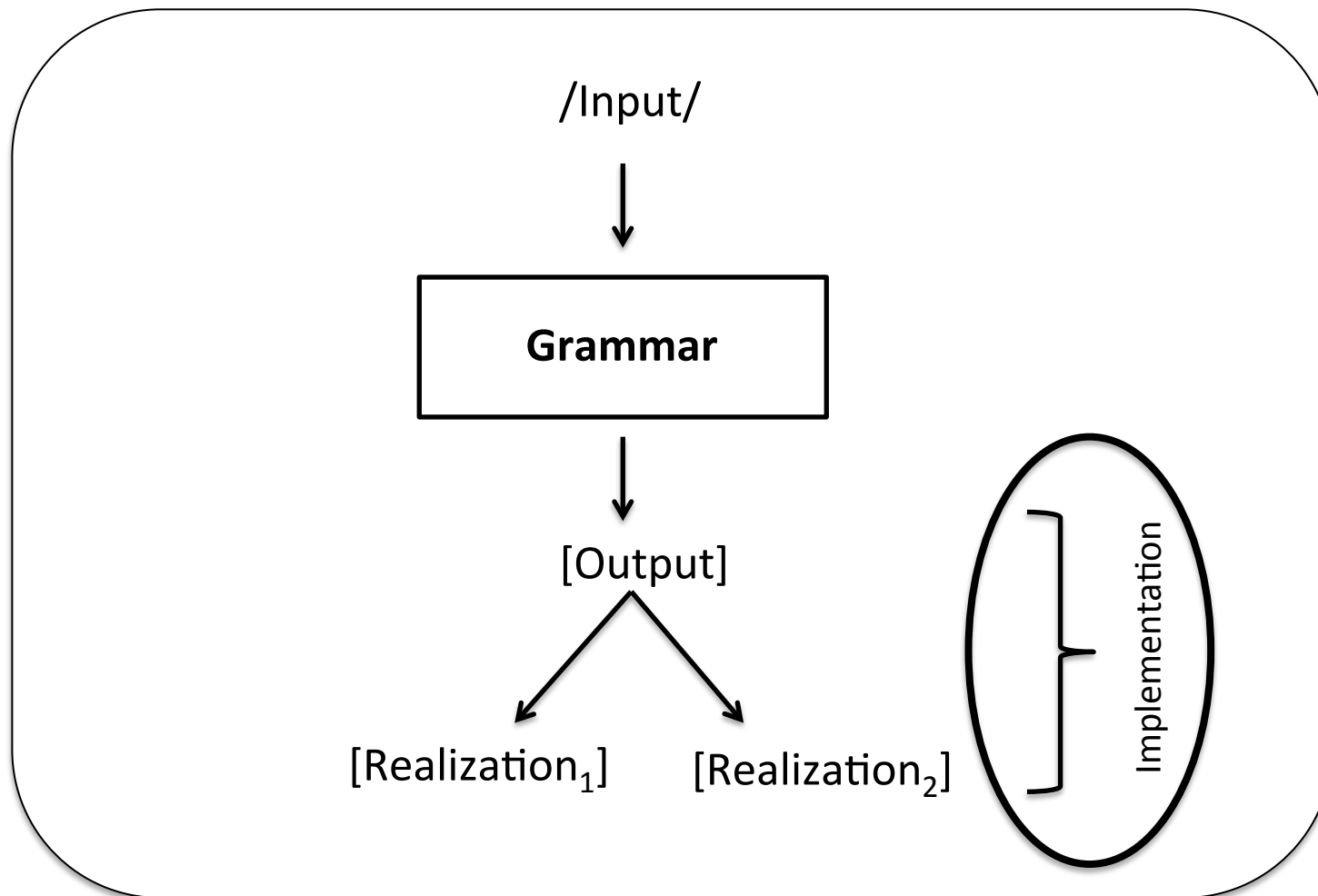


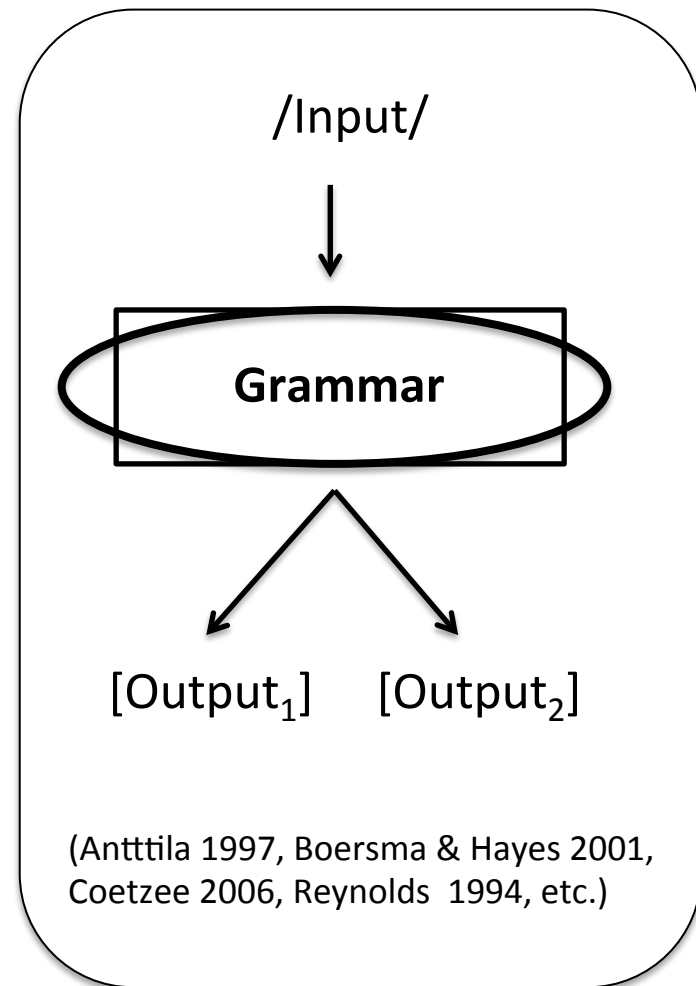
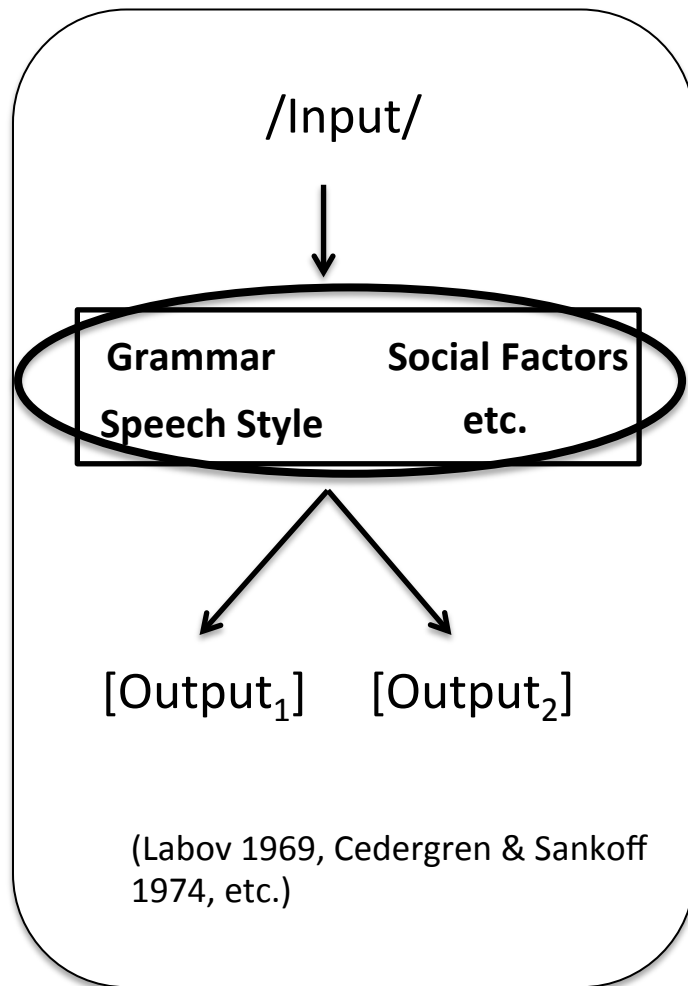
Grammar Defined Variable Space

Andries W. Coetzee
January 3, 2014
Linguistic Society of America
Minneapolis

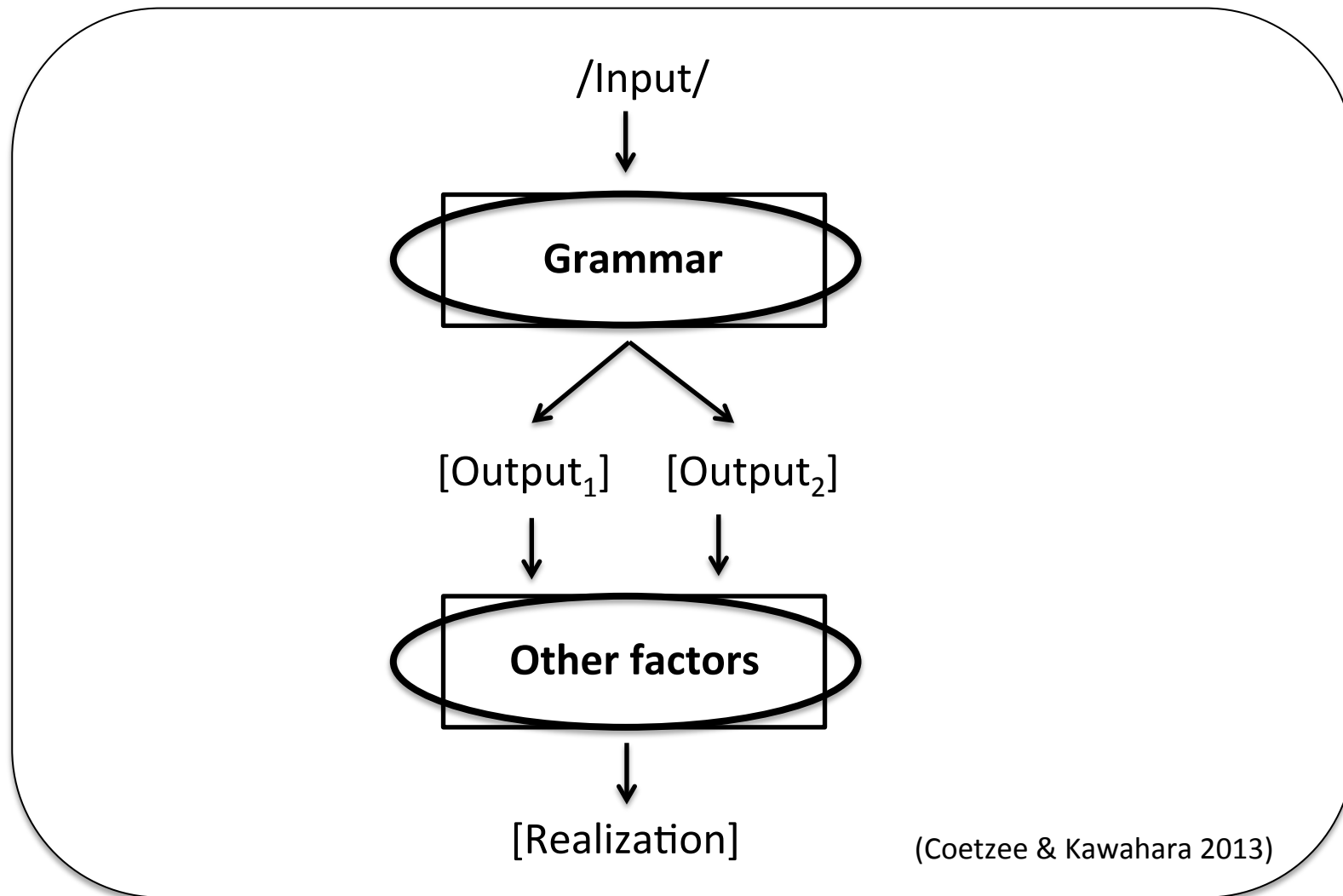
Invariant Grammar



Variable Grammar: Two models

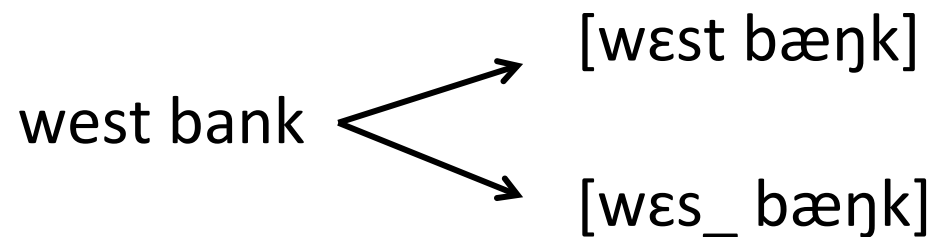


Grammar Defined Variable Space



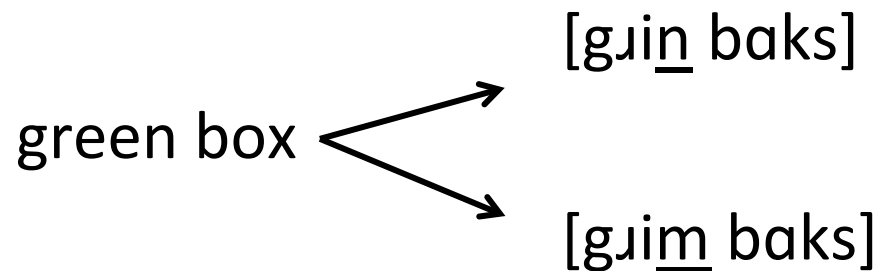
Other factors ...

t/d-deletion



Usage Frequency

Nasal Place Assimilation

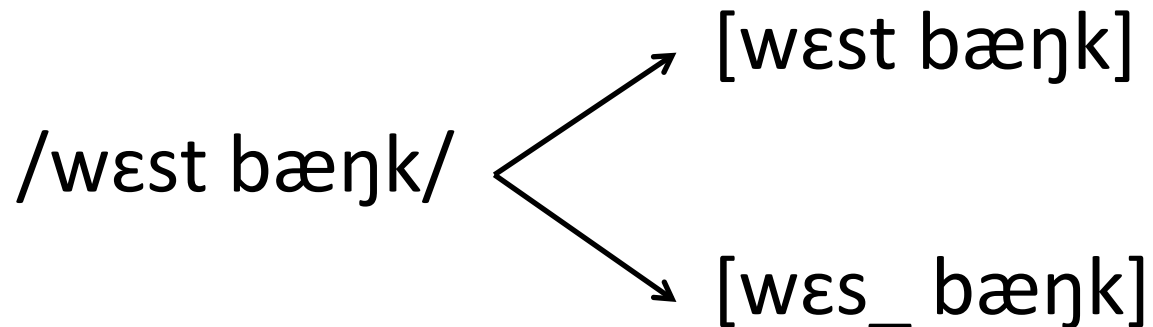


Speech rate

Variable t/d-deletion

*Collaboration with
Shigeto Kawahara*

- Word-final t/d variably deletes from consonant clusters



- Extensively studied in variationist sociolinguistics over the past four decades.

Grammatical influences

Following context

(Coetzee, 2004; Coetzee & Pater, 2011)

		Pre-C <i>west bank</i>	Pre-V <i>west end</i>	Pre-Pause <i>west.</i>
Pre-C > Pre-Pause > Pre-V	AAVE	76	29	73
	Jamaica	85	63	71
	NYC	100	66	83
	Tejano	62	25	46
	Trinidad	81	21	31
Pre-C > Pre-V > Pre-Pause	Philadelphia	100	38	12
	Chicano	62	45	37
	Columbus	80	76	63

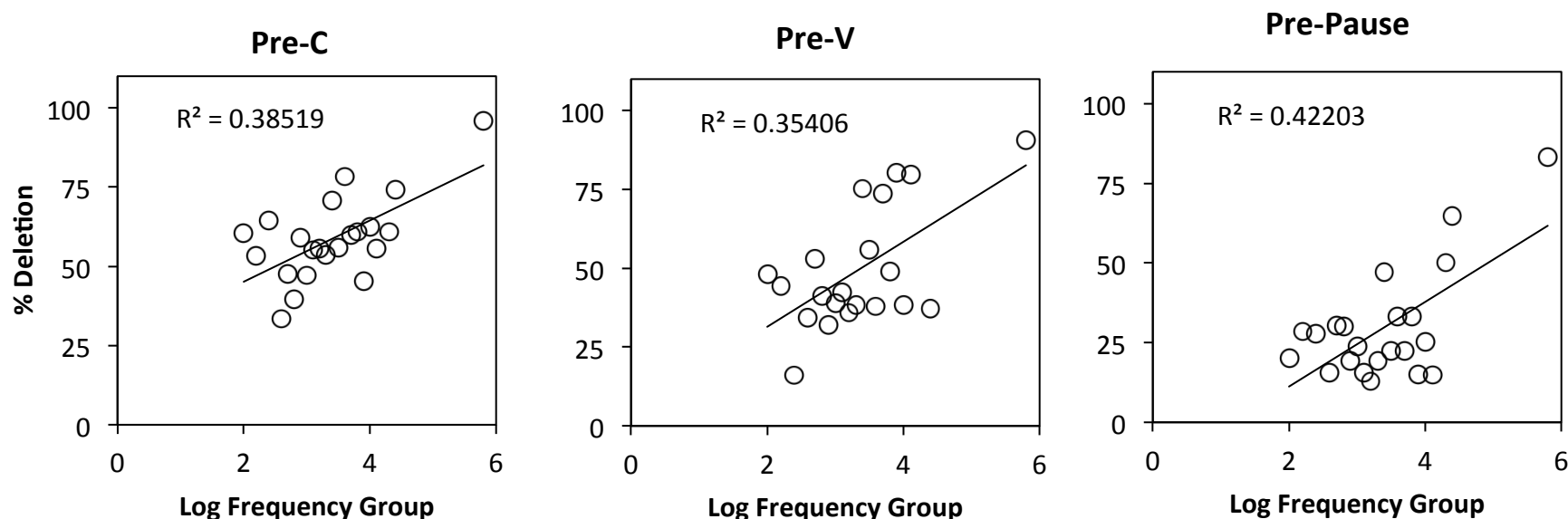
Non-grammatical influences

Usage frequency

Some variable processes apply more often to words with higher usage frequencies

(Hooper 1976; Bybee 2000, 2001, 2002, 2006; Jurafsky *et al.* 2001; Coetzee 2009; Gahl 2008; etc.)

t/d-deletion in the Buckeye Corpus (Pitt et al. 2007)



Following phonological context

- Constraints

*CT No word-final clusters ending on t/d

MAX No deletion

MAX-PRE-V No deletion before a vowel

MAX-PRE-# No deletion before a pause

- “Licensing by cue” (Steriade 2001, 2008; see Coetzee 2004 for perceptual motivation of the positional MAX-constraints.)

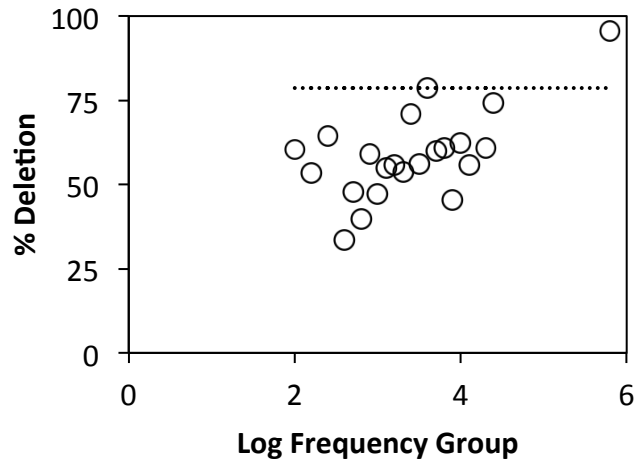
Grammar Only: Noisy HG

$$H(cand) = \sum_{i=1}^n (w_i + n z_i) C_i(cand)$$

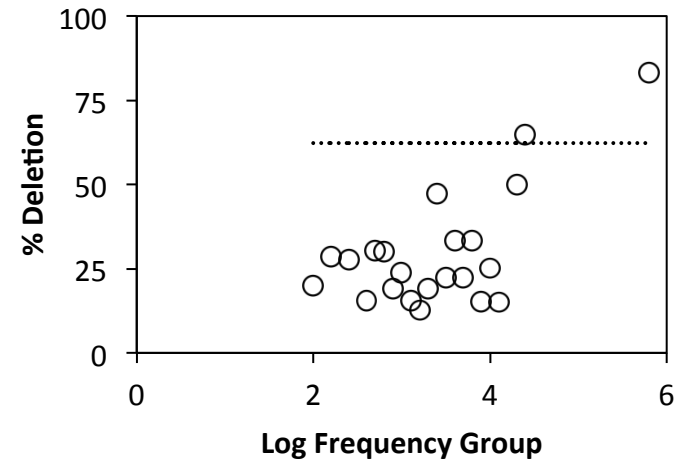
		101.1	98.9	0.9	-1.3	<i>H</i>	<i>Frequency</i>	
		*CT	MAX	MAX- PRE-##	MAX- PRE-V		<i>E</i>	<i>O</i>
west bank	west bank	-1				-101.1		
	wes_ bank		-1			-98.9	76	75
west end	west end	-1		-1		-101.1		
	wes_ end		-1		-1	-98.9	63	62
west.	west.	-1				-101.1		
	wes_.		-1	-1		-99.8	80	79

Evaluation

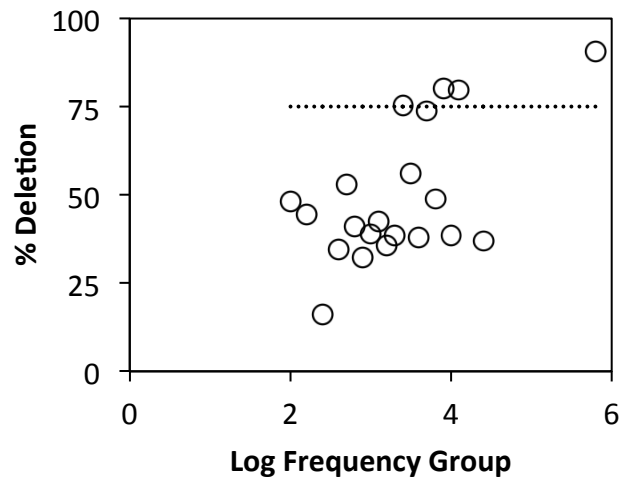
Pre-C



Pre-Pause



Pre-V



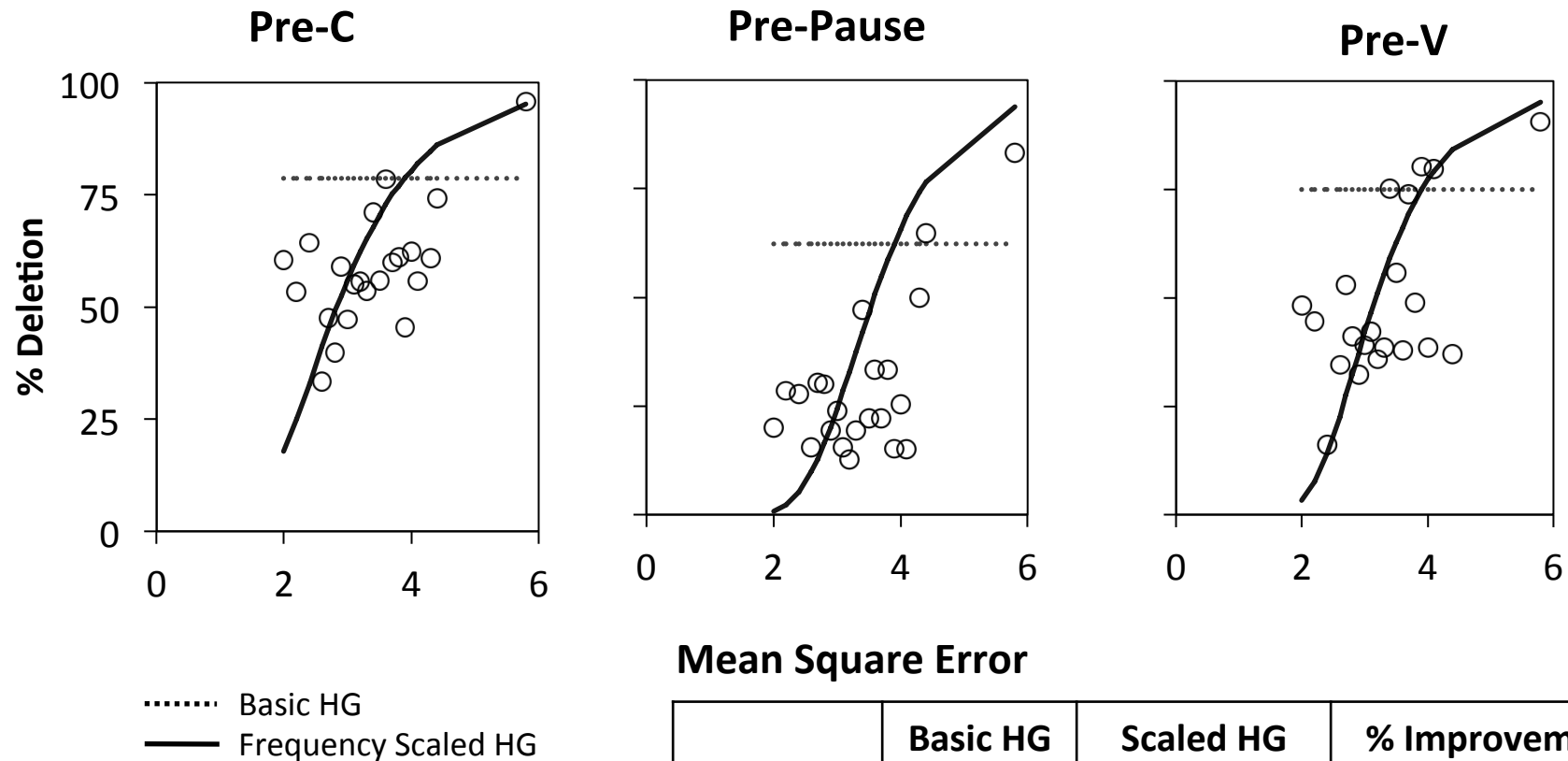
Frequency scaling

Frequency	Deletion	Importance of faithfulness
Low	Low	High
Average	Average	Average
High	High	Low

As frequency goes up, the weight of faithfulness constraints are scaled down.

$$H(cand) = \sum_{i=1}^n (w_i + nz_i + \boxed{sf}) F_i(cand) + \sum_{j=1}^m (w_j + nz_j) M_j(cand)$$

Evaluation

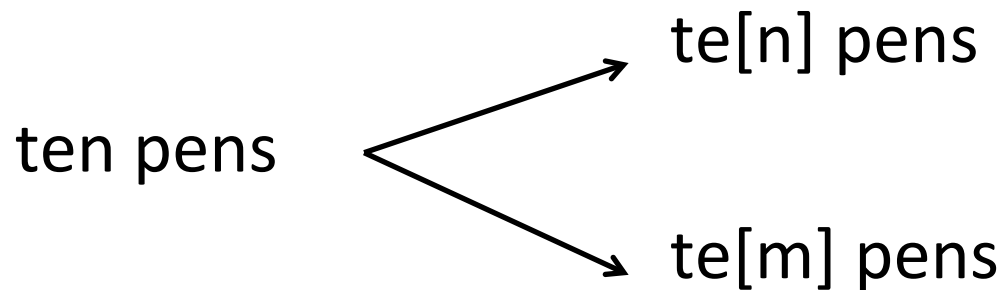


Mean Square Error

	Basic HG	Scaled HG	% Improvement
Pre-C	23,117	3,043	86.8
Pre-Pause	5,186	1,609	69.0
Pre-V	14,220	3,544	75.1

Nasal Place Assimilation

- Production:



- Perception

- Both pronunciations recognized as *ten*.
- Listeners have to “undo” assimilation.

Multiple influences

- **Place of articulation**
More before velar than labial.
te[ŋ] cats > te[m] pens
- **Speech rate** (Barry 1992)
More at faster rates
- **Frequency** (Dilley & Pitt 2007)
More in frequent than infrequent collocations
gree[ŋ] card > gree[ŋ] cardigan
- **Lexicality**
More in words than non-words.

Grammar

Other

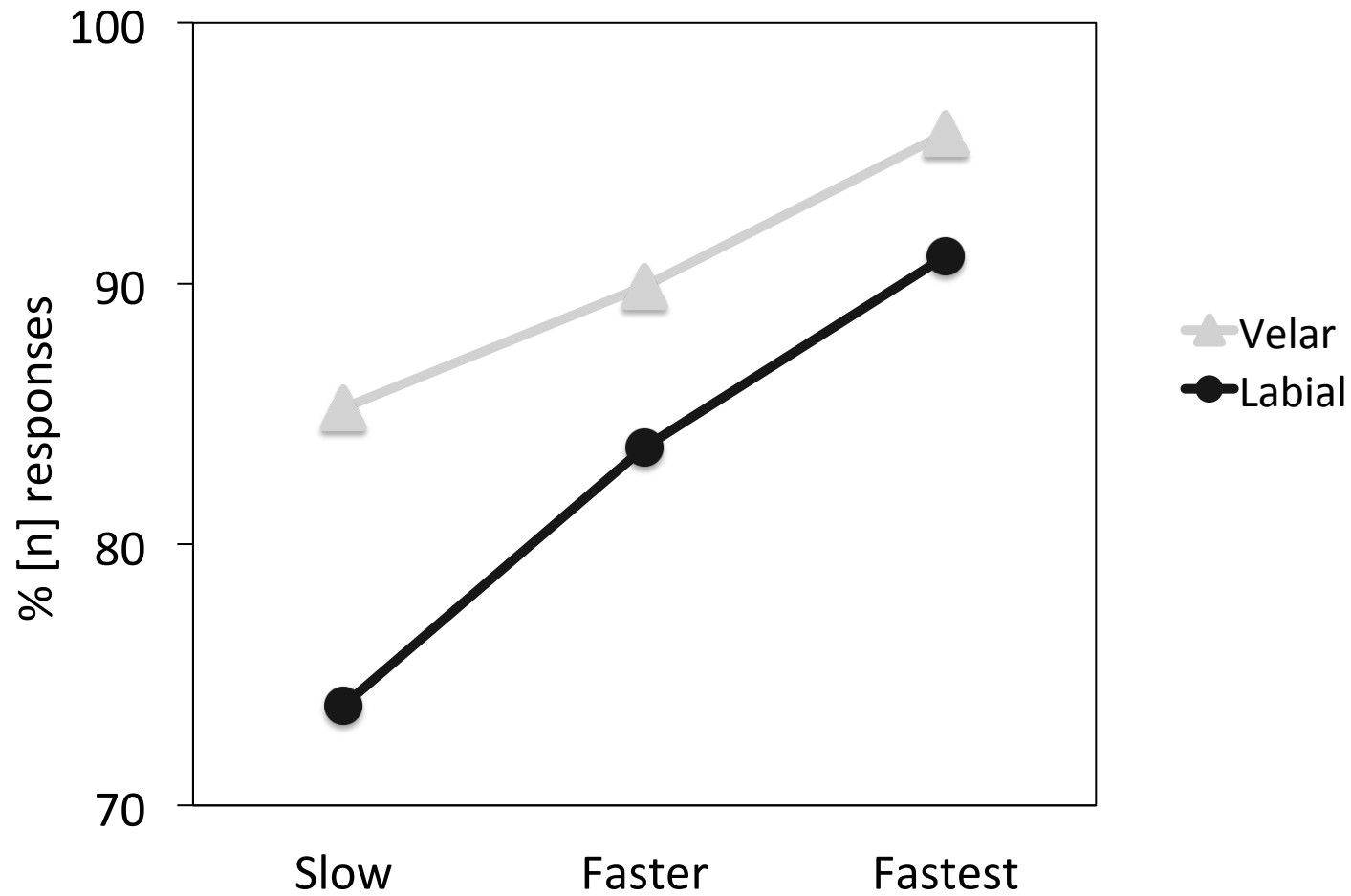
Experiment: Tokens

Alveolar	Velar	Labial
aspiri[n] tablet	apiri[ŋ] capsule	aspiri[m] powder
bargai[n] deal	bargai[ŋ] getaways	bargai[m] price
Be[n] Thomas	Be[ŋ] Kingsley	Be[m] Potter
billio[n] dollars	billio[ŋ] gallons	billio[m] barrels
canno[n] defense	canno[ŋ] guards	canno[m] balls
Joh[n] Doe	Joh[ŋ] Green	Joh[m] Black
muffi[n] tops	muffi[ŋ] cups	muffi[m] pans
pe[n] tip	pe[ŋ] case	pe[m] pocket
te[n] toes	te[ŋ] cats	te[m] pens
va[n] tires	va[ŋ] keys	va[m] price

Slow
Faster
Fastest



Results



Perceptual Harmonic Grammar

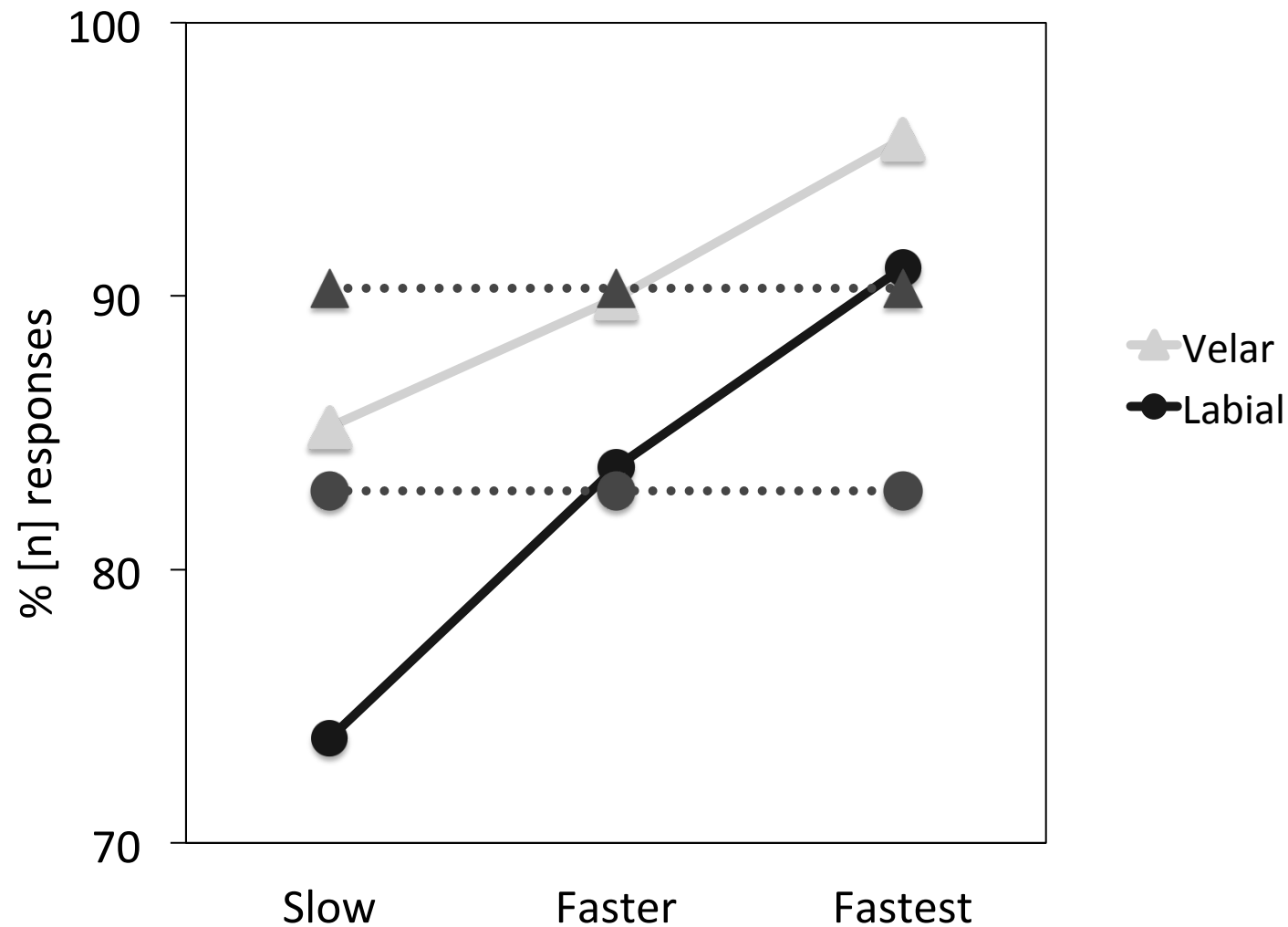
- Markedness

AGR-PLACE Nasal must agree in place with following onset

- Faithfulness

DEP[LAB] Don't insert [labial]
DEP[DOR] Don't insert [dorsal]
MAX[COR] Don't delete [coronal]

Predicted [n]-response in grammar only model



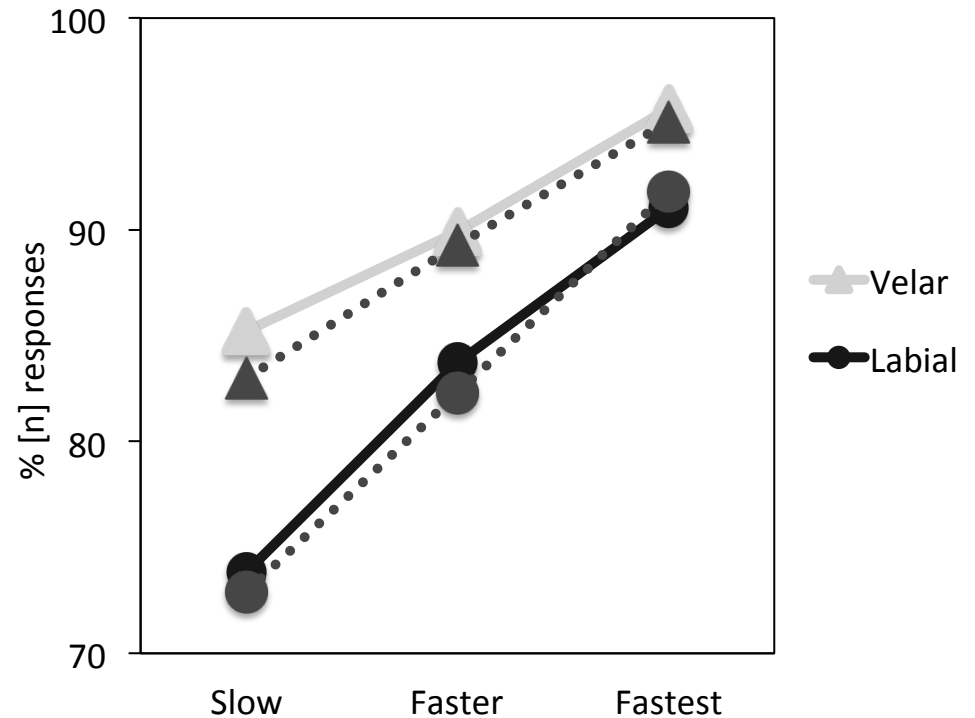
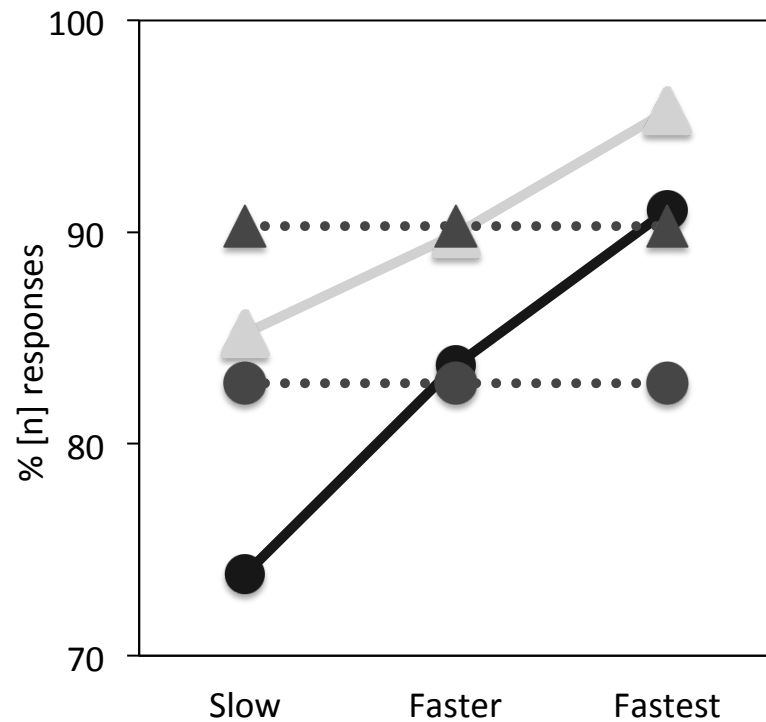
Rate Scaling

Rate	Assimilation	Importance of faithfulness
Slow	Less	Higher
Faster	More	Lower
Fastest	Even more	Even lower

As rates goes up, the weight of faithfulness constraints are scaled down.

$$H(cand) = \sum_{i=1}^n (w_i + nz_i + \boxed{sf}) F_i(cand) + \sum_{j=1}^m (w_j + nz_j) M_j(cand)$$

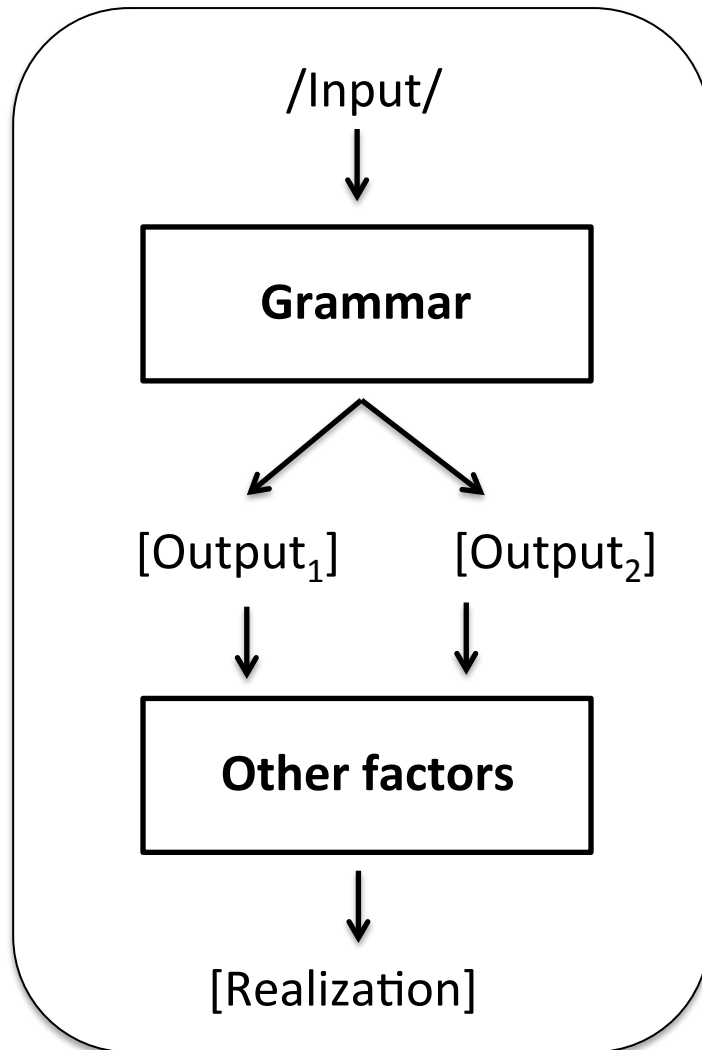
Model Comparisons



Mean Square Error

Basic HG	Scaled HG	% Improvement
34.1	1.5	91.4

Grammar Defined Variable Space



$$H(cand) = \sum_{i=1}^n (w_i + nz_i + sf) F_i(cand) + \sum_{j=1}^m (w_j + nz_j) M_j(cand)$$

Grammar Defined Variable Space

Grammatically determined limits

- Constraints have grammatical content

	MAX	MAX- PRE-PAUSE	MAX- PRE-V	H
/west bank/ → [wes_ bank]	-1			$-w_{MAX}$
/west end/ → [wes_ end]	-1		-1	$-(w_{MAX} + w_{MAX-PRE-V})$
/west/ → [wes_]	-1	-1		$-(w_{MAX} + w_{MAX-PRE-PAUSE})$

- $H(\text{wes_bank}) \geq \left\{ \begin{array}{l} H(\text{wes_end}) \\ H(\text{wes_}) \end{array} \right\}$

- Never more deletion in Pre-V or Pre-Pause than Pre-C

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