Syllable count judgments and temporal organization of articulatory gestures

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1. Introduction: Liquids - a special class

1. Sesquisyllables (Lavoie & Cohn 1999)

	Liquid	Rhotic	Nasal	Stop
Tense vowel	1σ < *feel* < 2σ	1σ < *beer* < 2σ	*beam* = 1σ	*peak* = 1σ
Diphthong	1σ < *file* < 2σ	1σ < *fire* < 2σ	*time* = 1σ	*bite* = 1σ
Lax vowel	*fill* = 1σ	*car* = 1σ	*bin* = 1σ	*pit* = 1σ

Table 1: Syllable count judgments as a function of nucleus type and coda consonant (liquid vs. non liquid) – Lavoie & Cohn 1999

- Variability attributed to acoustic rime duration (Tilsen & Cohn 2016)
- Higher syllable count judgments (SCJ): associated with longer rime durations (Tilsen & Cohn 2016)

2. Coordination patterns

- Coda liquids: pattern differently than coda nasals and stops (Marin & Pouplier 2010)
- Acoustic effect: significant vowel shortening in CVCC vs. CVC

	CVC vs. CVCC	Vowel duration
Lateral coda	*gull vs. gulp*	duration /ʌ/$_{gull}$ > duration /ʌ/$_{gulp}$
Rhotic coda	*bar vs. bard*	duration /ɑː/$_{bar}$ > duration /ɑː/$_{bard}$
Nasal coda	*ten vs. tent*	duration /e/$_{ten}$ ≈ duration /e/$_{tent}$
Stop coda	*gas vs. gasp*	duration /æ/$_{gas}$ ≈ duration /æ/$_{gasp}$

Table 2: Vowel duration in CVC-CVCC pairs as a function of coda consonant

2. Questions and Predictions

Theoretical question:
- Is there a shared representation for speech motor control and phonological knowledge?

Experimental question:
- Do consonant-specific coordination patterns influence speakers' intuitions about SCJ?

	If CVC SCJ →	*CVCC SCJ*	*If CVC SCJ* →	*CVCC SCJ*	*If CVC SCJ* →	*CVCC SCJ*
Liquid coda	1σ feel	1σ field	1.5σ feel	1.5σ field	2σ -	-
Nasal coda	1σ pain	1.5σ pained	1.5σ -	-	2σ -	-
Stop coda	1σ peak	1.5σ peaked	1.5σ -	-	2σ -	-

Table 3: Predictions for CVCC syllable count judgments based on judgments given for CVC tokens (based on Tilsen & Cohn 2016 and Marin & Pouplier 2010)

3. Methodology

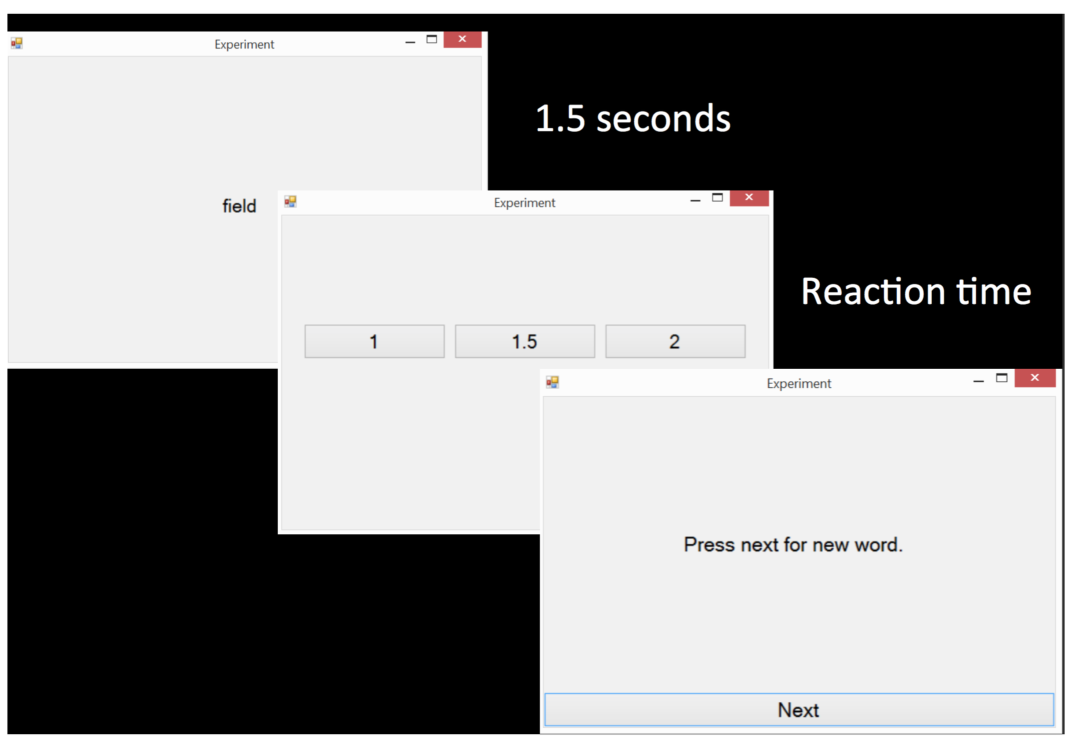
Two independent sequential tasks:

- Following Tilsen & Cohn 2016
- 7 ♂; 11 ♀ - undergraduate students at the University of Chicago

1. Production task

Carrier phrase	I say ____ now.
	(CV) - CVC - CVCC
Target	Tense vowel + Liquid coda *fee – feel – field, tie – tire – tired*
Controls	(1) Tense vowel + nasal/stop coda Zoo – zoom – zoomed, pea – peak – peaked
	(2) Lax vowel + liquid/nasal/stop coda *gull – gulp, ten – tent, miss - mist*
	(3) Unambiguous disyllabic words *bacon, public, unite*

2. SCJ task



4. Results I: Rime duration

Linear mixed models (fixed factor: *Coda_C*, random factors: *Speaker, Item, Lex_freq*)
- Strong effect of coda consonant (p=.025) → higher degree of vowel shortening in CVC1C2 for liquid C1 than nasal or stop C1 (Figure 1 left)
- Longer rime duration in the case of nasal and stop clusters (Figure 1 right)

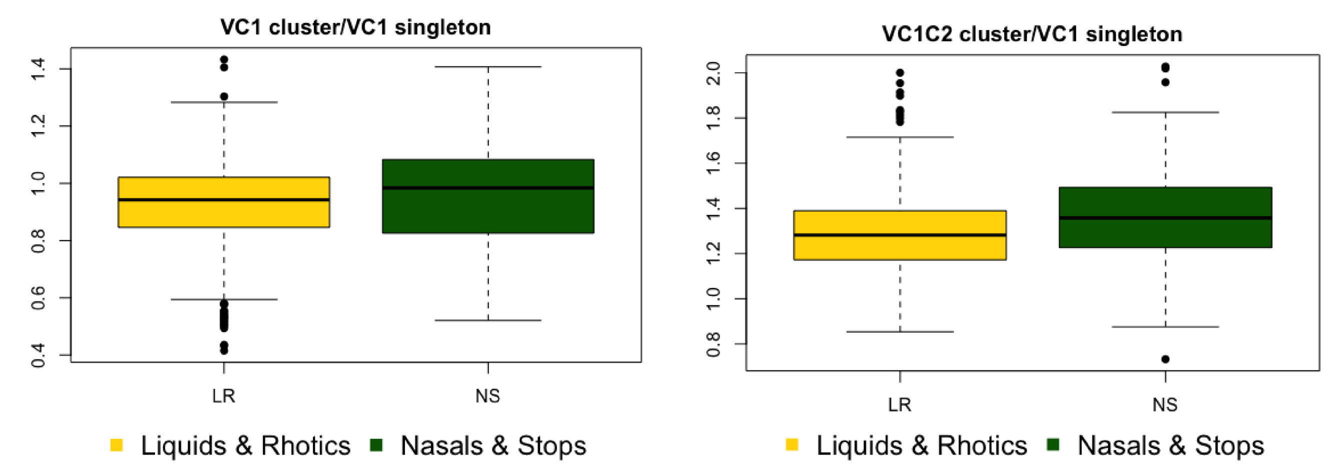


Figure 1: VC1$_{cluster}$/VC1$_{singleton}$ (left) and VC1C2/VC1 (right) as a function of coda consonant type (liquid vs. nasal/stop)

5. Results II: Syllable Count Judgments

- **CVC:** Higher than 1 SCJ (*SCJ=1.5, SCJ=2*) given exclusively to tense/diphthong + coda liquid tokens (confirms Tilsen & Cohn 2016)
- **CVCC:** High inter-speaker variability, different strategies
- **Reaction time:** Longer RT for *cluster vs. singleton* and for *liquids vs. nasals /stops* (p=.02, p=.03 - log values) → liquids form a special class

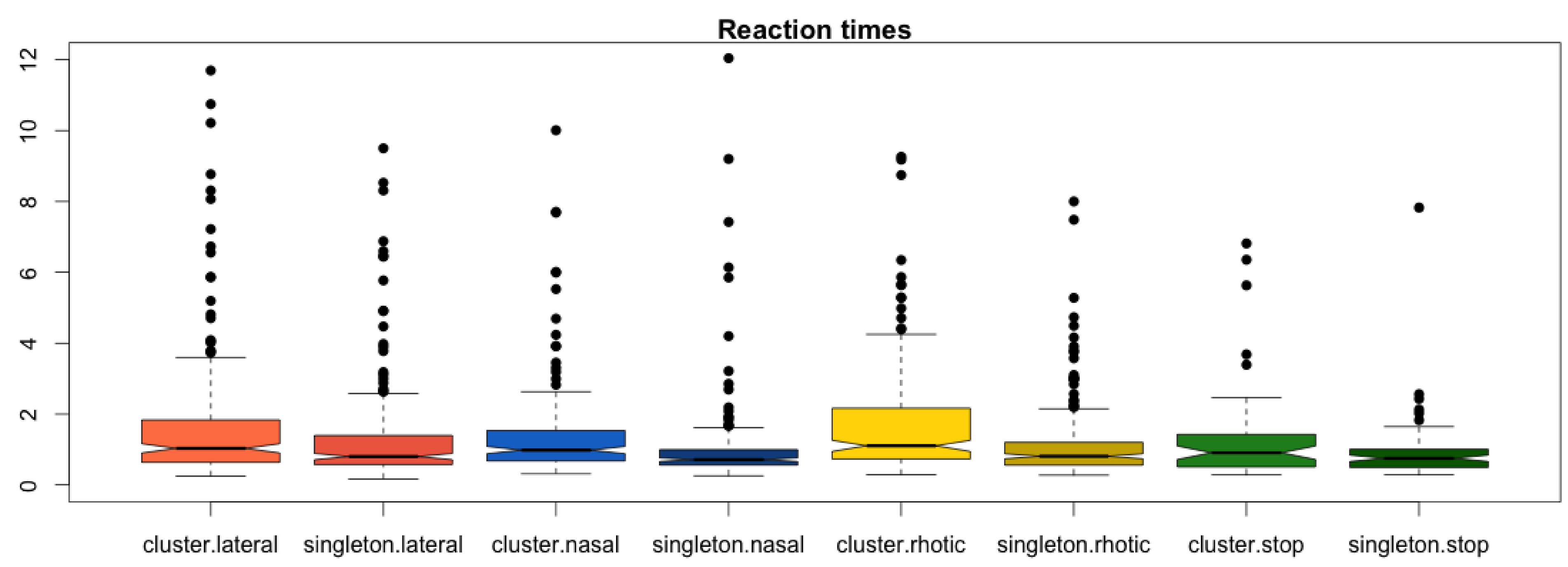


Figure 2: SCJ reaction times (*seconds*) for different types of coda C1 (*lateral*, *nasal*, *rhotic* ou *stop*) and coda complexity(*cluster vs. singleton*)

6. Results III: Correlation between Duration and SCJ

Ordinal cumulative regression model (Fix.F: *Duration*, Rand.F: *Complexity, Morphology, Lex_freq*)
- Total rime duration is a good predictor for SCJ (p<*0.0001*): SCJ > 1 associated to longer rimes
- Two strategies: correlation between degree of V shortening and SCJ value

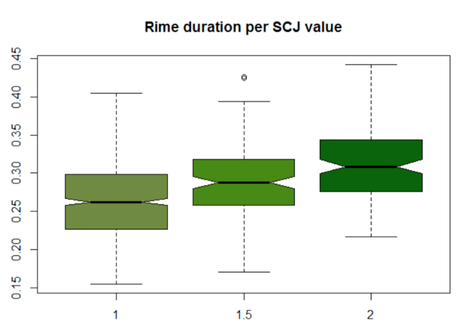


Figure 3: Rime duration per SCJ value – tense or diphthong nuclei

Strategy :	*CVC SCJ*	*CVCC SCJ*	*Degree of V shortening*
NO SCJ CHANGE	1 (1.5)	1 (1.5)	high for CVCC
SCJ CHANGE	1 (1.5)	1.5 (2)	low for CVCC

Table 4 : Observed strategies showing SCJ and V shortening correlation

7. Conclusion

- Consonant-specific coordination patterns have an influence on speakers' SCJ
- Results suggest a common representation for speech motor control and metalinguistic judgments
- Future work: Confirm results with articulatory data

8. References

(1) LAVOIE L.,M., COHN, A., (1999). Sesquisyllables of English : the Structure of vowel-liquid syllables. In Proceedings of the XIVth International Congress of Phonetic Sciences 109-112
(2)MARIN S., POUPLIER, M., (2010). Temporal Organization of Complex Onsets and Codas in American English : Testing the Predictions of a Gestural Coupling Model. Motor Control, 14, 380-407
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