What we know about what we've never heard: evidence from production

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Introduction

How do learners arrive at a complete grammar from inconclusive evidence? Two positions:

1) When the data support only a partial constraint ranking, learners pick a complete ranking at random knowing that any ranking they choose will be consistent with the data (Tesar & Smolensky 2000)
2) Ranking reflects the initial state, e.g, M >> F (Smolensky 1996)
   - ❖ Support for initial state markedness rankings comes from studies showing listener preference for unmarked structures despite having no direct experience (e.g., Berent et al. 2007).
   - ❖ However, some researchers have also pointed out problems with Berent et al's methodology and raised alternative interpretations of the results (e.g., Peperkamp 2007; Davidson 2011).

Japanese high vowel deletion offers a novel test of these positions

Background

Our past work has shown that the lingual target of the high vowel /u/ in Japanese optionally deletes between voiceless consonants, giving rise to heterosyllabic consonant clusters, e.g.:

/ʃutaisei/ → [ʃ.tai.sei]~[ʃu̥.tai.sei]
/ɸusoku/ → [ɸ.so.ku]~[ɸu̥.so.ku]

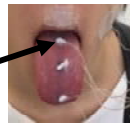
(Shaw & Kawahara, 2018a, 2018b, 2018c)

- ❖ Vowel deletion probability varies across items, possibly due to constraints on syllable contact (but the data were thin: one item each)
- ❖ Due to the absence of voicing, vowel presence/absence can be difficult for language learners to detect in the acoustic signal.
- ❖ When parsing weak signals, listeners rely more on prior expectations, making for insightful probes into latent phonological knowledge.

This study

Main question: Is vowel deletion more likely when it leads to consonant clusters with less marked syllable contact? Here, we test: **sonority plateau (fricative-fricative)** vs. **sonority fall (fricative-stop)**

Since the acoustic signal is ambiguous with respect to presence/absence of the vowel, we used Electromagnetic Articululography to track the movement of the **tongue dorsum**

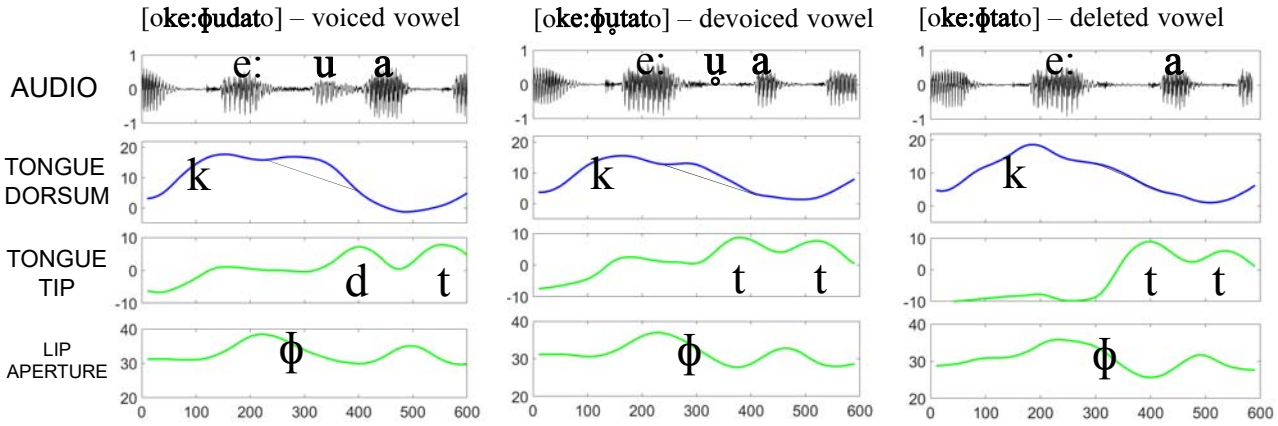


Participants: seven (four male) Tokyo natives aged 19-22
Materials: near minimal pairs with voiced/voiceless /u/ read in carrier phrase: *o:ke: ___ to it:e* 'okay, say ___'; 10-15 repetitions per word.

SONORITY PLATEAU		SONORITY FALL	
Fricative Fricative (FF)		Fricative Stop (FS)	
Voiced (control)	Devoiced (test)	Voiced (control)	Devoiced (test)
ɸuzoku 'attached'	ɸusoku 'shortage'	ɸudo: 'immobility'	ɸuton 'mattress'
ɸuzai 'absence'	ɸusai 'couple'	ɸudan 'ordinary'	ɸutan 'responsibility'
ɸuzakeru 'to frolic'	ɸusagaru 'to be closed'	ɸuda 'brevity'	ɸuta 'lid'

Analysis: analysis of tongue dorsum trajectories followed Shaw & Kawahara (2018a); the posterior probability of vowel deletion in devoiced contexts was computed using a Bayesian classifier trained on Discrete Cosine Transform coefficients fit to voiced vowel and vowel-absent (linear interpolation) trajectories. Effect of syllable contact on posterior probabilities was assessed using mixed effects models.

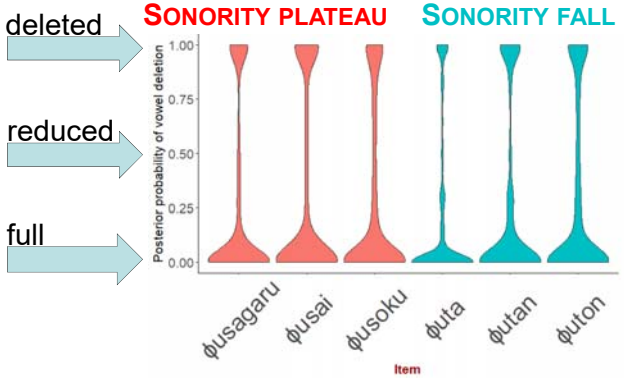
Example movement trajectories



Posterior probability of deletion in devoicing environments

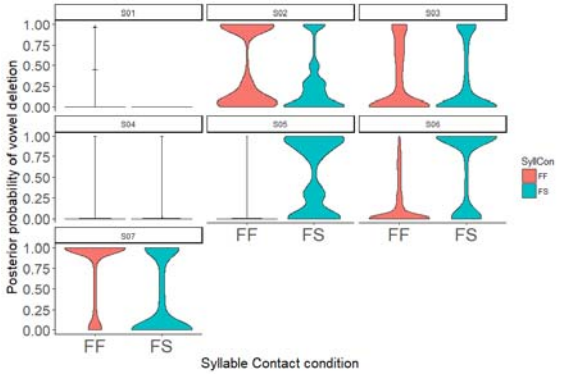
Items analysis

no difference between sonority sequencing conditions



Comparison of nested Linear Mixed Effects models	Df	AIC	Chisq
deletion_prob ~ (1|Subject)+(1|Item)	4	29734	
deletion_prob ~ (1+Sonority|Subject)+(1|Item)	6	25721	4017***
deletion_prob ~ Sonority+ (1+Sonority|Subject)+(1|Item)	7	25723	0.16 (n.s.)

Subjects analysis



FOUR DIFFERENT PATTERNS

1) No vowel deletion (S01, S04)
2) Equal vowel deletion for FS & FF (S02, S03)
3) TETU – more deletion in FS than FF (S05, S06)
4) Reverse TETU – more deletion in FF than FS (S07)

Discussion and Conclusion

Japanese high vowel deletion provides the right kind of case study for assessing latent phonological knowledge; because of weak perceptual cues to vowel deletion, it is difficult for learners to track the conditioning environments for deletion.

- ❖ Lacking clear evidence in the input for deletion environments, learners appear to **rank syllable contact constraints randomly**; of five possible patterns, four of them are attested in our sample of seven speakers.

Syllable contact constraints **are active** in conditioning deletion patterns but only on a speaker-specific basis.

- ❖ Supports the view that in the absence of direct evidence, listeners will randomly choose a full grammar, leading to speaker-specific variation in production
- ❖ Also accords with Tesar and Smolensky claim that learnability via constraint demotion requires a fully-ranked hierarchy.

References: Berent, I., Steriade, D., Lennertz, T., & Vaknin, V. (2007). What we know about what we have never heard: Evidence from perceptual illusions. *Cognition, 104*, 591-630. **Davidson, L.** (2011). Phonetic, phonemic, and phonological factors in cross-language discrimination of phonotactic contrasts. *Journal of Experimental Psychology: Human Perception and Performance, 37*(1), 270. **Peperkamp, S.** (2007). Do we have innate knowledge about phonological markedness? Comments on Berent, Steriade, Lennertz, and Vaknin. *Cognition, 104*, 631-637. **Shaw, J. A., & Kawahara, S.** (2018a). Assessing surface phonological specification through simulation and classification of phonetic trajectories. *Phonology, 35*(3), 481-522. **Shaw, J. A., & Kawahara, S.** (2018b). *Consequences of High Vowel Deletion for Syllabification in Japanese*. Paper presented at the Annual Meetings on Phonology (AMP 2017), New York University. **Shaw, J. A., & Kawahara, S.** (2018c). The lingual articulation of devoiced /u/ in Tokyo Japanese. *Journal of Phonetics, 66*, 100-119. **Smolensky, P.** (1996). *The initial state and 'Richness of the Base' in Optimality Theory* (JHU-CogSci-96-4). **Tesar, B., & Smolensky, P.** (2000). *Learnability in Optimality Theory*. Cambridge, Mass.: MIT Press.