The effect of language proficiency on patterns of epenthesis by Persian learners of English

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1. Background

Asymmetries in epenthesis

Illicit complex onsets are often repaired by *epenthesis* (Hall 2011)

Placement of epenthetic vowel differs based on onset type.

In Persian, /s/-stop, /s/- liquids, and /s/-nasal clusters are repaired with prothesis, and everything else with anaptyxis

Prothesis	Anaptyxis
/stɑp/ 'stop' → [es.tɑp]	/pliz/ 'please' → [pe.liz]
/s/-initial clusters	Other clusters

Are /s/-initial clusters different?

/s/-initial clusters also differ from obstruent + sonorant (OR) clusters in terms of their:

Articulation

/s/-intial clusters have **greater degrees of gestural overlap and stricter timing patterns** than OR clusters (Pouplier et al. 2022)

Acquisition

Relative to OR clusters, /s/-initial clusters are:
- **Acquired later** in L1 acquisition (Geirut 1999)
- **Repaired more frequently** in L2 (Carlisle 2001)

Perception

Epenthesis within an /s/-initial cluster is more **perceptually disruptive** than within OR clusters (Fleischhacker 2001)

Open questions

Do L2 learners acquire /s/-initial onsets more slowly than other types of onsets?

What can this tell us about the status of these onsets?

2. Experimental study

Hypotheses

1. /s/-initial onsets are repaired with prothesis, others with anaptyxis
2. /s/-initial onsets undergo more epenthesis than other types
3. Higher English proficiency corresponds to less epenthesis
4. Learners improve more slowly at /s/-initial clusters

Participants

19 native Farsi speakers
(14M, 36-80 y.o.)

Experiment

1. Produced 74 English words with complex onsets
2. English ability assessed with LEAP-Q

Relative English Dominance (RED)

LEAP-Q responses were aggregated to a single dimension called RED using Principal Components Analysis.

Analysis

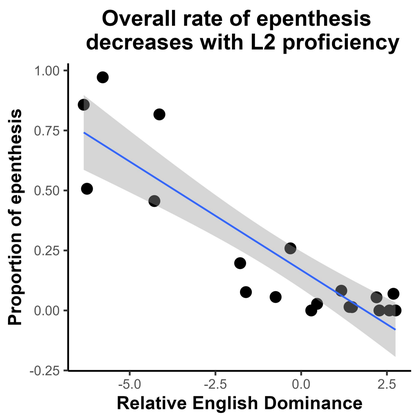
Mixed-effects multinomial logistic regression model predicting epenthesis type (none, prothesis, anaptyxis) from (among others)

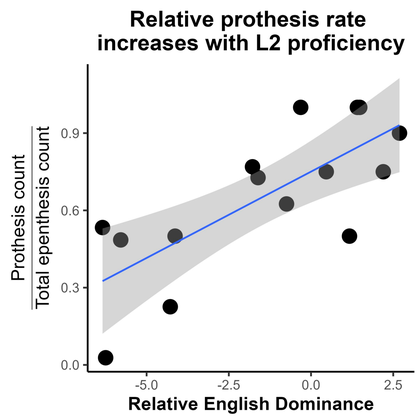
1. *Onset sonority Δ*
2. *Onset identity*
3. *Relative English Dominance (RED)*

Random intercepts for participant and word

Results

Learners improve more slowly at /s/-stop clusters





3. Phonological modeling

Analyzed using **MaxEnt OT** (Goldwater & Johnson 2003)
- Weighted constraints → probability distributions
- Weights can be learned from data
- Compare models by likelihood of data and # of constraints

Key constraints (Fleischhacker 2001)

1. ***Complex:** Don't have complex onsets
2. **Dep-V/{S_T, S_N, S_L, T_R}**: Penalize vowel insertion in different contexts

/stɑp/	Obs. Freq.	Pred. Freq.	Harmony	Dep-V/S_T *w=11.32*	*Complex *w=2.31*	L-Anchor *w=4.56*	…
[stɑp]	**0.87**	**0.90**	4.05		1		…
[estɑp]	**0.13**	**0.10**	6.30			1	…
[setɑp]	**0**	**0**	16.94	1			…

Scaling *Complex weights by RED of *j*th speaker

$$w_{*Complex\text{-}j} = w_{*Complex} - \rho * RED_j$$

Model comparison

Model	LogLik	Weights	BIC	Parameters
***Complex, ρ** *All onset clusters are equally difficult*	-759	10	1596	*Complex = 2.31 ρ = 0.5
***Complex-{S,T}, ρ** */s/-initial and other clusters can have different difficulties*	-654	11	1393	*Complex-S = 20.75 *Complex-T = 4.98 ρ = 0.5
***Complex-{S, T}, ρ-{S,T}** */s/-initial clusters and other clusters can have different difficulties and rates of improvement.*	**-642**	**12**	**1377**	***Complex-S = 20.75 *Complex-T = 4.98 ρ_S = 0.4 ρ_T = 0.6**

4. Discussion

/s/-initial clusters are repaired more frequently and acquired more slowly by Persian speakers than other types of clusters

Why are /s/-initial clusters hard?

Perceptual cost of anaptyxis into an /s/-initial cluster is high compared to OR clusters (Fleischhacker 2001)

Greater timing coordination required to generate desired outcome? (e.g. Pouplier et al. 2022)