Exploring adult learners' discrimination of non-native speech contrasts under an error-driven learning account

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Introduction

What underlying mechanisms drive statistical tracking in speech learning?

The current study investigates the role of prediction and prediction error, which serves to reduce uncertainty about outcomes via cue competition, in statistical learning. In this error-driven learning process, learners are expected to better discriminate informative from uninformative *acoustics* cues when spoken words are presented before referent objects, allowing predictions about the upcoming object on the basis of the speech cues (*discriminative condition*); if instead referent objects are presented first (*non-discriminative condition*), learning will depend solely on cue-outcome associations (Nixon, 2020; Ramscar et al., 2010). We tested this hypothesis in Mandarin speakers with an artificial language. Participants learned to discriminate an informative **Italian gemination cue** (double vs single consonants) and at the same time to ignore an uninformative tonal cue to learn words.

Materials & Methods

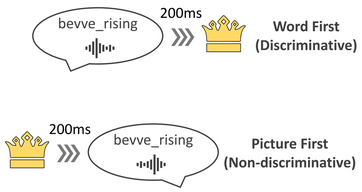
TRAINING

N=185
Chinese native
Do NOT know Italian

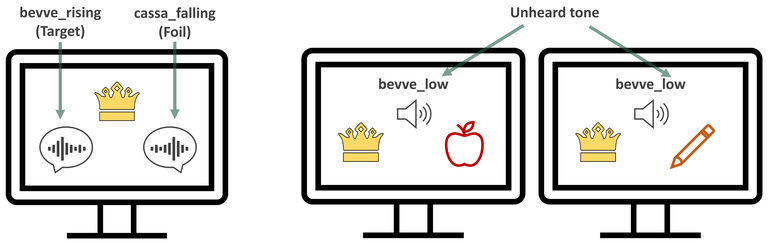
No. of trials = 60	Crown	Pencil	Shoe
High frequency (75% of trials)	be**vv**e_rising	fato_flat	cassa_**falling**
Low frequency (25% of trials)	casa_falling	be**v**e_**rising**	fatto_**flat**

vv/v: Gemination cue (informative, learn to discriminate)

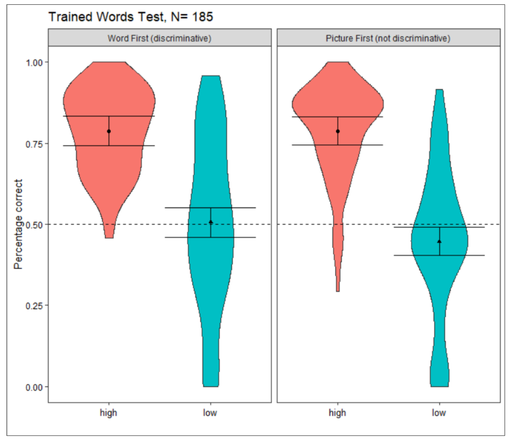
rising/falling/flat: Tonal cue (uninformative, learn to ignore)



TESTING



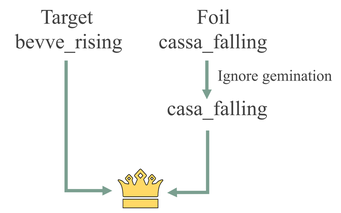
Analysis & Results

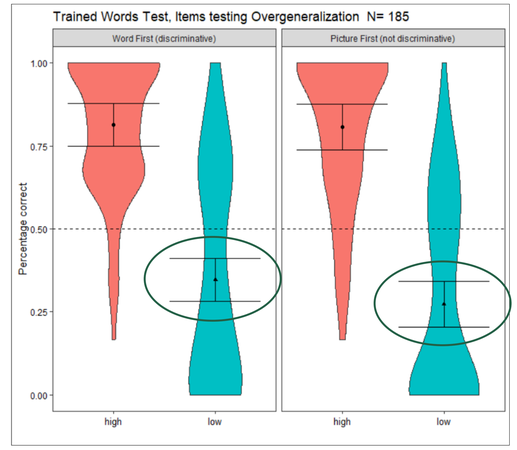


- **Ambiguous** evidence of interaction between frequency and learning condition (p=.206. BF = 0.841)
- **Ambiguous** evidence of simple effect of learning condition for low frequency items (p=.112, BF = 1.714)

Test 1 – Trained Words

Sub-analysis: Overgeneralization
Trials where – <u>if gemination is ignored</u> – both the target and the foil words are associated with the target picture.

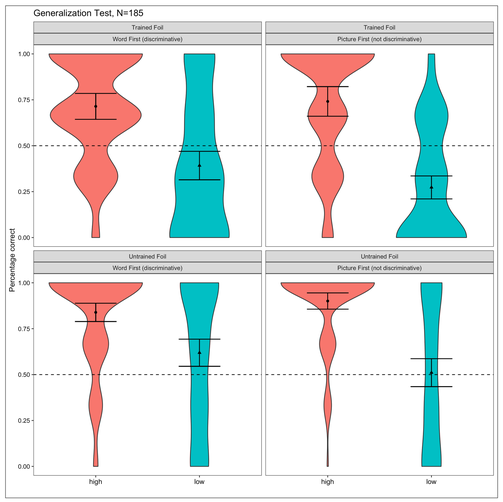




- **Ambiguous** evidence of interaction (p=.2. BF = 1.1426)
- **<u>Moderate</u>** evidence of simple effect of learning condition for low frequency items (p=.064, BF = 3.3754)

Test 2 – Generalization

- **<u>Strong</u>** evidence of interaction between frequency and learning condition (p=.011. BF = 11.915)
- **<u>Substantial</u>** evidence of simple effect of learning condition for low frequency items (p=.015, BF = 9.277)



Discussion

Participants in the discriminative order:

- showed stronger learning of the critical low frequency items in the generalization test with novel tones (Test 2)
- showed stronger learning of the critical low frequency items with trained words specifically for the subset of items where ignoring gemination leads to overgeneralization based on more salient (but not discriminatory) cues

★ It suggests that an ordering which allows for cue competition and prediction error leads to stronger learning.

References

[1] Ramscar, M., Yarlett, D., Dye, M., Denny, K., & Thorpe, K. (2010). The effects of feature-label-order and their implications for symbolic learning. *Cognitive science*, *34*(6), 909-957.

[2] Nixon, J. S. (2020). Of mice and men: Speech sound acquisition as discriminative learning from prediction error, not just statistical tracking. *Cognition*, *197*, 104081.