Language learning as uncertainty reduction

the effects of prediction error and entropy on generalization and item-learning

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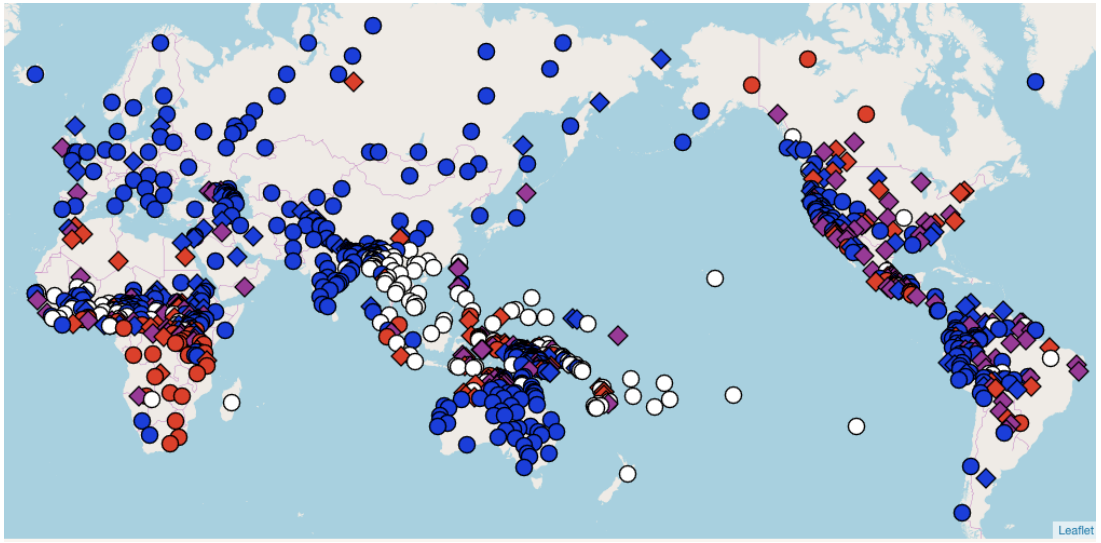
Language is shaped by learning & use

Suffixing more common than prefixing



St Clair et al., 2009; Hupp et al., 2009

Language learning as uncertainty reduction

Prediction error → critical for discriminating between informative (predictive) and uninformative cues

(Rescorla, 1968, 1988; Rescorla & Wagner, 1972)

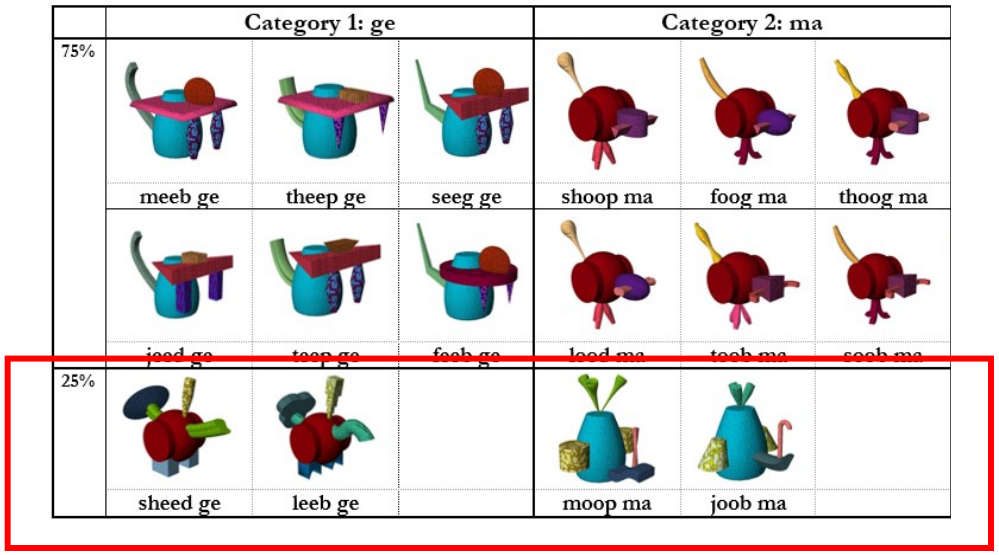
Ramscar et al. (2010): Order matters

That was a wug

This is a wug

Experiment 1: Prediction error in learning morpho-syntax

Artificial language with suffixes or prefixes; affix usage conditioned on critical discriminating features



Suffix condition will be better at generalization than the prefix condition, especially for the low-type frequency features

Affix-by-type-frequency interaction

Experiment 1: Procedure

TRAINING: 15 minutes (16 trials per item)

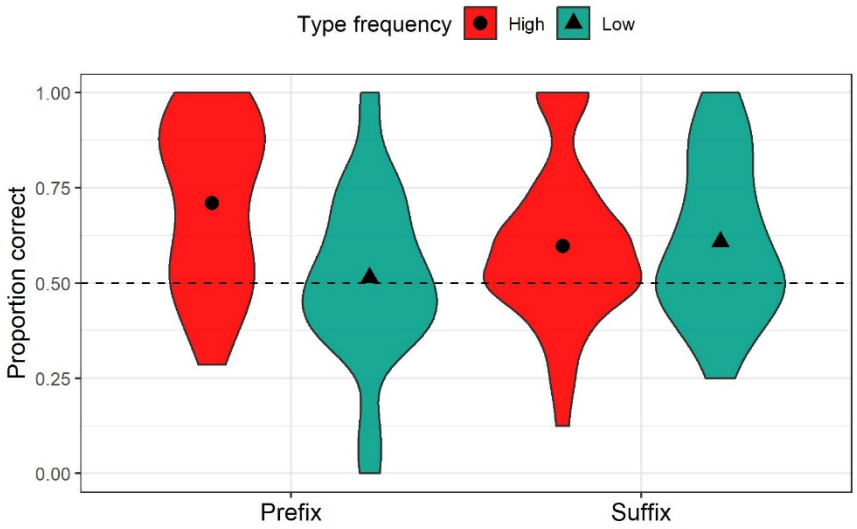
- Prefix condition: hear affix, then hear noun + see picture
- Suffix condition: hear noun + see picture, then hear affix

TESTING: unseen "fribble" and two labels: one with correct affix, other with wrong affix

- If participants learned the correct discriminating features, they will be able to group the novel item with the correct affix
- Prefix: better for HF than LF items
- Suffix: equally good on both

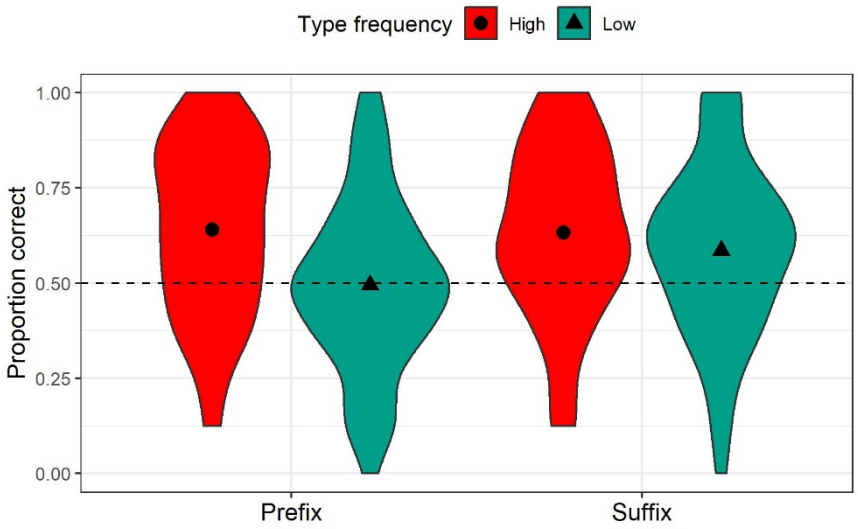
Experiment 1 Results

Experiment 1 (N = 84)



Stronger effect of type-frequency in the prefix condition
BF = 10.45

Replication (N = 120)



BF = 3.7

Experiment 1 + Replication combined (N=204) BF = 38

The story so far

- Suffix condition better at generalization than prefix condition due to greater prediction error during learning
- Content words can come *after:* prefixes, gendered articles, prenominal adjectives

➢Dye et al. (2017; 2018): gendered articles and prenominal adjectives reduce the uncertainty about the upcoming noun (entropy)

- … making the meanings of the nouns easier to learn (Arnon & Ramscar, 2012)

Prefixes reduce the entropy of nouns

pe	viltord deecha tombat paylig
da	koomo wazil etkot slindot

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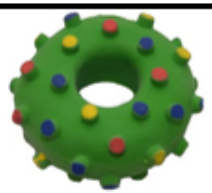
Better learning of affix+noun and noun+picture mappings in the prefix condition than the suffix condition

Experiment 2

- Eight novel words and pictures randomly assigned to one of the two novel affixes
- Random assignment: no obvious semantic or phonological patterns

Category 1: gɛ		Category 2: mʌ	
			
/tombat gɛ/	/ku:mo gɛ/	/pɪkru mʌ/	/ɛtkot mʌ/
			
/peɪlig gɛ/	/wazɪl gɛ/	/slindot mʌ/	/di:tʃə mʌ/

Experiment 2 Procedure

Day 1: audio training of affix+noun bigrams

pe slindot

slindot pe

Day 2:

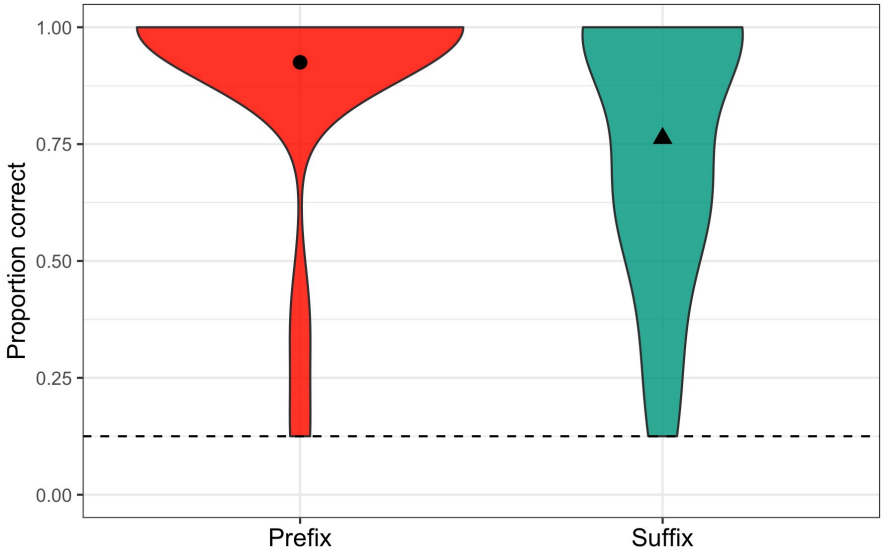
- Repeat Day 1 training
- Audio + pictures
- Testing

pe slindot

slindot pe

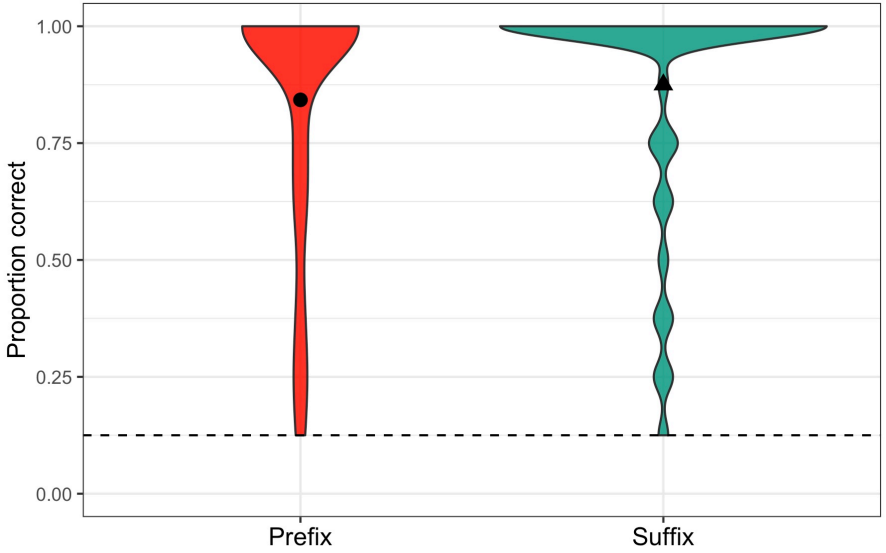
Experiment 2 Results

Experiment 2 (N = 40)



Prefix condition better than suffix condition (BF = 12.94)

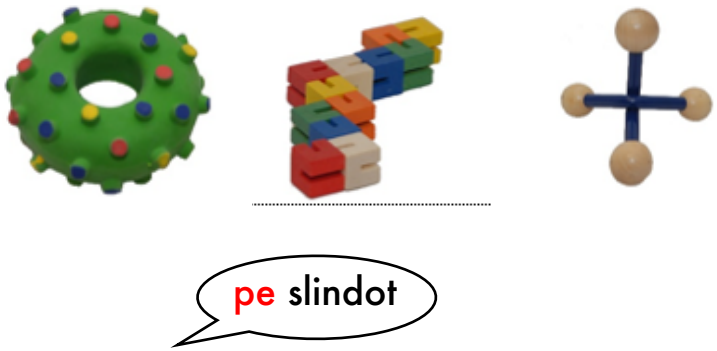
Replication (N = 100)



BF = 0.266 → evidence for the null

Take-home

- Experiment 1 → Strong evidence that learning via prediction error is critical for appropriate generalization
- Experiment 2 → mixed evidence that prefixes reduce entropy (in our paradigm)



Thank you!



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