Item-Bound vs Category-Based Generalizations
An Entropy Model

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From little evidence to abstract rules in language acquisition

(1) Item-bound generalizations
(2) Category-based generalizations (Gomez & Gerken, 2000)

- *dedeje*
- *kokoba*
- *leledi*

- *di* after 2x *le*
- end in *je*, *ba* or *di*

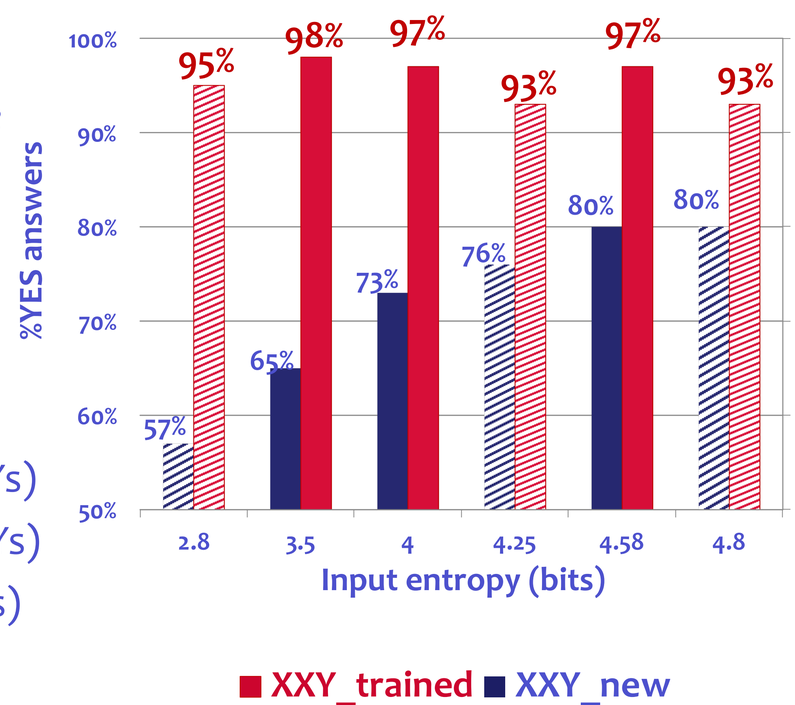
XXY

Research Question

Are **item-bound generalization** and **category-based generalization** independent and qualitatively different mechanisms? Or is rule induction a **phased mechanism:** it starts out with memorization of specific items and finding regularities between them (item-bound generalization) and gradually moves to category-based generalization, as a function of increasing input entropy.

Experiments 1&2 - Effect of Entropy on Rule Induction

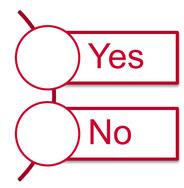
- **71 adults, ~22y, ~4min, between-subjects**
- **3-syllable XXY:** *daa_daa_lie*
- manipulated ***ENTROPY*** **(number & frequency)**
  - 2.8 bits (4 × 7Xs / 4 × 7Ys)
  - 3.5 bits (4 × 6Xs / 4 × 6Ys)
  - 4 bits (2 × 12Xs / 2 × 12Ys)
  - 4.25 bits (2 × 14Xs / 2 × 14Ys)
  - 4.58 bits (1 × 24Xs / 1 × 24Ys)
  - 4.8 bits (1 × 28Xs / 1 × 28Ys)



Test ("Could this string be possible in the language that you heard?")

5x4=20 items

- XXY_trained_syllables: daa_daa_lie √
- X_1X_2Y_new_syllables: reu_loo_gee *
- XXY_new_syllables: too_too_suu √
- X_1X_2Y _trained_syllables: teu_duu_saa *



Experiment 3 – Item-bound vs Category-based Generalizations

Low Entropy Condition

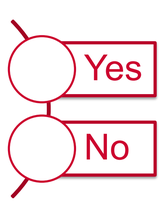
- 46 adults (age 18-46)
- 3-syllable XXY: *daa_daa_lie*
- **Low Entropy: 4*7 X/4*7 Y (2.8 bits)**

Medium Entropy Condition

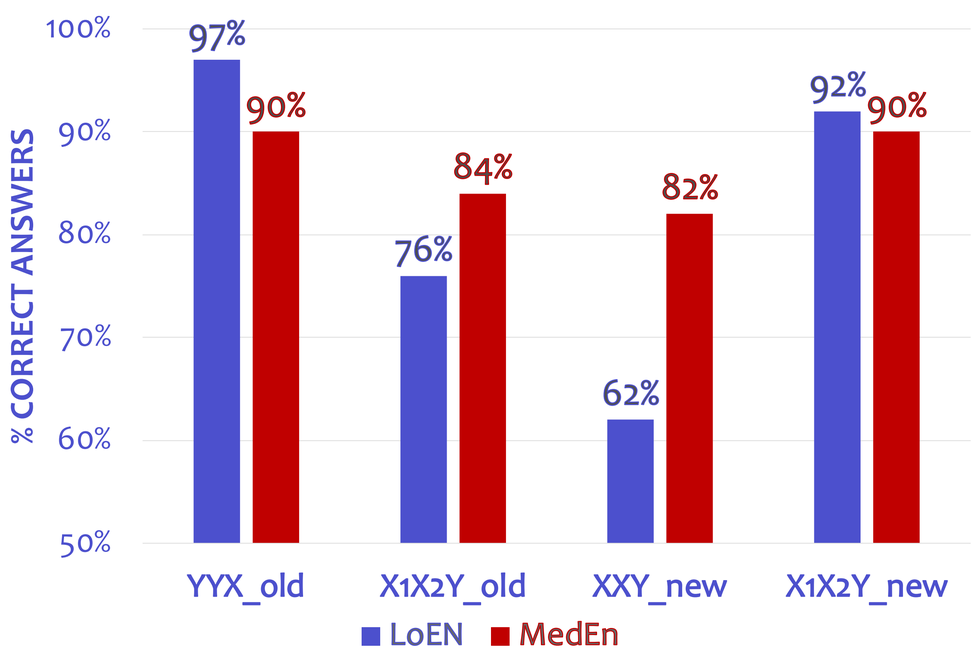
- 51 adults (age 19-44)
- 3-syllable XXY: *daa_daa_lie*
- **Medium Entropy: 2*14 X/2*14 Y (4.2 bits)**

Test ("Could this string be possible in the language that you heard?")

- **YYX_trained_syllables: lie_lie_daa √**
- X_1X_2Y_new_syllables: reu_loo_gee *
- XXY_new_syllables: too_too_suu √
- X_1X_2Y _trained_syllables: teu_duu_saa *



Results Linear Mixed Effects Model. Covariates in the model: 3 independent tasks: Forward Digit Span, Incidental Memorization Task, Raven's Standard Progressive Matrices.



Discussion Rule learning is a phased mechanism that starts out by memorizing specific items and finding regularities between them (*item-bound generalizations*) and gradually moves to an abstract *category-based* encoding, as a function of increasing input entropy.

Conclusions
If input entropy increases, the tendency to generalize increases gradually. Less *input complexity (entropy)* facilitates finding regularities between specific items, i.e. item-bound generalization, while a higher complexity exceeding *channel capacity* drives category-based generalization.

References

Aslin, R.N., and Newport, E. (2012). Statistical learning: From acquiring specific items to forming general rules. *Current Directions in Psychological Science*, 21, 170–176.
Gómez, R.L. & Gerken, L.A. (2000). Infant artificial language learning and language acquisition. *Trends in Cognitive Sciences* 4, 178–186.
Marcus, G. F., Vijayan, S., Rao, S. B., & Vishton, P. M. (1999). Rule learning by seven-month-old infants. *Science*, 283, 77–80.