Construction learning relies on usage and function
An artificial language learning study

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Usage-based linguistics

• Grammar emerges from usage
• Language acquisition is input-driven
• Speakers are sensitive to statistical information
A wealth of evidence

• Word segmentation can be learned from transitional probabilities (Saffran et al. 1996; Estes et al. 2007)

• Frequent strings of words are processed faster (Arnon & Snider 2010; Gathercole & Baddeley 1993)

• Artificial language learning studies (Hudson Kam & Newport 2005; Wonnacott et al. 2008)
Artificial language learning studies

• “Made-up” language taught to participants with scene-sentence pairs

• The statistical structure of the input can be manipulated, different inputs given to different groups

• Test the role of statistics in language learning
Wonnacott et al. (2008)

• Two constructions with same meaning
  – “Verb Agent Patient” (VSO)
  – “Verb Patient Agent ła” (VOS-ła)

• Distribution varied across conditions
  – Some verbs occur only in either VSO or VOS-ła
  – Some verbs alternate, i.e., they occur in both
Wonnacott et al. (2008)

• Learners depended on the statistics in the input:
  – “Lexicalist” input condition:
    No verb alternated $\rightarrow$ conservative behavior
  – “Alternating” input condition:
    All verbs alternated $\rightarrow$ fully productive behavior
  – 33% of verbs alternate in input condition:
    Partially general and partially lexically specific behavior.
Statistics in language learning

• Does language learning only consist of gleaning statistical regularities in the input?

• There are learning biases
  – Communicative (Piantadosi et al. 2012)
  – Cognitive: working memory (Gathercole & Baddeley 1993), inductive processes (Griffiths et al. 2010)

• What about the function of constructions themselves?
Our experiment

- Similar to Wonnacott et al.’s but more ecologically valid
  - Their constructions are interchangeable: atypical situation
  - Difference in form often corresponds to some difference in function (Bolinger 1968; Goldberg 1995)
  - E.g., information structure in the dative alternation (cf. Bresnan et al. 2007)

  She gave him a book          She gave it to the boy.

  ?She gave a book to him.      *She gave the boy it.

- We use constructions with a difference in function

- How does this interact with usage?
Our experiment

- Two word order constructions: SOV and OSV
- Difference in information structure:
  
  OSV order used exclusively with pronouns

  ‘the panda$_{agent}$ pushed the pig$_{patient}$’ intended meaning
  the panda the pig mooped SOV
  him the panda mooped ProSV

- Six novel verbs (e.g., *glim*, *moop*, *wub*) referring to transitive actions (e.g., ‘punch’, ‘push’, ‘head-butt’)


Our experiment

• Two test conditions
  – Lexicalist condition: 3 SOV-only, 3 ProSV-only verbs
  – (Partially) Alternating condition: 2 SOV-only, 2 ProSV-only, 2 alternating verbs

• A third “control” condition (same-meaning condition)
  – Same as lexicalist, but without the difference in information structure (no pronouns)
  – To replicate Wonnacott et al. and check that speakers are able to learn verb-specific behavior
Example of exposure pair

the rabbit the panda norped
Procedure

• Exposure (2 days)
  – 36 sentence-scene pairs, each verb used 6 times
  – Participants asked to repeat each sentence

• Sentence production task
  – Participants asked to describe new scenes with learned novel verbs.
  – Interspersed with distractor tasks (vocabulary questions, forced-choice sentence comprehension)

• Sentence rating task (not reported here; consistent with production)
Production task

• Different questions used to elicit pronouns
  – “What happened here?”: neutral context
  – “What happened to the <patient>?”: elicits the use of a pronoun for the patient argument

• Two trials per verb, one in each context
Example of production trial (neutral context)

what happened here?
Example of production trial (biasing context)

what happened to the panda?
Participants

- 64 Princeton undergrads, aged 18-22
  - 24 in the lexicalist condition
  - 18 in the “alternating” condition (2/6 verbs alternate)
  - 12 in the control, same-meaning lexicalist condition
Results

• To what extent do speakers generalize constructions to unattested verbs?

• Hypothetical data: conservative, verb-based behavior
Results

• To what extent do speakers generalize constructions to unattested verbs?

• Hypothetical data: full generalization across verbs
Results: alternating vs. lexicalist condition

Alternating condition: two alternating verbs

Lexicalist condition: no alternating verbs

Verb-based conservativeness

Full generalization
Mixed effects logistic regression

SOV ~ Bias + VerbType * Condition + (1 | Subject) + (1 | Verb) + (1 | Meaning)

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<th>Estimate</th>
<th>Std. error</th>
<th>z-value</th>
<th>p-value</th>
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<td>(Intercept)</td>
<td>3.1838</td>
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<td>2.0295</td>
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- Main effect of Bias: responses are context-dependent in both conditions
- Interaction between Condition and VerbType: the (conservative) effect of verb type is specific to the lexicalist condition
Results: lexicalist vs. same-meaning

Lexicalist: no alternating verbs, different functions

SOV–only verbs

ProSV–only verbs

Same-meaning: no alternating verbs, same function

OSV–only verbs

Verb-based conservativeness

Full generalization
Mixed effects logistic regression

SOV ~ Bias * Condition + VerbType * Condition + (1 | Subject) + (1 | Verb) + (1 | Meaning)

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- Condition interacts with both Bias and VerbType
- No effect of context in the same-meaning condition
- Effect of VerbType stronger in same-meaning than in lexicalist condition
Summary

• Tendency for participants to generalize
  – Viz. to use verbs in the contextually appropriate construction
  – They may ignore usage of individual verbs

• This tendency interacts with the input
  – Alternating verbs promote productivity, as in Wonnacott et al.
  – But here: full generalization with only 1/3 alternating verbs

• Sentence rating results in line with production data

Cf. Perek & Goldberg (R&R at JML)
Conclusion

• There is indeed an interaction between usage and the function of constructions

• Refinement of the usage-based hypothesis
  – Statistical information is essential to learn both item-specific patterns and general constructions
  – But the communicative functions of constructions determine which dimensions of similarity are relevant to generalizations
  – Item-based constraints are less relevant when other dimension is available
Thanks for your attention!
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