The role of variability in linguistic generalization: evidence from a computerized language training game with 7-year-olds

Elizabeth Wonnacott, Maša Vujović & Chantal Miller
University College London

Hypothesis: Generalization is promoted by exposure to more varied exemplars, since this allows structures to be **disassociated from trained instances.**

We find evidence for this in a language training study with 7 year olds.

Training Input

Japanese spatial postpositions

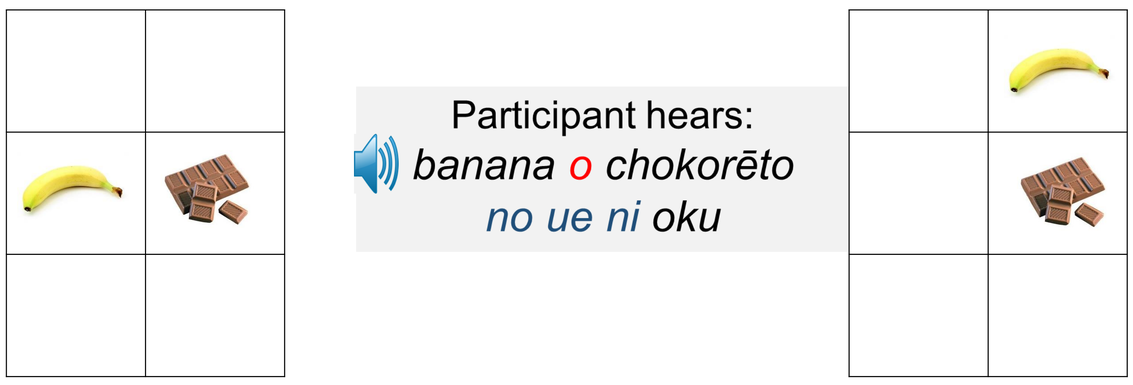
"above" sentence	*banana o chokorēto no ue ni oku* object case-marker · ABOVE · oku = put "Put the banana above the chocolate"
"below" sentence	*banana o chokorēto no shita ni oku* object case-marker · BELOW · oku = put "Put the banana below the chocolate"

High variability (HV) exemplars:
28 unique "above" sentences, 28 unique "below" sentences

Low variability (LV) exemplars:
2 (repeated*14) "above" sentences, 2 "below" sentences
each sentence had two unique nouns (8)

- HV & LV matched for: total exposure (56) & numb nouns (8)
- All nouns are **ENGLISH COGNATES**

Computerized training game



- All stimuli produce by native speaker
- Participants receive FEEDBACK as to whether response is correct.

Participants

- HV: 44; LV 42 7-8 year olds- tested individually in schools
- Native English speakers, no prior knowledge of Japanese or other postpositional language

Procedure

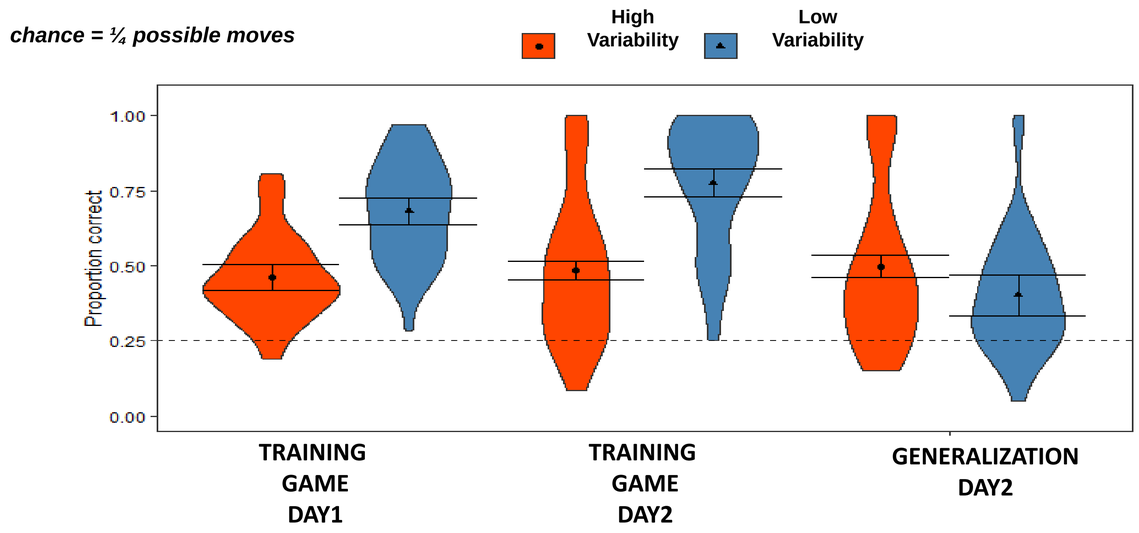
- Exposed to language by playing the game over two sessions (no instruction)
- Data collected during training
- **Generalization test at the end of day 2:** play the game with **NOVEL NOUNS (more cognates)** and NO FEEDBACK

Modelling

- NDL model (Baayen et al., 2011; Ramscar et al. 2010) with a discriminative implementation of the delta rule (Widrow & Hoff, 1960)
- CUES (10) : 8 nouns + ABOVE/BELOW,
- OUTCOMES (2)**:** noueni + shitani
- Trained using the same two input sets as human children

References
Baayen, R. H., et al. (2011). An amorphous model for morphological processing in visual comprehension based on naive discriminative learning. *Psychological review*, *118*(3), 438.; Training understanding of reversible sentences: a study comparing language-impaired children with age-matched and grammar-matched controls. PeerJ, 2, e656; Ramscar, M., et al. (2010). The effects of feature-label-order and their implications for symbolic learning. *Cognitive science*, *34*(6), 909-957; Wonnacott, E., et al. (2012). Input effects on the acquisition of a novel phrasal construction in 5 year olds. *Journal of Memory and Language*, *66*(3), 458-478.;

Findings

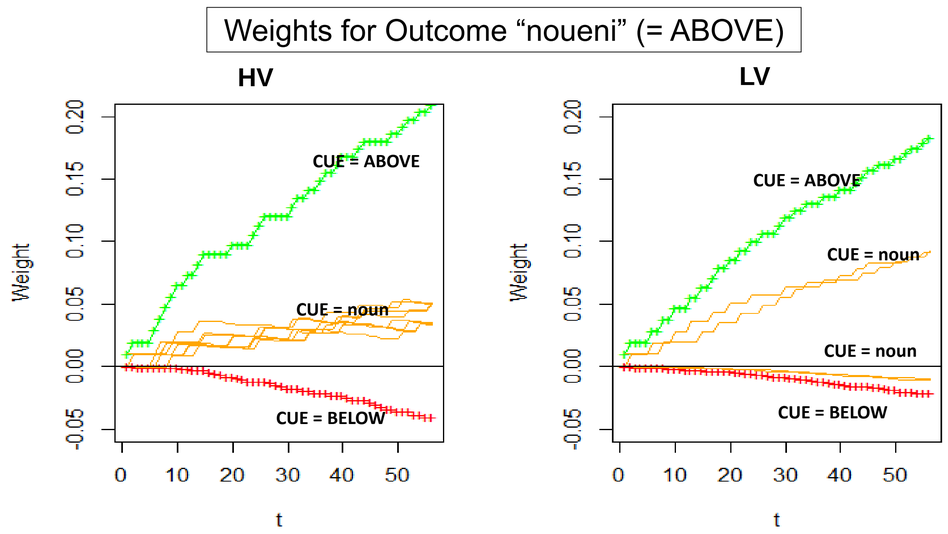


DURING EXPOSURE:
LV > HV (*BF* > 10)
(repetition makes it easier!)

AT TEST:
HV > LV (*BF* = 4.5)
variability promoted generalization

- Breaking down error types: LV participants show poor learning of semantics post-position semantics- i.e. that noueni = ABOVE, noshitani = BELOW
- HV participants show strong correlation between performance in training performance at test (r=.8); LV participant do not (r=.007)

Computational Model



Slower learning of correct semantics for post-position in LV condition due to lesser dissociation with highly associated nouns.

Further Ongoing and Planned Research

ONGOING (so far, N=19): Skewed condition: like HV input, but with 2 high F, repeated exemplars per postposition.

- Will repeated exposure to a subset of instances in skew aid generalization (Hsu & Bishop 2014)?

PLANNED: Experiment comparing HV/LV input given exposure with mixed NP order (i.e. as in natural Japanese)?

- Will 7year olds manage this more difficulty task and still show HV advantage?

PLANNED: Experiment with the two possible word orders with variability manipulated across the whole utterance.

- Will participants show weaker learning of meaning of the post-positions given an input set where the meaning of the utterance can always be discriminated *before* the post-position is encountered (=strong test of discrimination learning account)