Free variation learning in syntax and in phonology

Youngah Do, Jonathan Havenhill, and Samuel Sui Lung Sze
The University of Hong Kong

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Learning biases and typology

- Hypothesis: Typology reflect *learning biases*.
  - Learning biases: (a) learners better acquire vowel harmony than vowel disharmony, (b) due to phonetic support for the former and (c) such 'learning bias' is reflected in languages.
- Prediction: typologically better attested patterns are also learned better.
- Empirical support for the link between learning biases and typology
  - Syntax (e.g., Hudson Kam & Newport, 2005, 2009)
  - Phonology (See Moreton & Pater, 2012a,b for a review; more recent reviews in Glewee, 2019 and Lysvik, 2020).
- Some studies tested this prediction in variation learning.

Morphosyntactic variation learning

- Learning of morphosyntactic variation (Culbertson & Newport, 2015; Kam & Newport, 2005, 2009; Schuler et al.,2016; Singleton & Newport, 2004).

- Typologically: Harmonic > Non-harmonic word order

Table 1
Distribution of languages which (predominantly) use each combination of noun, adjective and noun, numeral ordering in the WALS sample.

	Adjective-Noun	Noun-Adjective
Numeral-Noun	227 (27%)	149 (17%)
Noun-Numeral	32 (4%)	443 (52%)

Harmonic

Non-Harmonic

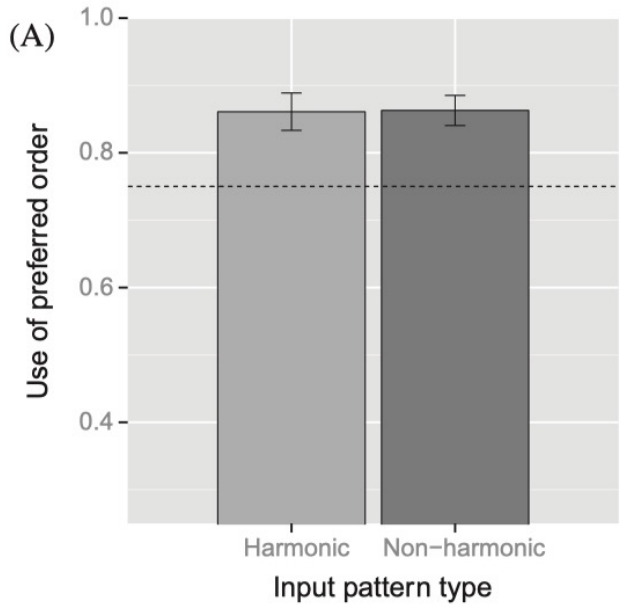
Non-Harmonic

Harmonic

Culbertson et al. 2012, *Cognition*

Morphosyntactic variation learning

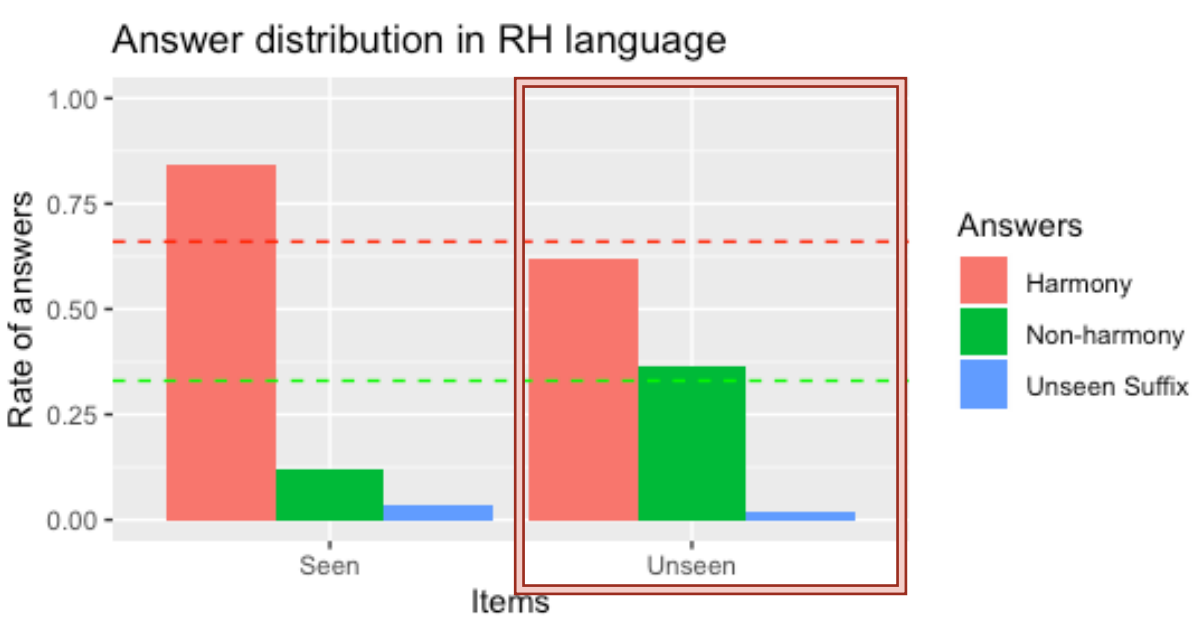
- When exposed to a language with a variation of harmonic vs. non-harmonic word order, children chose harmonic pattern and regularized a system.

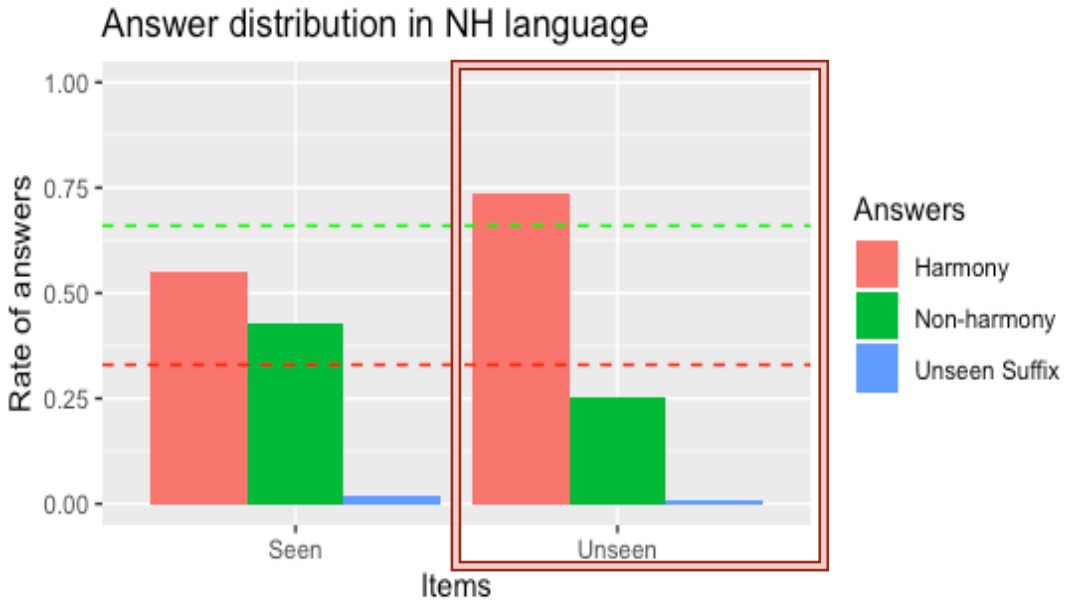


Culbertson & Newport (2015, *Cognition*, p.78)

Phonological variation learning

- Do & Mooney (2021) tested the learning of free variation of rounding harmony among preschoolers.
- Children's subsequent production reversed the pattern so that harmony predominates.





Syntactic vs. phonological variation learning

- In both domains, children tended to reproduce natural variants.
- Syntactic vs. Phonological
  - Studies testing morphosyntactic variation learning showed that children *regularized* languages.
  - In the phonological learning study (although evidence is limited), children *modulated* the variants' distribution.
- Where do the discrepancies between syntactic and phonological variation learning come from?
- No study compared syntactic vs. phonological variation learning controlling for structural complexity.

Learners (participants)

- 76 Hong Kong Cantonese native speaking preschoolers
  - mean age = 5;6, age range = 5;01-6;11 (K1, K2, & K3)
  - Participants' dominant language: HK Cantonese
  - Parents' dominant language: HK Cantonese
  - English as a second language, learned 2-5 hours / week at local kindergartens.

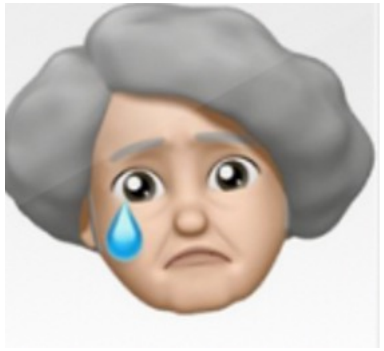
Artificial languages

	Categorical	Variable
Syntactic (Gender agreement)	le miko (mas.) ~ lo pita (fem.)	le (67%) ~lo (33%) (mas.) ~ lo~le (fem.)
Phonological (Rounding agreement)	le miko ([-round]) ~ lo nuta ([+round])	le ~lo ([-round]) ~ lo~le ([+round])

- Neither gender agreement nor rounding agreement is attested in HK Cantonese.

Design and stimuli

- 4 of CV.CV kinship terms (2 masculine, 2 feminine) were introduced, e.g., miko ‘brother’ vs. pita ‘sister’.
- Each noun was presented with 6 preceding CV adjectives denoting emotion, e.g., le ~ lo ‘happy’.
- 3 learning repetitions, totalling up 72 trials (4 kinship terms x 6 emotions x 3 learnings).
  - ‘happy’ → le miko ‘happy brother’ vs. lo pita ‘happy sister’




Testing

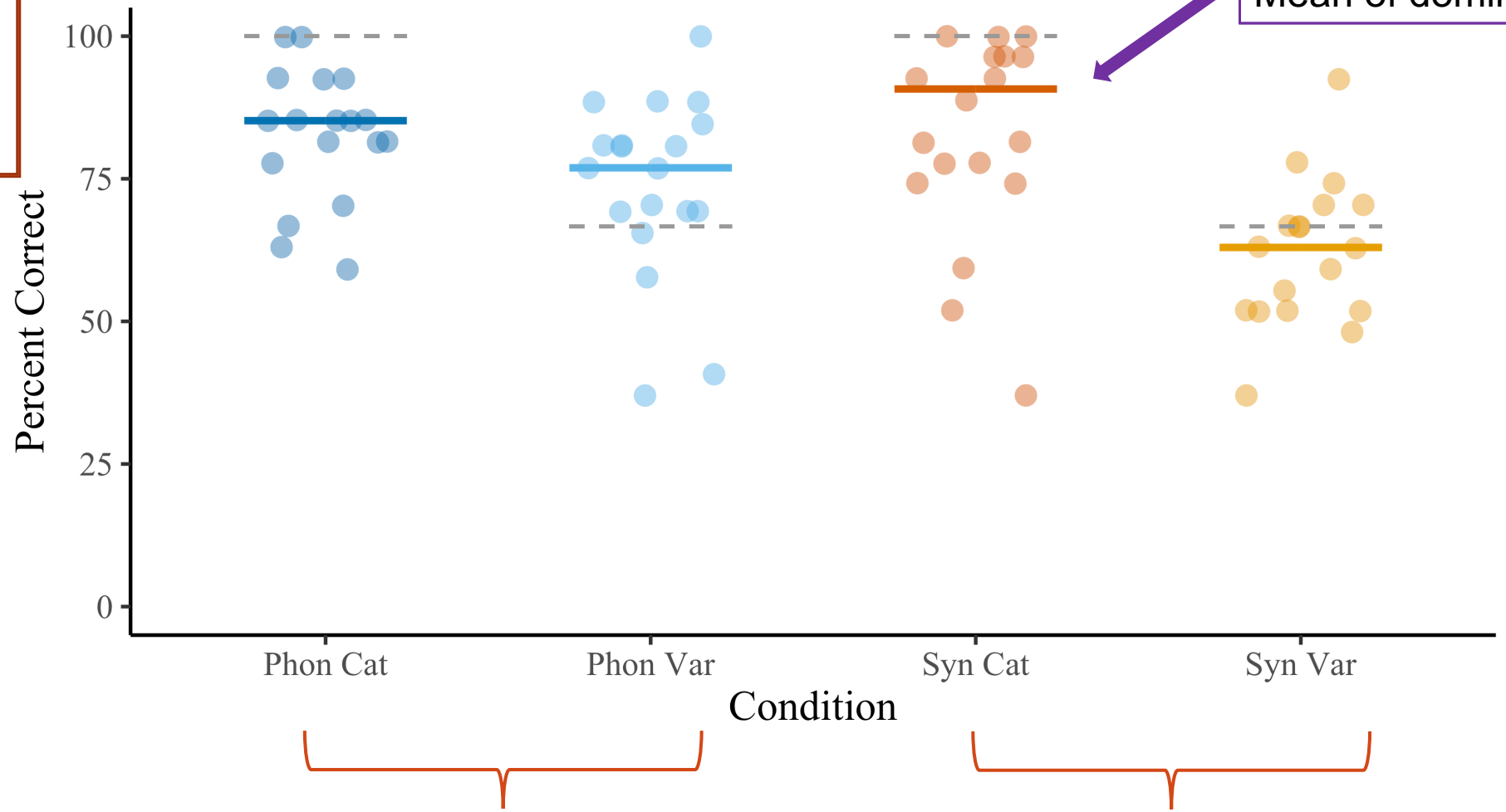
- 6 trained items (2 trained nouns x 3 trained adjectives)
- 24 novel items (4 novel nouns x 6 trained adjectives)
- A two-alternative forced choice test
- Test 1 tested the acquisition of the meanings of the kinship terms
  - ‘le miko’ vs. ‘le pita’ for happy brother
- Test 2 tested the learning of agreement
  - ‘le kuno’ vs. ‘lo kuno’ for happy grandma
- The control group – preference checking with no training
  - 50.0% choices for agreeing and for disagreeing patterns, showing no a priori bias.

Agreement learning results (Test 2)

Input proportion of a dominant pattern

Mean of dominant pattern choices

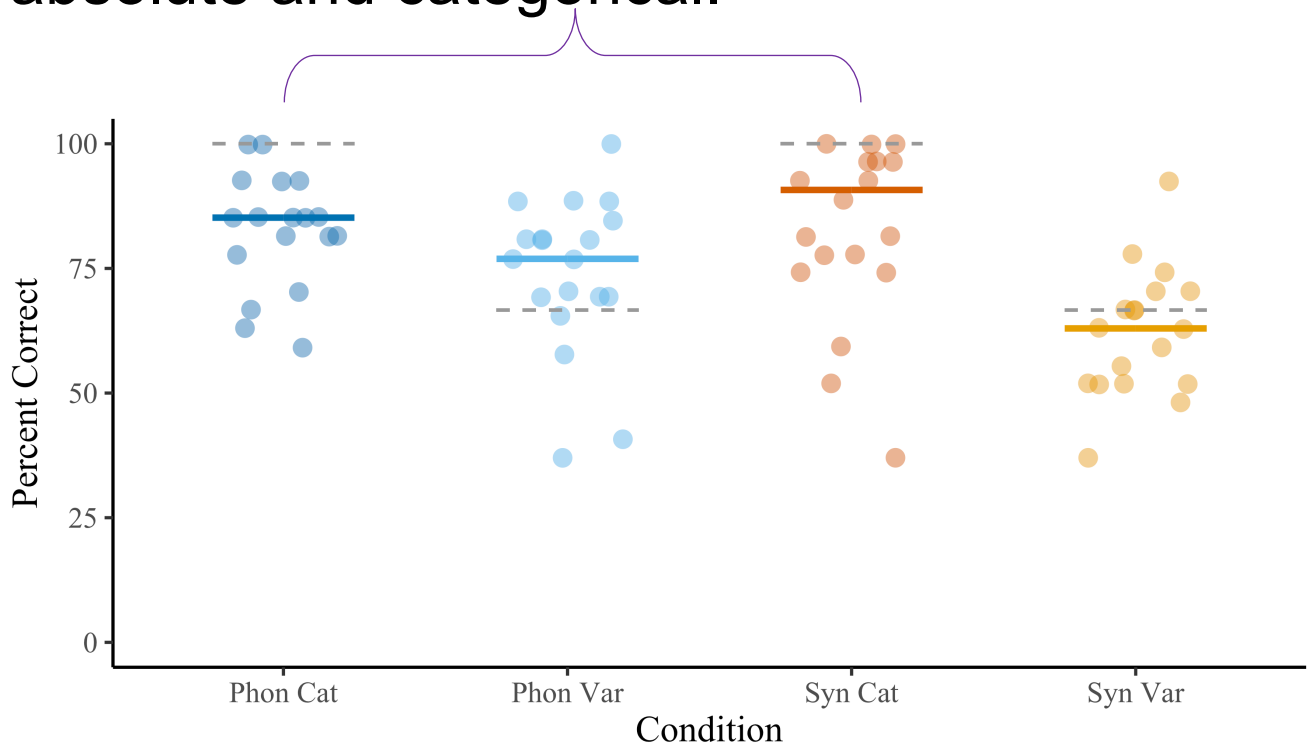
Choices of dominant patterns



Categorical learning

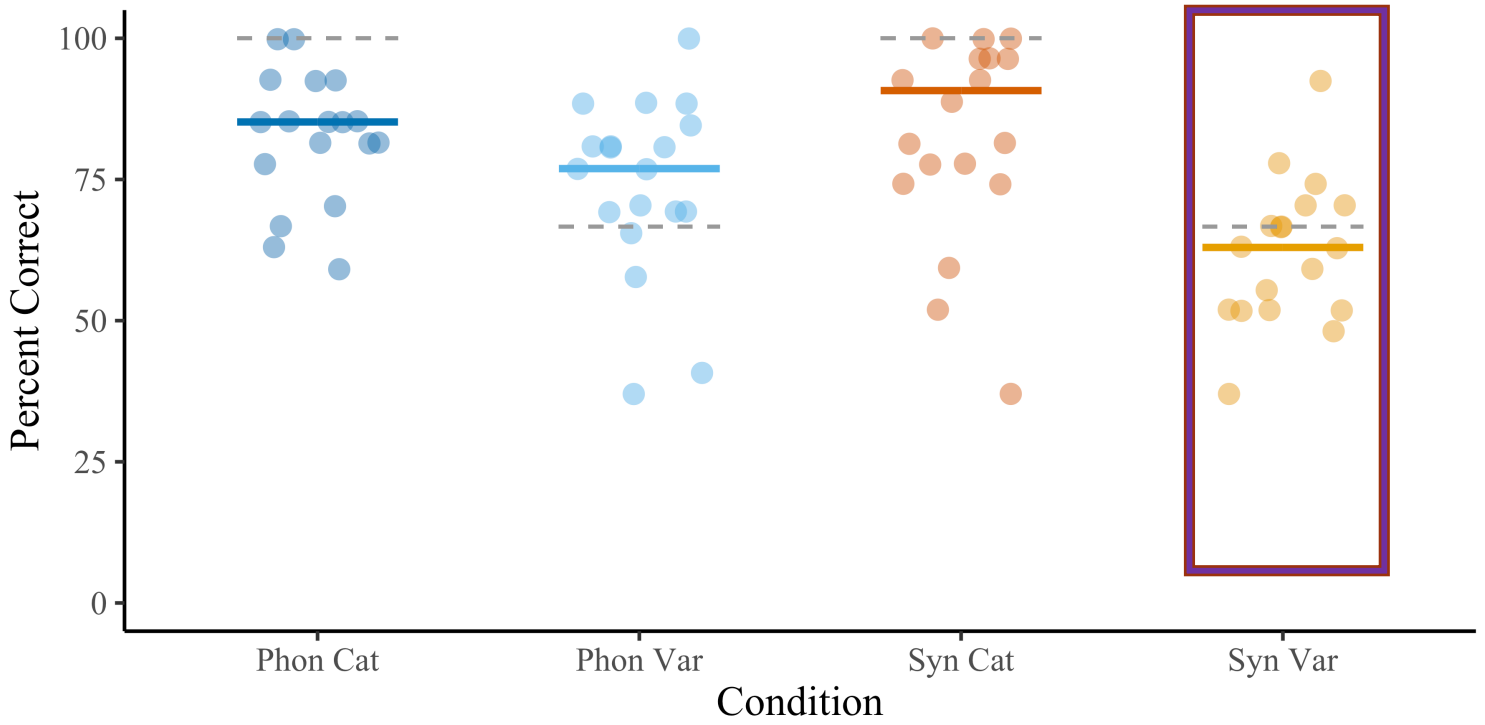
- Median in phonology (85.2%) vs. in syntax (90.7%) is not significantly different ($p < .05$).

- Both syntactic and phonological patterns are learned equally, so far as the patterns are shown absolute and categorical.



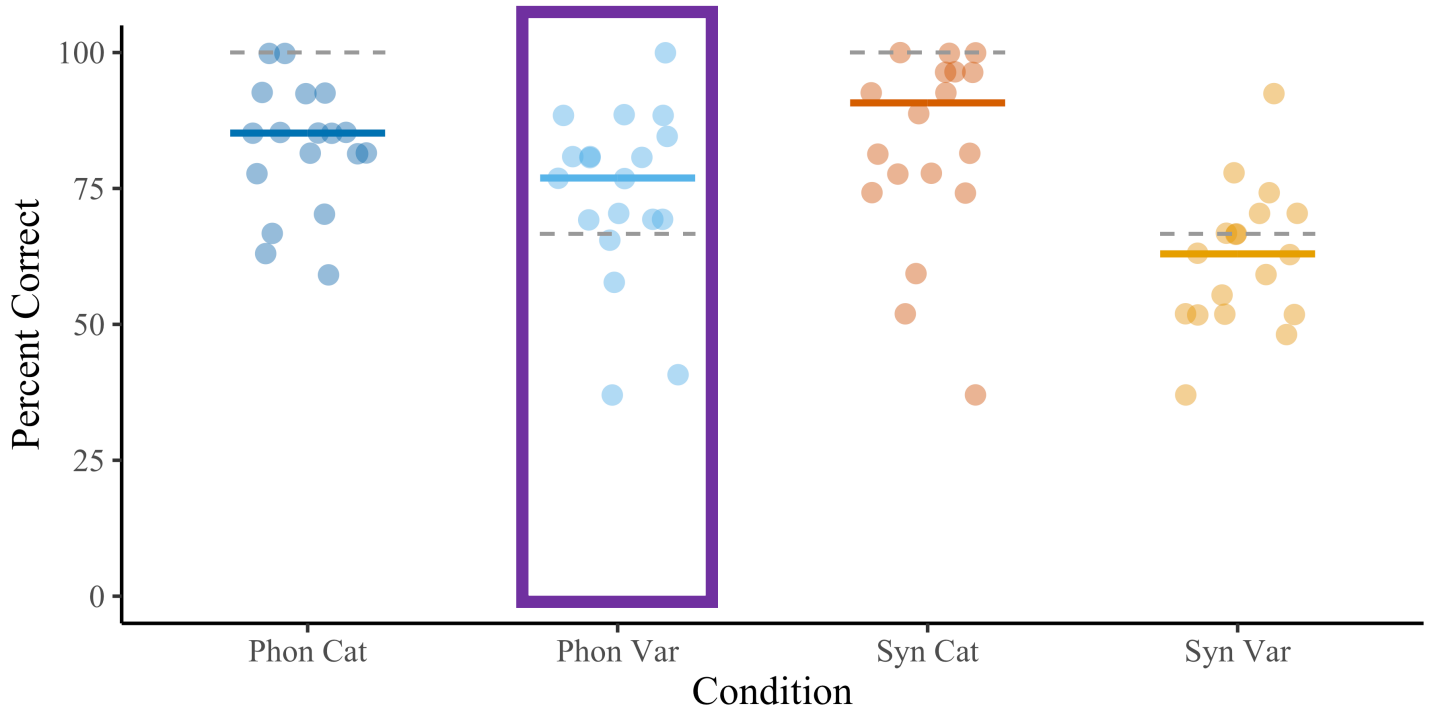
Learning of syntactic variation

- Participants applied gender agreement slightly below the rate of exposure (63% with 67% exposure; p > .05).



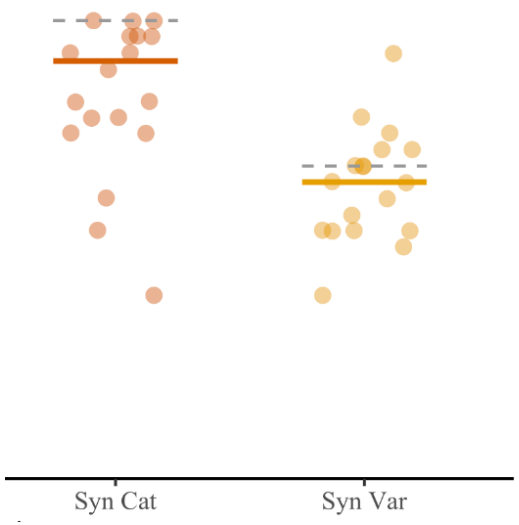
Learning of phonological variation

- The rounding rate was lower than the categorical condition but nevertheless exceeded the rate of exposure to rounding agreement in training (76.9% accuracy with 67% exposure; $p < .05$).

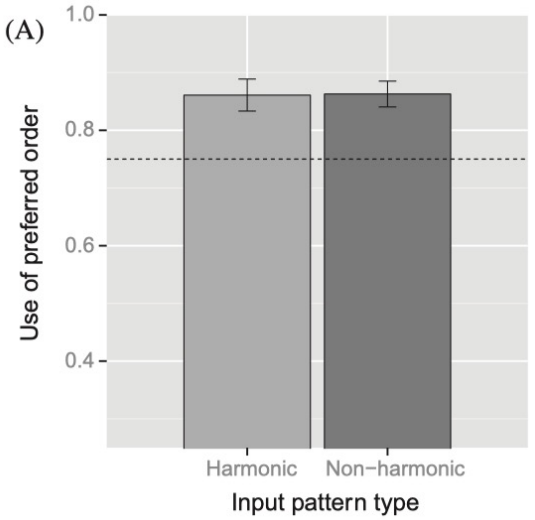


Syntactic variation learning: failure?

- The current result is opposite to what's been reported.
  - Current study: statistical learning of variable distribution.
  - Previous studies: regularization of a system, without reflecting proportional distribution of variables.



vs.



L1 effect and variation learning

- The target pattern in the current study: a novel syntactic pattern, i.e., gender agreement is novel to HK Cantonese speakers.
- Target patterns in previous studies: existing syntactic patterns, e.g., word order.
- Speculation: the non-existence of a syntactic pattern makes learners highly sensitive to detailed proportional properties (variation) found in a language?
- Crucially, there seems to be no biased redistribution of variables in syntactic learning.

Biased learning of phonological variation

- Phonological variation learning is biased toward a natural variant.
- Phonological properties in linguistic input are inherently more variable than its syntactic properties.
- Due to such high level of variability, learners are exposed more to phonologically (un)natural variables, enhancing their sensitivity to phonological (un)naturalness.
- As a result, naturalness-based learning bias, or substantive bias, becomes more active when learning proportional distribution of phonological variables than syntactic variables.

Youngah Do, Jonathan Havenhill, and Samuel Sui Lung Sze
{youngah, jhavenhill, u3564255} @hku.hk

for slides and/or references, please contact us.