The emergent typology of reduplication: Universals and variations in learning biases.

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1. Summary

Big picture questions

- What are the **analytic biases** (e.g., Wilson, 2006; Moreton and Pater, 2012) that guide (morpho)phonological learning?
- How do these biases reflect natural language **typology** (e.g. Moreton, 2008)?

Artificial grammar learning experiments with reduplication

When reduplicative patterns are only observed in relatively short forms
e.g., monosyllabic copying ['pif] ∼ ['pifpif] or ['pif] ∼ ['pipif]

- On what levels of **phonological abstraction** (e.g., syllables, feet, or prosodic words) are human learners biased to form reduplicative generalizations?
- What does the **hypothesis space** for a human learner look like given the input?

Findings and takeaway

- Human learners generalize in a manner that is sensitive to phonological abstractions characterizable **by the vocabulary of prosody**
  ↪ support for the Prosodic Morphology (McCarthy and Prince, 1986)

  Participants were guided by other theoretically grounded principles (see paper)
- **Spontaneous responses appeared to reflect the reduplicative typology.**
  - the most frequent forms were consistent with the typological trends
  - the variations in individually biased grammars reflected the attested variations.

2. The reduplicative typology

Cross-linguistic variation along many crucial dimensions (e.g., Inkelas and Downing, 2015)

- Dimension I: the phonological shape (i.e., how much to copy)
  1. Total (Indonesian; Austronesian; McCarthy and Cohn, 1998)

     bu.ku ∼ bu.ku-bu.ku *'book'* *'book-PL'*

     ma.ša.ra.kat ∼ ma.ša.ra.kat-ma.ša.ra.kat *'society'* *'society-PL'*
  2. Partial
     1. A bisyllabic foot (Diyari; Pama-Nyungan; Austin, 1981)

        pir.ta ∼ pir.ta-pir.ta *'tree'* *'DIM- tree'*

        wil.ha.pi.na wil.ha-wil.ha.pi.na *'old woman'* *'DIM-old woman'*
     2. A heavy syllable (Ilokano; Austronesian; Hayes and Abad, 1989)

        kut.tóŋ ∼ naka-kut-kut.tóŋ *'thin'* *'ADJ-INTENS-thin'*

        bu.téŋ ∼ naka-but-bu.téŋ *'afraid'* *'ADJ-INTENS-afraid'*
     3. A light syllable (Tonkawa; Coahuiltecan; Gouskova, 2007)

        to.po s ∼ to-to.po s *'I cut it'* *'REP-I cut it'*

        xej.tso s ∼ xe-xej.tso s *'I rub him'* *'REP-I rub him'*
  3. Infixation (Samoan; Austronesian; Broselow and McCarthy, 1983)

     alófa ∼ a-lo-lófa *'love'* *'love-PL'*

     saváli ∼ sa-va-váli *'walk'* *'walk-PL'*
- Dimension II: which part of the stem is copied if partially reduplicated
  1. Left-edge oriented (see above)
  2. Right-edge oriented (Manam; Austronesian; Lichtenberk, 1983)

     salaga ∼ salaga-laga *'be long'* *'long-SG'*

     sapara ∼ sapara-para *'branch'* *'having branches'*
  3. Infixation (Samoan; Austronesian; Broselow and McCarthy, 1983)

     alófa ∼ a-lo-lófa *'love'* *'love-PL'*

     saváli ∼ sa-va-váli *'walk'* *'walk-PL'*
- Other possible variations
  1. Vowel reduction (Palauan; Austronesian; Zuraw, 2002)

     tóɾð ∼ bəkə-təɾ-tóɾð *''frustration''* *'easily frustrated'*
  2. Templatic back-copying (?) (Guarijio; Uto-Aztecan; Austronesian; Caballero, 2006)

     toní ∼ to-tó *'to boil'* *'to start boiling'*

     muhíba ∼ mu-mú *'to throw'* *'to start throwing'*

*See the draft of the paper for more details!

3. Experiment

Poverty of the stimulus paradigm (Wilson, 2006 *et seq.*)

Participants: Engish speakers recruited from Prolific ($N_1 = 144$; $N_2 = 105$)

Familiarization: auditory input, no orthographic help

Listen to the singular.
Expt. 1 + 2: ['pif]

Listen to the plural.
Expt. 1:['pifpif] **Expt. 2:**['pipif]

- Four pairs of base and reduplicated forms
- Bases are all monosyllabic $C_1V_2C_3$ forms (e.g.,['pif]) with variegated segment choices
  - Expt. 1: reduplicant is $C_1V_2C_3$ (e.g.,['pifpif]) Expt. 2: reduplicant is C_1V_2 (e.g.,['pipif])

Testing: auditory input, free spontaneous production responses

Testing types	*Shapes*	*Examples*	*# Seg.*	*# σ*
FAMILIAR	$_{\sigma}C_1V_2C_3$	['noʊg]	3	1
DISYLLABIC CV	$_{\sigma}C_1V_2.C_3V_4C_5$	['ti.kɐp]	5	2
DISYLLABIC CVC	$_{\sigma}C_1V_2C_3.C_4V_5C_6$	['dɛb.gɪv]	6	2
TRISYLLABIC	$_{\sigma}C_1V_2.C_3V_4.C_5V_6C_7$	['ti.fæ.pəs]	7	3
PENTASYLLABIC	$_{\sigma}C_1V_2.C_3V_4.C_5V_6.C_7V_8.C_9V_{10}C_{11}$	[ˌpi.sæ.'goʊ.bɛ.kʊt]	11	5

- Four trials for each of the five testing types (20 trials in total); tested together, order randomized

Possible hypotheses: Expt. 1

Hypothesis	DISYLLABIC CV ['ti.kɐp]	DISYLLABIC CVC ['dɛb.gɪv]	TRISYLLABIC ['ti.fæ.pəs]	PENTASYLLABIC [ˌpi.sæ.'goʊ.bɛ.kʊt]
total	**'ti.kɐp**-'ti.kɐp	**'dɛb.gɪv**-'dɛb.gɪv	**'ti.fæ.pəs**-'ti.fæ.pəs	**ˌpi.sæ.'goʊ.bɛ.kʊt**-ˌpi.sæ.'goʊ.bɛ.kʊt
$_{wd}$[FT	**'tik**/**'tikɛ**-'ti.kɐp	**'dɛb**/**'dɛb.gɪ**-'dɛb.gɪv	**'tif**/**'tifæ**-'ti.fæ.pəs	**ˌpis**/**ˌpisæ**-ˌpi.sæ.'goʊ.bɛ.kʊt
$_{wd}[\sigma_{\mu\mu}$	**tik**-'ti.kɐp	**dɛb**-'dɛb.gɪv	**tif**-'ti.fæ.pəs	**pis**-ˌpi.sæ.'goʊ.bɛ.kʊt
$\sigma_{\mu\mu}]_{wd}$	'ti.kɐp-**kɐp**	'dɛb.gɪv-**gɪv**	'ti.fæ.pəs-**pəs**	ˌpi.sæ.'goʊ.bɛ.kʊt-**kʊt**
$'\sigma_{\mu\mu}$	**tik**-'ti.kɐp	**dɛb**-'dɛb.gɪv	**tif**-'ti.fæ.pəs	ˌpi.sæ.-**goʊb**-'goʊ.bɛ.kʊt

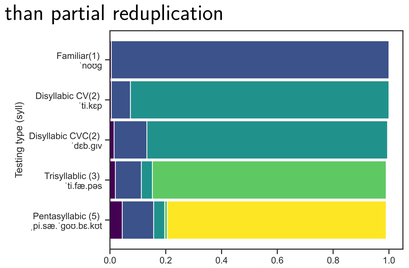
Possible hypotheses: Expt. 2

Hypothesis	DISYLLABIC CV ['ti.kɐp]	DISYLLABIC CVC ['dɛb.gɪv]	TRISYLLABIC ['ti.fæ.pəs]	PENTASYLLABIC [ˌpi.sæ.'goʊ.bɛ.kʊt]
WD + NOFINALCODA	**'ti.kɐ**-'ti.kɐp	**'dɛb.gɪ**-'dɛb.gɪv	**'ti.fæ.pə**-'ti.fæ.pəs	**ˌpi.sæ.'goʊ.bɛ.kʊ**-ˌpi.sæ.'goʊ.bɛ.kʊt
$_{wd}$[FT+NOCODA	**'ti.kɐ**-'ti.kɐp	**'dɛb.gɪ**-'dɛb.gɪv	**'ti.fæ**-'ti.fæ.pəs	**ˌpi.sæ**-ˌpi.sæ.'goʊ.bɛ.kʊt
$_{wd}[\sigma_{\mu}$	**ti**-'ti.kɐp	**dɛ**-'dɛb.gɪv	**ti**-'ti.fæ.pəs	**pi**-ˌpi.sæ.'goʊ.bɛ.kʊt
$\sigma_{\mu}]_{wd}$	'ti-**kɐ**-kɐp	'dɛb-**gɪ**-gɪv	'ti.fæ.-**pə**-pəs	ˌpi.sæ.'goʊ.bɛ-**kʊ**-kʊt
$'\sigma_{\mu}$	**ti**-'ti.kɐp	**dɛ**-'dɛb.gɪv	**ti**-'ti.fæ.pəs	ˌpi.sæ-**goʊ**-'goʊ.bɛkʊt

4. Results I: the universals

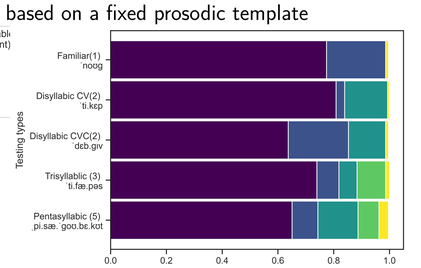
Expt 1: Total reduplication

Typology: total reduplication is more frequent than partial reduplication



Expt 2: fixed light syllable copying with more variations

Typology: partial reduplication is characterized based on a fixed prosodic template



*Figures: the averaged proportion of affix shape conditioned on testing type

*The most frequent shapes were verified by Bayesian mixed multinomial logistic regression with by-subject random effects.

5. Results II: the individual variations

Expt. 1: example individual grammars

- **word-final heavy syllable copying** (to a varying degree, N = 15)

  'zi.vɪb 'zi.vɪb-vɪb
  'tɛf.kʊp 'tɛf.kʊp-kʊp
  'gɑ.və.dus 'gɑ.və.dus-dus
  pi.sæ.'goʊ.bæ.kʊt pi.sæ.'goʊ.bæ.kʊt-kʊt
- **Templatic Backcopying** (to a varying degree, N = 3)

  'gɑ.və.dus 'gɑv-gɑv
  pi.sæ.'goʊ.bæ.kʊt 'pis-pis (3/4 for one participant)

Expt. 2: example individual grammars

- **Bisyllabic trochaic foot copying**: (N = 10)

  ˌpi.sæ.'goʊ.bæ.kʊt ˌpi.sæ-ˌpi.sæ.'goʊ.bæ.kʊt
- **Total + No word final coda** (N = 2, all categorical)

  'zi.vɪb 'zi.vɪ-'zi.vɪb
  'tɛf.kʊp 'tɛf.kʊ-'tɛf.kʊp
  'gɑ.və.dus 'gɑ.və.du-'gɑ.və.dus
  ˌpi.sæ.'goʊ.bæ.kʊt ˌpi.sæ.'goʊ.bæ.kʊ-ˌpi.sæ.'goʊ.bæ.kʊt
- **Infixation** (to a varying degree, N = 14)

  ˌpi.sæ.'goʊ.bæ.kʊt ˌpi.sæ.-ˌgou.bæ-'goʊ.bæ.kʊt
- **Vowel reduction** (to a varying degree, N = 20)

  'zi.vɪb zə-'zi.vɪb
  'tɛf.kʊp tə-'tɛf.kʊp
  'gɑ.və.dus gə-'gɑ.və.dus
  ˌpi.sæ.'goʊ.bæ.kʊt pə-ˌpi.sæ.'goʊ.bæ.kʊt

*For more detailed investigations on the individual variations, see the draft of the paper.

6. Discussions

- Human learners generalize reduplicative patterns in a manner that is sensitive to phonological abstractions characterizable by the vocabulary of the **prosody**.
- The **systematicity** in participants' responses → the possibility of the *poverty of stimulus* design as a **sampler** of the learner's hypothesis space conditioned on the input, at least for reduplication learning.
- The **diversity** of possible linguistic structures may also have its root in learning, reflected by the great variety of possible analyses ***individual*** human learners are biased towards.

7. Future directions

- A **large-scale corpus** of AGL experiments as a benchmark for **quantitative** predictions
- **Computational modeling** to capture the general trends and variations (current work in progress)

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QR code to a dissertation chapter

QR code to this poster (with references).

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