REGULATING THE INTERACTION BETWEEN LEXICAL STATISTICS AND THE GRAMMAR: A NATURALNESS BIAS IN LEARNING WEIGHT

Guilherme D. Garcia ∘ Ball State University ∘ guilhermegarcia.github.io ∘ gdgarcia@bsu.edu

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1. INTRODUCTION

Can speakers acquire subtle phonological patterns in the lexicon?

- Not all patterns learned are in the lexicon/input *(Poverty of the stimulus)*
- Not all patterns in the lexicon/input are learned *(Surfeit of the stimulus)*
  - E.g., Unnatural patterns → harder to learn [1]
- **What if such patterns contradict typology?**
  - **E.g. 1:** Initial-σ faithfulness in English laryngeal alternations [2]: life → lives
    Monosyllables > polysyllables in the lexicon **but** monosyllables ~ polysyllables in wug test
  - **E.g. 2:** Sonority sequencing in Polish (initial clusters) [3]
    Sonority plateaux > sonority rises in the lexicon **but** sonority rises favoured by children
  - **This study:** weight effects on antepenultimate stress in Portuguese:
    negative in the lexicon, **positive** in speakers' grammars

2. PORTUGUESE STRESS

- Trisyllabic window
- Categorical weight: H = heavy, L = light

Traditionally: XH́]$_{Wd}$ else H́X]$_{Wd}$

1. **Final (U)** if σ is heavy *pomár* 'orchard'
2. **Penultimate (PU)** otherwise *macáco* 'monkey'
*3. **Antepenultimate (APU)** *patético* 'pathetic'

∴ Weight effects are constrained to the σ]$_{Wd}$

- **But** this does not capture sub-patterns [4]:

i. Weight is **gradient**
ii. All syllables in the domain are affected
iii. Some **negative** effects, *contra* weight typology

Lexicon: ĹLL > H́LL

3. QUESTIONS

1. **How do speakers generalize weight effects?**
2. **How do they deal with a contradictory pattern?**

4. LEXICAL BASELINE

Notation: **H$_3$ H$_2$ H$_1$]$_{Wd}$**

- H$_3$ has a negative effect in the entire lexicon
- **But is H$_3$ negative in the input?**

i. Examine posterior distribution of H$_3$
ii. Simulate smaller lexica and model H$_3$
iii. Model only frequent words

☞ All three methods confirm H$_3$ < 0

- **How about speakers' grammars?**

5. METHODS

- Auditory forced-judgment task (**two versions**)
  Native speakers of Br. Portuguese (n = **27, 32**)
  - Nonce words (n = 240) with ≠ weight profiles
  - **Weight profiles:** HLL, LHL, LLL; LLH (control)
    E.g.: **H$_3$** → APU *vs.* PU stress in HLL *vs.* LLL
- Bayesian (hierarchical) logistic regression (Stan)

REFERENCES

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[2] M. Becker, A. Nevins, and J. Levine, "Asymmetries in generalizing alternations to and from initial syllables," *Language*, vol. 88, no. 2, pp. 231–268, 2012.
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[4] G. D. Garcia, "Weight gradience and stress in Portuguese," *Phonology*, vol. 34, no. 1, pp. 41–79, 2017. Project materials available at http://guilhermegarcia.github.io/garcia2017.html.
[5] B. Hayes and C. Wilson, "A maximum entropy model of phonotactics and phonotactic learning," *Linguistic Inquiry*, vol. 39, no. 3, pp. 379–440, 2008.
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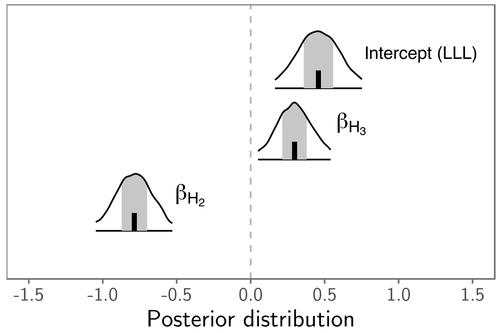
6. ANALYSIS AND RESULTS

Experimental results: Version A shown (n = 27). Posterior distributions + 50% and 95% HDI

Antepenultimate ($\hat{\beta}_{H_3}$) & penultimate ($\hat{\beta}_{H_2}$) weight effects

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stress.APU ~ weight + (1 + weight | speaker) + (1 | word)
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- **H$_3$, H$_2$, H$_1$**: **all** positively affect stress
  - H$_1$ (control) not shown in plot
- ☞ **Posterior distribution H$_3$ > 0 (plot)**
  - All values in log-odds
  - Positive values → preference for APU stress
  - H$_2$ > H$_3$: **LH́L >> ĹHL & H́LL > HĹL**
- Results replicated in Version B (n = 32)

∴ Gradient weight & **positive H$_3$**

What's an "equivalent" MaxEnt model? *Weights below learned with MaxEnt Grammar Tool* [5]

$\mathcal{C}$ emulates the intercept in the models above (e.g., $\mathcal{C}$ = {FtBin, Align(Ft, R), NonFinality}); provides grammatical interpretation for positional bias represented by intercept

- Weights maximize observed probability (averaged across words within weight profiles):
  Mean observed p(H́LL|HLL) = Predicted p(H́LL|HLL) s = 0.15

	w = 0.70	w = 0.49	w = 0.24			
HLL	WSP$_2$	$\mathcal{C}$	WSP$_3$	$h(x)$	$P^*(x)$	$P(x)$
H́LL	0	0	0	0	1	0.67
HĹL	0	1	1	0.73	0.48	0.33

☹ Weights are point estimates, *not* posterior distributions
☹ Standard MaxEnt implementation *not* hierarchical (i.e., no by-speaker/-word variation)

7. CONCLUSION

- Speakers generalize weight gradience: LLH: U > PU | LHL: PU > APU | HLL: APU > PU
- They do not, however, generalize H$_3$ effects in the lexicon: rather, they **repair** such effects
- Speakers' grammars are generalizing the expected effects given that Portuguese is weight-sensitive

ĹLL > H́LL → H́LL > ĹLL

Lexicon Grammar

- Crucially, the weight gradience in question is **positionally defined**
  - One way to capture this in a probabilistic grammar: positional WSP$_n$: $H_3 < H_2 < H_1$ cf. [6]