A substantive bias for perceptually minimal alternations in Artificial Grammar learning

A growing body of work has investigated the cognitive basis of typological asymmetries, using Artificial Grammar tasks to investigate acquisition of phonological patterns by adult learners in the lab. Abundant evidence has emerged for formal preferences regarding the scope and application of rules (simplicity, transparency, locality), but substantive preferences for typologically common processes have proven more elusive, leading some researchers to question whether typological frequency has a universal cognitive basis (see Moreton and Pater 2012a,b for review). Nonetheless, preferences for specific phonological processes have emerged in various studies (Wilson 2006; Carpenter 2010; Greenwood 2016), so the real challenge (as with all phonological analysis) is determining *which* typological asymmetries reflect grammatical constraints or biases. In this talk, we investigate a bias for perceptually minimal alternations (P-Map hypothesis; Steriade 2001). We present experimental results showing a preference for the typologically common process of final devoicing over a rare/unattested process of final nasalization.

As observed by Steriade (2001), if a language bans final voiced obstruents, they are generally repaired by devoicing rather than by other processes. Final devoicing also emerges spontaneously in L1 and L2 acquisition (Stampe 1979; Broselow 2004) and is acquired rapidly (van de Vijver and Baer-Henney 2011), leading some to posit an innate bias. Steriade (2001) attributes this bias to the fact that final voicing contrasts are perceptually difficult, and devoicing is the 'minimal' repair. To test for bias, we designed an experiment in which singular/plural pairs exhibited final devoicing (deɪ**p** ∼ deɪ**b**-iː) or nasalization (tɹiː**m** ∼ tɹiː**m**-iː). Equal numbers of devoicing and nasalization items were presented, so that both processes received equal support in training (6 each). Fillers included items with non-alternating voiceless stops (18), nasals (18), and liquids (6). The plural suffix harmonized in backness with the preceding vowel, and participants were explicitly told to learn the suffix quality. Implicit learning of final obstruent alternations was tested by presenting untrained plurals, with a forced choice between singulars with devoicing, nasalization, or neither. To test generalization to unseen segments, participants were trained on two places of articulation, and tested on all three (labial, coronal, dorsal). Ninety native English speakers were recruited via Amazon Mechanical Turk from U.S. I.P. addresses.

The results are shown in Figure 1. A mixed effects poisson regression model reveals no significant differences across training conditions; alternations generalized equally regardless of which place of articulation was withheld. Response type (Helmert coded) shows a significant preference for non-alternation over alternations ($p < .0001$) and, crucially, for devoicing over nasalization ($p < .05$). Thus, although both alternations were presented equally in training, participants generalized devoicing more readily. This bias is 'soft' (participants were able to learn final nasalization to some extent), but the direction is consistent with the P-Map hypothesis. Furthermore, this bias is unlikely to come from native language experience. English does not have systematic devoicing or nasalization alternations, and prior knowledge of this may contribute to the strong observed preference for non-alternation, but would not favor devoicing.

When we consider rates of alternation across different places, we find an unexpected effect, however: regardless of which place was withheld, we find significantly higher rates of nasalization for /g/. This preference for [ŋ] is not mirrored in typology or acquisition. We hypothesize that it is an artifact of the experimental design: [ŋ] items were phonotactically and orthographically odd for English speakers, and were thus a salient feature of the artificial language. A follow-up is underway in which [ŋ] training items are removed, and phonotactic ratings of test items are collected, in order to control further for phonotactic confounds.

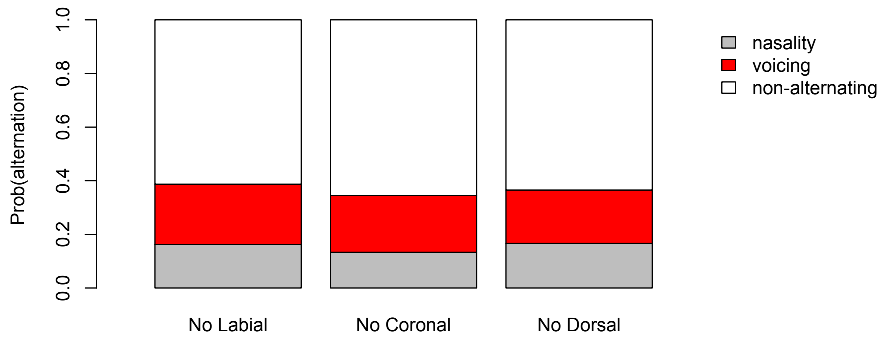

Figure 1: Proportion of responses across training conditions

Factor	Coefficient	Std. Error	z	$p(>\|z\|)$
Intercept	-1.295	0.052	-25.00	$<$.0001***
Response:				
Alternating vs. non-alternating	0.161	0.073	2.22	.0267*
Devoicing vs. nasalization	0.420	0.030	13.86	$<$.0001***
Training:				
Withhold Labials	0.028	0.070	0.40	.6881
Withhold Coronals	-0.036	0.074	-0.48	.6301
Response(alternating) × No labials	0.005	0.098	0.05	.9609
Response(alternating) × No coronals	0.069	0.105	0.65	.5129
Response(devoicing) × No labials	-0.031	0.0412	-0.76	.4491
Response(alternating) × No coronals	0.035	0.043	0.80	.4231

Table 1: Coefficients from mixed effects poisson regression

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