Learning vowel harmony with transparency in an artificial language

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Transparent vowels in harmony, which appear to be ignored in featural agreement between vowels, have been studied extensively both theoretically (e.g. Goldsmith 1985; Kiparsky & Pajusalu 2003; Pulleyblank 1996) and experimentally (Benus & Gafos 2007; Gordon 1999; Hayes & Londe 2006). Well-known examples include Finnish and Hungarian, where (non-low) front unrounded vowels are neutral to front/back harmony and are skipped in determining suffix vowels, as in Hungarian [pɔpiːr-nɔk] 'paper-DAT' vs. [røvid-nɛk] 'short-DAT' (Siptár & Törkenczy 2000). Transparency is particularly interesting because it violates the locality requirements typical of phonological patterns (Ní Chiosáin & Padgett 2001).

Finley (2015) found that participants in an artificial language learning task had great difficulty learning transparency; they succeeded only when exposure to disharmonic neutral stems was doubled compared to other stem types, but natural language lexicons are not biased in this way. However, one limitation of her study was that the artificial language was based on the English vowel system, which conflates rounding and backness; as such, the overall pattern was not characteristic of attested systems of front/back harmony with transparency (the English inventory requires harmony to change more than one feature). We report on an experiment that instead uses a French-based artificial language, with adult L1 speakers of (Canadian) French, to probe learning of transparency. French has a similar vowel inventory to Hungarian and Finnish, enabling us to design a harmony pattern that closely parallels these systems, with back-harmonic [o,u], front-harmonic [ø,y], and neutral [i,e]. Synthetic stimuli were generated using MBROLA (Dutoit et al. 1996). CVCV nonce stems of four types were created: back-back (BB), front-front (FF), front-[i] (Fi), and back-[i] (Bi); versions of these stems suffixed with [-ko] and [-kø] were also generated. Participants in the experimental group (n=20) underwent a training phase, exposing them to stems paired with their suffixed forms; the suffix was back ([-ko]) in BB and Bi words and front ([-kø]) in FF and Fi words. Stimuli were equally divided among the four stem types. Control participants (n=21) received no training. In the testing phase, participants in both groups encountered novel stems of all previously encountered types, as well as the unfamiliar stem types front-[e] (Fe) and back-[e] (Be), and chose between back and front suffixed forms.

Results for suffix choice were analyzed by fitting a GLMM with fixed effects for Group, V1, V2 and their interactions, and with by-subject random intercepts and slopes. A significant three-way interaction emerged: the effect of V1 on suffix choice varies by V2, but only for the Training group (Fig. 1). V1 and V2 have no effect on suffix backness for the Control group, but Training participants strongly favour harmony with BB and FF items. Fig. 1 indicates a trend toward harmony with V1 for Bi vs. Fi (middle panel) and Be vs. Fe (right panel)—suggesting a tendency toward transparency of not only V2 [i] but also [e]—though these differences do not emerge as significant in post-hoc comparisons. (They do, however, when Training-group responses on Bi/Fi, or on Be/Fe, are analyzed in isolation.) For the Training group, there are more front responses after [e] than [i] (regardless of V1 backness); there is no significant difference between Be and FF stems, unlike between Bi and FF. In sum, neither [i] nor [e] was treated as fully transparent, nor as fully opaque (front-harmonic); however, [e] tends more toward front-harmonic status than [i].

The findings provide suggestive evidence about the learning of transparency in vowel harmony. While participants did not treat Bi and Fi as identical to BB and FF, respectively, the differentiation between Bi and Fi is consistent with learning that V1 affects suffix choice (across an intervening V2). In other words, participants were sensitive to the long-distance dependency, without an excessively biased training set, though they were not able to acquire it reliably. The results are also consistent with a universal effect of height on transparency to front/back harmony (e.g. Hayes & Londe 2006 on Hungarian height effect), with [e] more front-harmonic than [i].

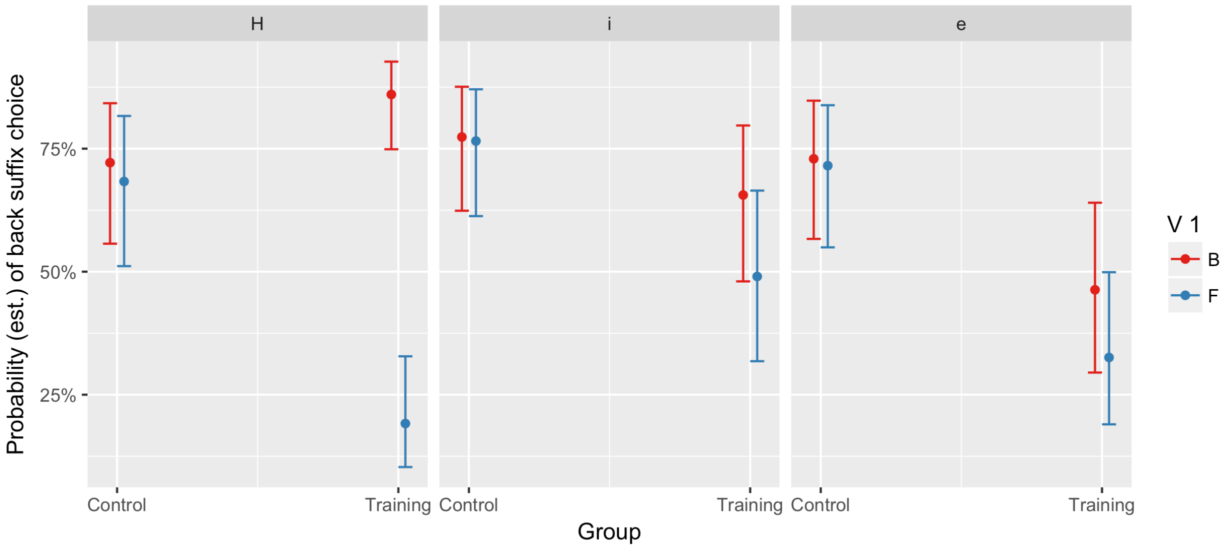

Figure 1: Predicted probabilities (from GLMM) of back suffix choice ([-ko] rather than [-kø]) by Group (Control vs. Training), V1 of stem (B=[o,u] vs. F=[ø,y]) and V2 of stem (H[armonic] = [o,u] or [ø,y], depending on V1, vs. [i] vs. [e]). Error bars show 95% confidence intervals.

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