Regularity versus phonetics in sound systems: experimental and typological data

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Already over 80 years ago, phonologists noted that sound systems tend to be regular, i.e. they maximally combine their distinctive features [1, 2]. Recent work attributes the tendency towards regularity to considerations of learnability [3, 4]. We conducted two experiments in which participants were exposed to simple sign languages of varying degrees of regularity, and subsequently selected the signs they had seen. We quantify the regularity of an inventory using Hall's [5] EXPLOITATION measure, abbreviated *E*. This measure scales between 0 and 1 and indicates which proportion of the possible feature space is occupied by phoneme categories; $E = 1$ for any regular inventory. In the first experiment, the input sets were drawn from a 3×1, 2×2 or 3×2 search space; in the second experiment, from a 3×3 search space (see bottom of page). In both experiments, learners significantly increased the *E* values of their inputs, suggesting a learning bias towards regularity. However, complete regularization only occurred in the first study, contrary to our expectation that regularization is more likely in a larger search space, as it puts more demand on working memory. Instead, learners would often only introduce one or two unseen categories, which was sufficient to fill a 2×3 space, but not a 3×3 space, given the input sets.

We also determined search space sizes and *E* values for all 317 languages in UPSID [6], a typological database of phoneme inventories. We found size and regularity to be negatively correlated, i.e. larger spaces tend to be exploited to a lesser degree. One possible explanation for this observation is that learners may lose track of regularities in larger spaces, like they seemed to do in our second experiment. Another explanation is that certain categories and contrasts are dispreferred in sound systems for phonetic reasons, i.e. because they are articulatorily effortful or even impossible, and/or because they are not sufficiently perceptually distinctive. A well-known example is the observation that many languages have irregular plosive systems that contain /k/ but lack /g/, because the voicing contrast in velars is relatively difficult to perceive and produce. This latter explanation is also supported by evidence from sound changes: for instance, Proto-Indo-European had a regular obstruent system, but the voiceless stops lenited nevertheless, causing a number of chain shifts that resulted in another regular inventory. Our experimental and typological data suggest that a regularity bias exists in learners, but that it may be counteracted by phonetic factors.

References:

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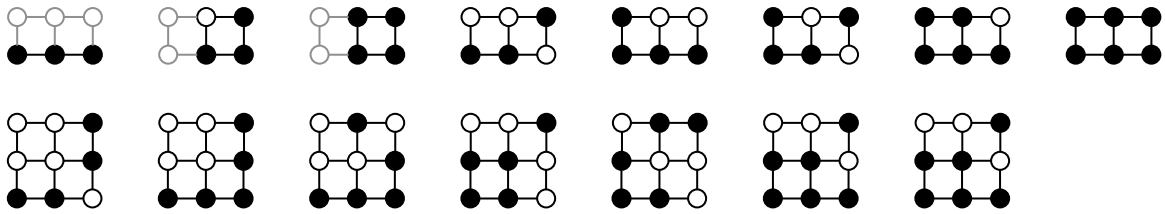

The data sets from the first (top row) and second (bottom row) experiments. The sets can be described in terms of two distinctive features; each line in the grids represents a feature value. Black circles indicate signs (i.e. combinations of feature values) that occur in the set, white circles indicate signs that do not.