

Mapping out the cultural evolutionary dynamics of probability matching behavior

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Probability matching is a pervasive behavior found from language learning (Hudson Kam & Newport, 2009), to decision making (Koehler & James, 2009), to basic perception (Wozny et al, 2010). Probability matching behavior (PMB) occurs when learners produce responses in the same frequency as their observations (with some error). During cultural transmission, learners' responses become the input for the next generation to learn from, where variance in error defines the system's evolutionary dynamics. The present research describes this variance, derives the resulting evolutionary dynamics for PMB, and compares them with models of drift and selection. Finally, the evolutionary dynamics of PMB are considered for language evolution.

160 participants completed a frequency-learning task with random marble drawing and these results are used to predict the outcome of iterated learning for this task. Participants' population-level behavior is better modeled as selection than drift and different training inputs elicit different biases from participants: marble frequencies near 50/50 yield a directional bias toward a 50/50 output, and extremely asymmetric conditions yield stabilizing selection. This means our cognitive architecture creates selective pressures by both constraining and shifting variation, and highlights an important aspect of cultural evolution where selection can precede the generation of variation.

Many cultural evolutionary processes seem explainable by drift (Bentley et al, 2004), but PMB models may be a better fit. Since marble drawing is not a natural culturally transmitted data set, the next step is to apply this methodology to PMB in statistical language learning to help explain the dynamics of cultural transmission in language learning experiments.

References

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