

The acquisition, contact, and transmission of phonological variation

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Variation may occur in the course of language acquisition, language contact, as well as diachronic language change [1]. Research on morphosyntactic variation has consistently reported that variation patterns tend to be regularized toward natural variants [2]. Results on phonological variation are less consistent across contexts. For instance, a system is partially regularized toward a phonetically natural patterns during language acquisition [3], yet such tendency is not consistently found in the course of language transmission [4,5]. This study explores the production of phonological variation in three contexts - language acquisition, contact, and transmission - in order to test the characteristics of biases that affect variation learning in different systems of language dynamics. Specifically, we examine the bias favoring phonetically natural patterns, such as those that involve articulatory ease or facilitate perceptual salience [6]. We ran three types of artificial language experiments, simulating the three contexts, expecting that the naturalness bias will amplify the presence of the phonetically natural variant within the variation pattern. Phonological variation was created with variable vowel (rounding) harmony (VH) or disharmony (VD) patterns (e.g., VH [sɔk^hu-mɔ] vs. VD [sɔk^hu-mi]). VH is motivated by anticipatory coarticulation [7,8] and provide perceptual enhancement [9]. It is thus believed that VH is phonetically more natural than VD [10].

Experiment 1 tested how learners acquire synchronic phonological variation. Participants were exposed to either a VH-dominant (72% VH) or VD-dominant (72% VD) language (training items $n = 96$). They were then tested on (a) items seen in the training phase, (b) semi-generalization (different CV combinations with the same vowels as training), and (c) full generalization items (novel vowels). The same types of testing items were also used in the two subsequent experiments. As in Fig 1, the rates of choosing the dominant pattern in the VH-dominant language were significantly higher than in the VD-dominant language (semi: $p = 0.009$; full: $p = 0.024$), suggesting that participants were more likely to acquire a VH-dominant pattern. In the VD-dominant language, the learners even flipped the pattern's dominance to VH (semi: VD rate < 50%). **Experiment 2** simulated language contact situation. Learners were first exposed to a phonological pattern with no dominance (i.e., 50% VH & 50% VD) as their "L1", and tested on their L1 knowledge. They then engaged in communication contact with an "L2" containing either 100% categorical VH or VD pattern, followed by the same testing phase as Experiment 1. While the learners exposed to the VD language produced no dominant pattern, those in contact with the VH language significantly increased the VH pattern compared to their L1 production (full: $p = 0.05$; see Fig 2). This suggests that participants more readily adopted the VH language than the VD language in the context of language contact. **Experiment 3** focused on how phonological variation dynamically changes through learning iteration, providing insights into the diachronic transmission of phonological patterns [11]. Participants were randomly assigned to eight independent transmission chains, each with four generations. Four chains of participants were exposed a VH-dominant language (72% VH) as the initial input (*gen0*), and the other four received the VD-dominant language (72% VD). The production of the preceding generation was fed to the subsequent generation as the input. As in Fig 3, learners converged towards languages without dominance in later generations regardless of the dominant pattern in the initial input, rendering no evidence of a preference for VH over VD.

Taken together, our results suggest that phonological variation is guided by a bias towards phonetically grounded vowel harmony in language acquisition and language contact contexts, but not during language transmission. These findings show qualitative differences from studies on morphological and syntactic variation, which is systematically regularized or simplified due to a cognitive and conceptual bias. Our acquisition and contact experiments revealed an additional bias favoring phonetically natural patterns in phonological variation. However, this bias is overridden during language transmission, which involves a higher level of individual variability and complexity in our data.

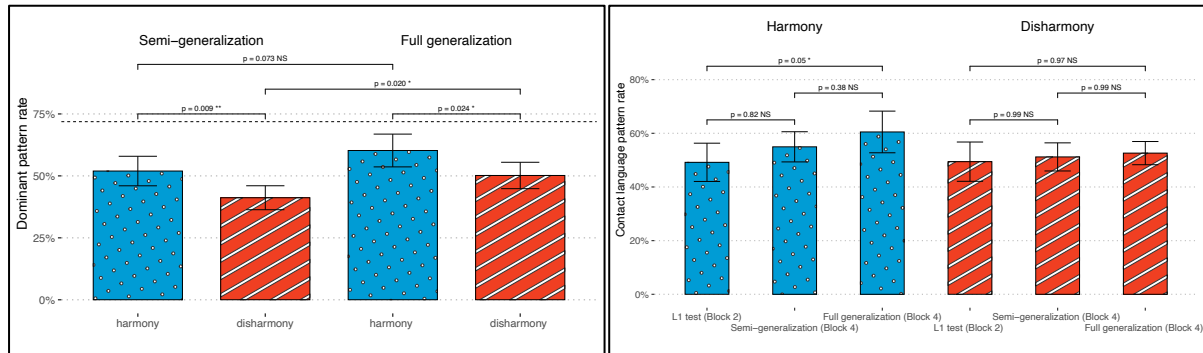


Figure 1. Rates of choosing the dominant patterns in language acquisition (Experiment 1; left).
Figure 2. Rates of choosing the dominant patterns in language contact (Experiment 2; right).

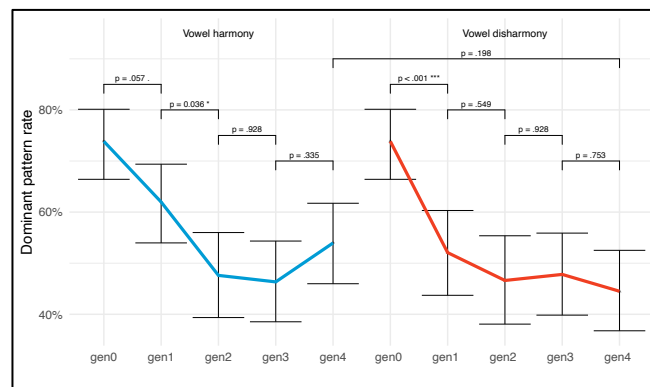


Figure 3. Rates of choosing the dominant patterns in language transmission (Experiment 3).

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