Learning alternations affects phonotactic judgments

It has long been recognized that alternations often serve to resolve violations of the phonotactic constraints of a language, and it has often been claimed that this entails a unified analysis. Chomsky and Halle (1968) advocate in favor of encoding both types of generalizations in terms of rules that apply both to create alternations and "internally to a lexical item" (p. 382). Optimality Theory (Prince and Smolensky 1993/2004) uses a single constraint ranking to both rule out ill-formed structures, and generate alternations. However, there are many cases in which alternations have no phonotactic motivation, for example in derived environment effects (Kiparsky 1973; Mascaró 1976), in which a rule is specifically blocked from applying morpheme-internally, and the reverse can occur when a restriction is limited to the roots of a language, as is often the case in OCP-Place effects. It thus remains plausible that phonotactics and alternations are encoded completely separately. In this paper, we provide experimental evidence that the learning of an alternation does affect phonotactic judgments, thus arguing against such a completely disjoint treatment.

Pater and Tessier (2003) investigated the relationship between phonotactics and alternations in adults, by asking whether knowledge of a phonotactic generalization affected the ease with which an alternation is learned. The experiment involved teaching two novel alternations to English speakers, only one of which served to resolve a phonotactic violation. While the phonotactically motivated alternation was indeed better learned, Pater and Tessier note that many of their test items involved phonotactically illicit forms, and that when these items were removed, the results showed a trend in the predicted direction, but were not statistically significant. In our design, we avoid this problem by using a counterbalanced design in which the only difference between the two conditions is whether they learned one of two alternations.

One of the phonotactic constraints was against a voiced obstruent followed by a voiceless obstruent (*DF), and the other was against a nasal followed by an obstruent of a different place (*NF). One rule was constructed to repair each constraint: voicing dissimilation is repaired by devoicing the first obstruent, and place dissimilation is repaired by changing the place of the nasal. These constraints and rules guided the construction of words in an artificial language. The language has a plural suffix -[fa], and singular nouns have no suffix. When pluralization is applied to stems ending in voiced obstruents, which in this language include only [b] and [d], *DF is violated and Devoicing applies. When pluralization is applied to stems ending in non-labial nasals, which in this language include [n] and [ŋ], *NF is violated and Place Assimilation applies. All of the stimuli were orthographically presented.

The experiment has a between-subjects design, where the participants are divided into two groups and each exposed to a different exposure and training phase. Neither group sees any violations of either constraint. However, each group only sees direct evidence for one rule. Thus, for each treatment there is an active rule and a hidden rule. For a given treatment, participants are shown both the singular and plural form of stems that undergo the active rule, but only a singular or a plural for each stem that would undergo the hidden rule. Thus, the application of the hidden rule is neither confirmed nor denied.

An exposure phase was to familiarized the participants with the language without

testing their memory. Participants simply repeated the words by typing in the words after they were orthographically presented. Examples of the exposure stimuli, and the numbers of each type, are shown in the following table.

Exposure stimuli examples when Devoicing is the active rule

Singular-only (10): lobon	Singular-plural, faithful (5): teldus - teldusfa
Plural-only (10): funemfa	Singular-plural, alternating (10): nemab - nemapfa

Exposure stimuli examples when Place Assimilation is the active rule

Singular-only (10): nemab	Singular-plural, faithful (5): teldus - teldusfa
Plural-only (10): funepfa	Singular-plural, alternating (10): lobon - lobomfa

In the subsequent training phase, the goal was to choose the correct plural for a singular. Feedback, in the form of presentation of the correct response, was given only for the active rule and non-alternating fillers.

The test phase, which is the same for both groups, then poses two-alternative forced choice questions concerning both constraints. For each constraint, there are questions pitting an apparently stem-internal violation of the constraint against a word that satisfies the constraint.

One hundred participants were recruited from Mechanical Turk and paid for their participation. They were all located in the United States and claimed to be over 18 years old and native speakers of English. One participant was excluded based on having response times under 50 ms, and 36 failed to learn the rules to an 80% correct criterion over a training block, leaving 63 participants whose data were analyzed.

If the treatment affects performance in the test phase, we expect a statistical interaction between the treatment and the tested constraint in predicting the proportion of violations chosen in the test phase. The prediction held: the participants trained on Devoicing chose fewer *DF violations than those trained on Place Assimilation, and the participants trained on Place Assimilation chose fewer *NF violations. A logistic mixed effects model was fitted to the data. It included random slopes and intercepts for subjects and items. The fixed effects were the training condition, the testing condition, their interaction, and one "nuisance variable," the side of the page the constraint-violating word was presented on. The interaction was in the predicted direction, with $p < 0.001$.

A potential confound is the fact that the feedback in the training phase may have drawn extra attention to the sequences generated by the alternation, increasing their phonotactic acceptability. A second experiment was thus performed, removing feedback from the design, resulting in an experiment with an exposure phase, one iteration of training where no feedback is given, and a testing phase. 200 participants were tested, since the lack of feedback generally resulted in lower performance on the training items. The criterion was also reduced to 70% in order to have 80 participants, rather than 57, in the final analysis. Once again, the predicted interaction was found, with $p < 0.001$ in a mixed effects model with the same structure as in the last experiment.

Selected reference. Pater, J. and Tessier, A.-M. (2003). Phonotactic knowledge and the acquisition of alternations. Proceedings of the 15th International Congress of Phonetic Sciences, pages 1177–1180.