Infants' contribution to the stability of patterns involving natural sound classes

Sound patterns are ubiquitous in language. In every language that has been described, certain sounds and sound sequences are less frequent than others, and some altogether absent. Furthermore, sound patterns often concern natural sound classes. For example, in German and Russian, final devoicing affects both stops and fricatives, but not some subset of the two. Patterns affecting natural sound classes could be a consequence of language use, since similar sounds face similar phonetic pressures. Additionally, **there could be cognitive biases at play during language acquisition, which lead to better learning, and consequently greater stability, of sound changes resulting in patterns involving a natural class.** This paper reports on **7 artificial grammar studies, where learning biases were experimentally isolated**. Together, these studies suggest that infants could indeed provide a filter for sound patterns, as ease of learning and spontaneous generalization tendencies converge to favor patterns that involve natural sound classes.

Experiments 1-3 suggested that infant language learners favor natural sound classes as a function of experience. Training consisted of passive exposure to a sound pattern embedded in pseudowords (words that are legal but meaningless in the listeners' ambient language; henceforth *items*). At test, infants' interest was estimated through the time they orientated towards the source of the sound while different types of items were being played. In these and all subsequent studies, different items are used across training and test so that the task can only be solved through an abstracted pattern; and careful counterbalancing ensures that results cannot be explained by which items are used during training or test. In Experiment 1A, 7-month-olds was exposed to items beginning with 2 nasals and 2 stops, all of which can be captured within the natural class of non-continuants. At test, infants preferred items beginning with novel fricatives over items beginning with novel stops. In contrast, 7-month-olds exposed to an arbitrary grouping (nasals and fricatives) showed no preference at test (Experiment 1B), suggesting they could not as easily generalize from this set. A control study showed that this was not due to an inherent difficulty in learning patterns with fricatives (Experiment 2). In Experiment 3, 4-month-olds were equally capable of generalizing the natural class and arbitrary grouping, suggesting that the naturalness effects documented in 7-month-olds is acquired through experience, rather than via innate biases.

Experiments 4-7 documented that only infants spontaneously encode sound patterns in terms of natural classes. In Experiments 4 and 5, 6-month-olds were trained with pseudowords where the onset was restricted to a subset of obstruents sharing voicing (e.g., /p t ʃ/). Infants in Experiment 4 were subsequently tested with novel onsets of the same voicing (i.e., /k f s/) versus different voicing (i.e., /g v z/). At test, these infants showed a significant preference for the relatively more novel (/g v z/) items. In contrast, infants tested with exposure (/p t ʃ/) versus within-class sounds (/k f s/) showed no significant preference at test (Experiment 5). Thus, infants appear to have automatically encoded the pattern in terms of the minimal natural class encompassing all training onsets. Two additional studies suggested that such strong and immediate generalization is not apparent in adults. In Experiments 6 and 7, adult participants were told that they would help us select made-up words to use in a study on children's word learning. During training, they answered how well-formed each item was, and at test, they were asked how frequently each item had been presented before (as in the infant studies, test items had not been used during training). Experiments 6 and 7 differed in the variability of training materials (e.g., number of onsets). In both studies, adults rated within-class items as having been presented significantly less frequently than exposure ones, showing that they spontaneously encoded the specific training onsets. Moreover, generalization (higher ratings for items where the onset was more versus less similar to the training onsets) could altogether disappear in low-variability conditions. Thus, class-based patterns are reinforced in infancy to a greater extent than in adulthood.