Young infants learn sound patterns involving unnatural sound classes

Phonological features, such as [voiced] and [continuant], are commonly viewed as the building blocks of phonology (Chomsky & Halle, 1968; Donegan & Stampe, 1979). Features have gained this privileged status in theoretical phonology because they can capture a number of generalizations that occur in all sound systems. For instance, using features we can economically encode both sound contrasts and patterns concerning classes of sounds. To take some examples from English, /p,b/, /t,d/, /k,g/, /s,z/ and several other pairs differ only on voicing; put simply, obstruents contrast in [voice]. Similarly, the plural morpheme “s” is implemented as [z] after sonorants and voiced obstruents, but as [s] after voiceless obstruents; again, this can be easily expressed by using the feature [voice].

Recent research suggests that phonological features exist in the grammar of speakers/listeners (Cristià & Seidl, 2008; Endress, Nespor, & Mehler, 2009; Finley & Badecker, 2009; Peperkamp & Dupoux, 2007; Peperkamp, Skorupa, & Dupoux, 2006; Seidl, Cristià, Onishi, & Bernard, 2009; Wilson, 2006). Specifically, all else being equal, learning phonotactic constraints affecting a natural class (such as /p,t,k/ occur word-initially) is easier than learning a constraint affecting an arbitrary set of sounds (such as that /p,l,a/ occur word-initially). For example, 7-month-old English-learning infants fail to generalize a phonotactic pattern involving the unnatural class of fricatives and nasals, but succeed learning the natural class of oral and nasal stops (Cristià & Seidl, 2008). These results could be due to learning being innately guided, as this pattern of results fits in with the traditional description of nasals and stops being a natural class (represented as [-continuant]), while nasals and fricatives are not (it cannot be expressed in terms of a single set of features: [-continuant,+nasal] \land [+continuant,-sonorant]). If this were indeed a case of innately guided learning, we would predict that younger infants would also display the same learning pattern.

To assess this prediction, we tested 48 4-month-olds using the same stimuli and procedure as that previous study: Infants were familiarized with a sound pattern instantiated in non-words, and later presented with new non-words that either followed the same pattern (were legal) or violated it (were illegal). Sound presentation during test is contingent on the infant looking, as previous work has shown that if infants can learn such patterns, they attend longer to trials that violate the pattern from the familiarization (Chambers, Onishi, & Fisher, 2003). For half of the infants, the onsets of all the non-words during familiarization belonged to the unnatural class of fricatives and nasals; for the other half of the infants, the pattern involved the natural class of nasals and stops. Both groups of infants were tested with novel sounds: in half of the trials, non-words began with new fricatives, in the others with new stops. Unlike older infants, 4-month-olds were able to learn in both conditions, displaying significantly longer looking times to the illegal trials (main effect of Legality in a repeated-measures ANOVA: $F(1,44) = 11.56, p = .001$ and no significant interaction; paired two-tailed $t$-tests confirms that both groups learned: in the stops and nasals condition $t(23) = 2.03, p = .05$; in the fricatives and nasals condition, $t(23) = 2.82, p < .05$). These results suggest that the bias that makes phonotactic constraints on natural classes easier to learn could be the result of experience, rather than innately guided learning.
References