English-learning children's processing of salient phonetic distinctions varying in phonological relevance for word identity

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Processing spoken language requires attributing only some types of phonetic variation to lexical distinctions. Children learning an intonation language like English must rule out pitch contour as lexically contrastive, attributing pitch variation to other sources, like stress or phrasal intonation. The developmental time-course of this learning is unclear. Quam and Swingley (2010), using a language-guided looking method, found that English-speaking 30-month-olds and adults disregarded pitch-contour changes, but did attend to vowel changes, in newly learned words. Two further studies indicated that children learning English rule out pitch as lexically contrastive prior to 24 months, but different methods have led to different developmental timelines. Singh et al. (2014), using a similar method, found 18-month-olds responded to both tone and vowel mispronunciations (MPs), whereas 24-month-olds responded only to vowel MPs. Hay et al. (2015), using the Switch habituation procedure, found 14-month-olds detected mismatches of tone-object pairings, whereas 17- and 19-month-olds did not; however, no segmental baseline was tested. Understanding how children learn to correctly interpret readily perceptible phonetic variation is important, with implications for development of the lexicon and acquisition of prosody.

Here, we compared children's interpretation of the same stimuli across ages and methods. Using the pitch and vowel contrasts of Quam and Swingley (2010), we tested English learning 3- to 5-year-olds, 24-month-olds, and 18-month-olds. Three- to five-year-olds (N=35) and 24-month-olds (N=37) were tested in the language-guided looking procedure from Quam and Swingley (2010). Children were taught a label ("deebo") for a novel toy with a consistent, exaggerated pitch contour in a story and then via ostensive labeling. At test, the toy was accompanied on the screen by a previously unlabeled (but equally familiar) distracter. Children's fixation of the target image (**Fig. 1**) was measured in response to the correct pronunciation, a vowel MP ("dahbo"), or a pitch MP (rise-fall to low fall, or vice-versa). Three- to five-year-olds were tested with both MPs; 24-month-olds were each tested with either pitch or vowel MPs. Preschoolers showed phonologically constrained responses, attending to vowel but not tone changes, replicating Quam and Swingley's (2010) finding with 30-month-olds. In an ANOVA, an effect of Pronunciation, $F(2,108) = 16.7$, $p < .001$, reflected lower target fixation in response to the vowel MP than the correct pronunciation, $t(36) = 5.53$, $p<.001$—but there was no looking decrement for tonal MPs. Surprisingly, 24-month-olds ignored changes to *both* pitch and vowel, an effect that conflicts with prior findings of phonological constraint at 24 months; if anything, 24-month-olds showed numerically stronger effects of pitch changes than vowel changes, in contradiction to English phonology. Perhaps the rich teaching context increased the task difficulty relative to Singh et al. (2014), impairing learning.

Other work in our lab indicates 18-month-olds do not always learn words robustly in the procedure used by Quam & Swingley (2010). Thus, here we tested 18-month-olds (N=64) in the Switch habituation method, with two word-object pairs presented during habituation. Half of children were habituated to vowel-contrasted words ("veedo" and "vahdo"), the other half to pitch-contrasted words (rise-fall and low-falling contours). Within each cue condition (pitch or vowel), half of children were habituated with stimuli in which variability was added on the non-criterial dimension (children learned vowel-contrasted words in the presence of pitch variability, or pitch-contrasted words in the presence of vowel variability, e.g., "veedo," "vahdo," "viddo"). The results (**Fig. 2**) show that 18-month-olds could be induced to learn word pairs whether the words contrasted in pitch contour or vowel identity. This learning effect was significant for children who habituated (N=53), $F(1,49) = 4.46$, $p = .04$, and across all children, $F(1,60) = 4.05$, $p = .049$. Our results suggest that 18-month-olds can flexibly learn lexical distinctions inconsistent with English phonology; 24-month-olds are still in transition, apparently accepting vowel MPs in novel words; and from 30 months (Quam & Swingley, 2010) through preschool and onward, children detect arbitrary vowel changes, while accepting ("listening through") salient pitch variation.

References

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Figures

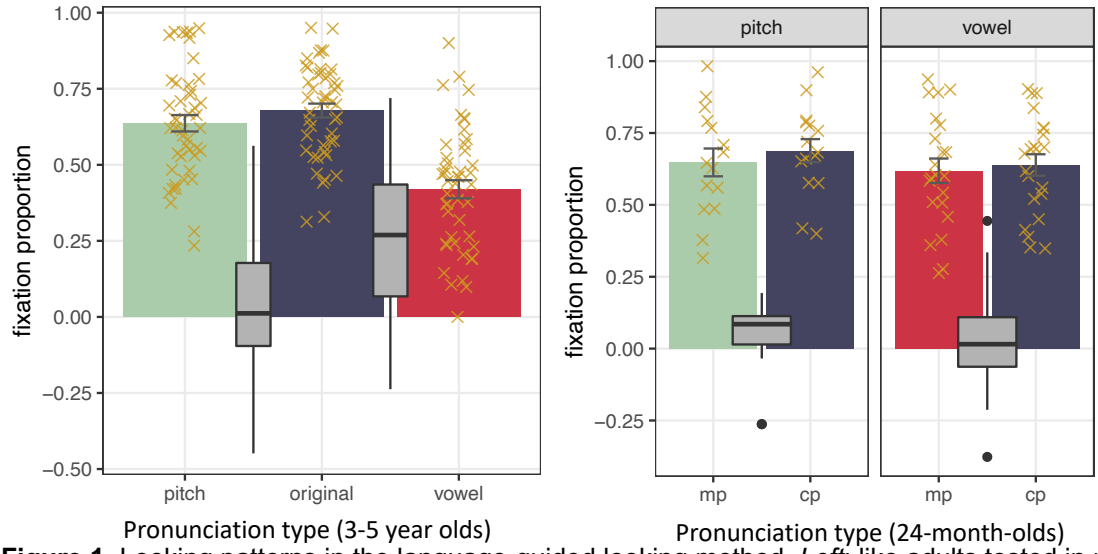

Figure 1. Looking patterns in the language-guided looking method. *Left*: like adults tested in prior work, 3- to 5-year-olds (N=35 tested in all 3 conditions) fixated the target picture less only in vowel-mispronunciation ("vowel") trials vs. correct-pronunciation ("original") trials. *Right*: 24-month-olds did *not* fixate the target picture significantly less in mispronunciation ("mp") trials vs. correct-pronunciation ("cp") trials, for either pitch (n=15; trend *ns*) or vowel changes (n=22). Box plots indicate within-subject difference scores between correct-pronunciation and mispronunciation trials.

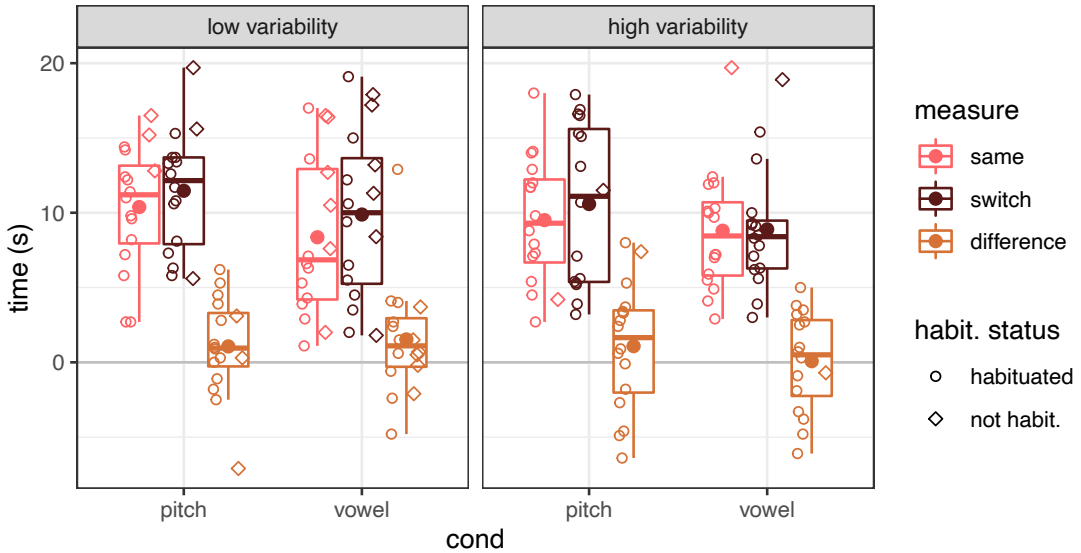

Figure 2. 18-month-olds in the Switch procedure. Switch > Same looking times mark recovery from habituation, indicating label-object learning. Learning was not significantly different across pitch-contour vs. vowel differentiated word-contrast conditions ("cond"), though learning appears informally to not be evident for vowel distinctions (/i/-/a/) amid high contour variability.