

Infants' discrimination of native versus non-native within-organ and between-organ speech contrasts

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Background

Infants under 6 – 8 months of age can discriminate both native and non-native consonant contrasts, while infants over 10 months have difficulty discriminating non-native consonants that are also found difficult by adult speakers in their language environment (see reviews by Best, 1994; Werker, 1989).

The Articulatory Organ Hypothesis (Goldstein & Fowler, 2003) predicts that infants attend more to the articulatory organ that is active in a gesture than to the specific gestures a given organ makes. The hypothesis predicts that infants will continue to discriminate between-organ contrasts but will show a decline for within-organ ones. This is consistent with infant discrimination findings:

- Developmental decline in discrimination has been found for English-learning infants' discrimination of within-organ contrasts: Hindi dental vs. retroflex stops and Nthlakampx velar vs. uvular ejectives (Werker et al., 1981; Werker & Lalonde, 1988; Werker & Tees, 1984b), Zulu voiceless aspirated vs. ejective velar stops and plosive vs. implosive bilabial stops (Best et al., 1995).
- Conversely, discrimination remains high for non-native between-organ contrasts (Best & McRoberts, 2003; Best et al., 1988): Dental vs. lateral clicks (tongue tip vs. body) and bilabial vs. alveolar ejectives (lips vs. tongue tip). However, these contrasts involve organs that are also contrastive in English.

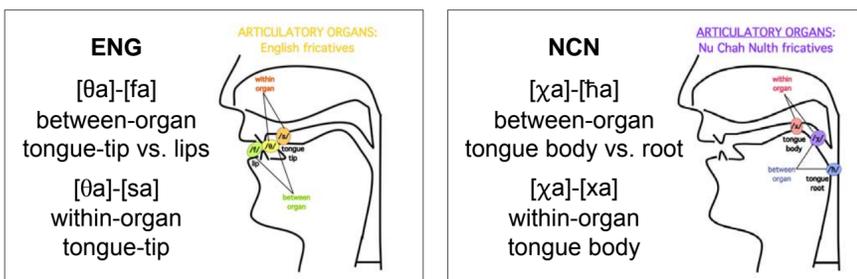
Question: Does this lack of developmental decline hold when the contrast involves an organ that is not used in the native language?

The Present Study

We tested English-learning 6-7 month-old and 11-12 month-old infants' discrimination of native English between- vs. within-organ contrasts and those involving an organ distinction that is not used in English: Tongue root vs. body.

Furthermore, previous studies have tested the Articulatory Organ Hypothesis using between-organ and within-organ contrasts from different languages. Here we improve on this by contrasting the same consonant in a between-organ and a within-organ vocal-tract gesture distinction from the same language.

Here infants listened to between- and within-organ contrasts from Australian English (ENG) and a native Canadian language Nuu Chah Nulth (NCN).



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Method

Participants: 24 infants aged 6-7 months & 24 infants aged 11-12 months

Stimuli: Four tokens of each ENG syllable spoken by a female Australian ENG speaker and each NCN syllable by female speaker of NCN.

Fricative lengths were similar across tokens (ENG and NCN $M = 241$ ms). The large difference between amplitudes of ENG fricatives were reduced to avoid discrimination based on loudness alone. [θ] and [f] were increased to 41dB SPL and [s] was reduced to 50dB SPL. All NCN fricatives were 60dB SPL.

Vowels of ENG tokens were stretched by a common factor (using Praat) to match stimuli on overall length.

Procedure: An infant-controlled conditioned visual fixation habituation paradigm was used. Infants completed one test per language (counterbalanced). An additional 11 infants in each age group were excluded because they failed to complete both tests. In each test they were first habituated to randomly presented tokens of an ENG ([θa]) or NCN ([χa]) syllable. After habituation they heard novel stimulus tokens from the same language (between-organ [fa] or [ħa] or within-organ [sa] or [xa]) alternating with habituation stimulus tokens, or a habituation stimulus control trial. Order of test trials was counterbalanced:

HABITUATION — Between — Control — Within — Control — Between — Control — Within
 HABITUATION — Within — Control — Between — Control — Within — Control — Between

Dishabituation relative to the control trials indicates successful discrimination.



Testing Procedure

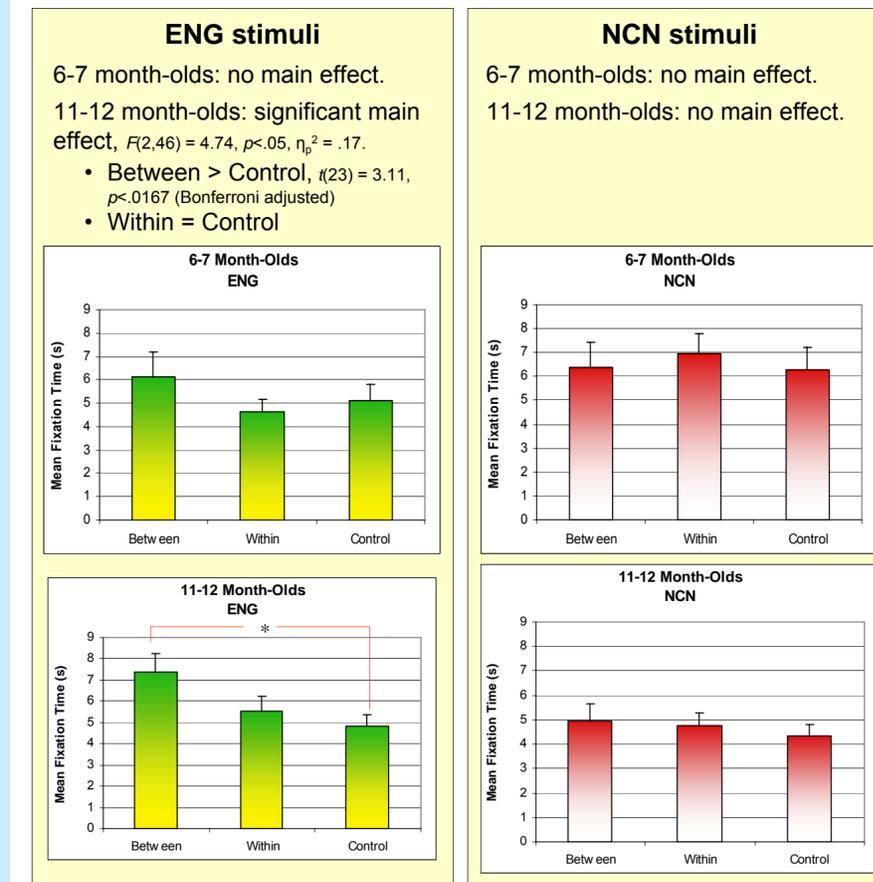
Sounds play from the speakers whenever the infant looks at the coloured checkerboard.

Fixation times are measured.

When the infant looks away, the current stimulus is terminated immediately. If the infant looks again within 2 seconds, the trial continues, otherwise it ends.

Results

Data were analysed separately for each test using a repeated-measures ANOVA with a single factor, *contrast* (between vs. within vs. control).



Conclusions

Consistent with the Articulatory Organ Hypothesis (AOH), 11-12 month-olds discriminated the ENG between-organ contrast, but not the within-organ contrast.

- However, they did not discriminate either Nuu Chah Nulth contrast. This may be due to lack of experience with the tongue root organ and/or with tongue body vs. root contrasts – [ħa] may have been perceived as tongue-dorsum (undifferentiated body + root) rather than as separate tongue-root by these English-learning infants.
- An alternative interpretation is that the NCN fricatives all belong to a phonological class of “gutturals” (McCarthy, 1994), which could be thought of as a “super-organ”. As such, all of the NCN fricatives, but not the ENG fricatives, would be within-organ and therefore difficult to discriminate according to the AOH.
- We are currently testing infants who are exposed to both English and Arabic, as the latter employs tongue-body/tongue-root distinctions. If the linguistic experience hypothesis is correct, these infants should discriminate the NCN between-organ contrast, whereas the guttural hypothesis would predict the same poor discrimination observed here.

Whereas previous research suggests that 6-7 month-olds should have discriminated all of the contrasts, here they discriminated none of the contrasts (although the pattern of data for English suggests emerging discrimination of the between-organ contrast).

- Completing two tests in a single session (in addition to two contrasts per test) may have been too taxing for the infants. We are currently testing an additional 24 infants per group to reanalyse the data in a between-participants design.

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