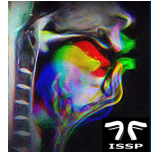


Setting the Stage for Speech Production: Infants prefer listening to speech sounds with infant vocal properties

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Theoretical Background

- Little is known about how infants learn to link self-generated vocal tract movements with their time-varying kinematic and acoustic/auditory consequences (Guenther 2016, Kuhl & Meltzoff, 1996).
- In a recent series of experiments, it was discovered that 4.5 month-old infants preferentially attend to infant speech (vowels) over adult speech (Polka *et al.*, 2014; Masapollo, Polka, & Ménard, 2016).
- An attraction to infant speech signals could support the acquisition of **speech production targets** by biasing **infant attention** toward their own prelinguistic vocalizations and encouraging **vocal exploration**.
- Knowledge gap:** What signal properties drive infant preference for infant speech, and does that change with age and emerging vocal production abilities during infancy?

Current Research

Hypotheses & Predictions:

H1: Infants are biased toward infant speech signals because of their higher fundamental frequency (F_0), or voice pitch.

Prediction: Infants should be attracted to the high F_0 of infant speech, which has been shown to attract infant attention in infant-directed speech.

H2: Infants show a preference for infant speech because they connect information in the signal to their own emerging articulatory abilities.

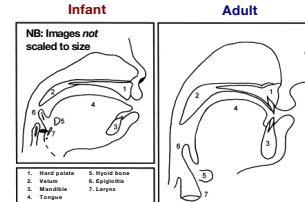
Prediction: Infants should be attracted to both the high F_0 and formant frequencies (vocal resonances) of infant speech, which jointly form infant speech signals. Such preferences should increase with age as infants become more articulatorily active.

Approach:

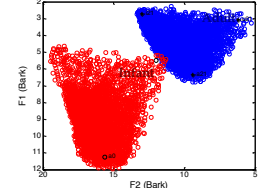
Utilize speech synthesis techniques to manipulate the source characteristics (F_0 values) of infant speech, and then examine the effects of those manipulations on infant listening preference.

Articulatory-Acoustic Relations for Vowels

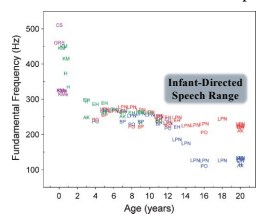
Vocal Tract Growth: Infancy to Adulthood



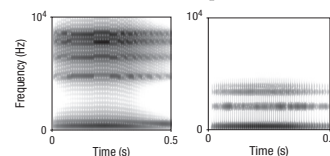
F1/F2 Acoustic Vowel Space



Voice Pitch (F_0) Values Across the Lifespan



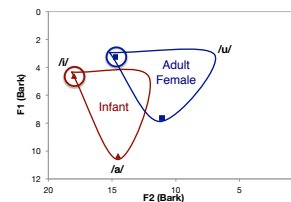
Formant Frequencies



Methods & Materials

Participants & Speech Stimuli

- 6-to-7-month-old infants (mean age: 7:11)
- Isolated /i/ vowels synthesized using the Variable Linear Articulatory Model (Ménard *et al.*, 2004) to simulate productions by adult female and 6-month-old infant speakers
- Matched in their intensity, duration and intonational contour.
- Voice pitch (F_0) values varied across experiments.



Procedure & Design

Sequential preferential listening procedure

- Fixating on a static pattern triggers an auditory stimulus.
- Looking serves as an index of listening
- Dependent variable:** Looking time



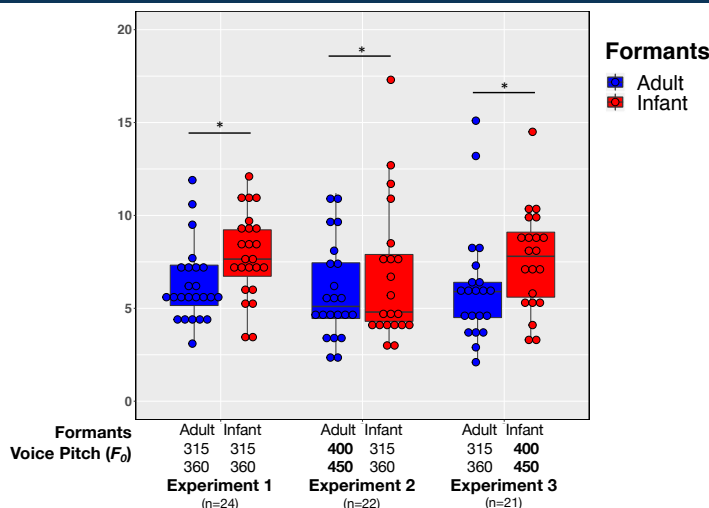
Alternating Trials

Adult Infant Adult Infant ...

Infant Adult Infant Adult ...

Test Orders

Results



Conclusions

- Consistent with H2, infants preferentially attend to vowels with infant vocal resonances independent of manipulations to F_0 . In addition, resonance properties appear to play a stronger role in driving this preference at the older ages tested.
- Given that infants begin producing vowel-like sounds at 3-months, these findings suggest that infants are biased toward speech elements that align with their own vocal production patterns (cf. Vihman's [2017] "articulatory filter" hypothesis).
- Future experiments will test whether this bias is speech-specific, or can be elicited with any infant vocalization (e.g., coos).
- Limitation:** The present findings do not show how infants perceive and monitor their own *self-generated* speech-like articulatory movements, but the perceptual bias identified here may support them in doing so.
- The present findings bring us a step closer to understanding the complex interplay between the speech production and perception systems in early infancy.