From melody to meaning: the influence of humming and singing on infant categorization

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Background

- Speech and music are key components of caregiver-infant communicative interactions, capturing infants' attention, regulating infants' affect, and promoting social bonding.[1-6]
- Speech and music differ considerably in acoustic and linguistic features, communicative intent, and propositional meaning.
- By 3m, listening to speech supports infants' core cognitive processes (e.g., object categorization) in ways that other closely matched acoustic signals (e.g., backwards speech or tone sequences) do not.[7-10]

Research Question: Does listening to music, with (sung) and without (hummed) words, offer the same cognitive advantages as speech in early infancy?

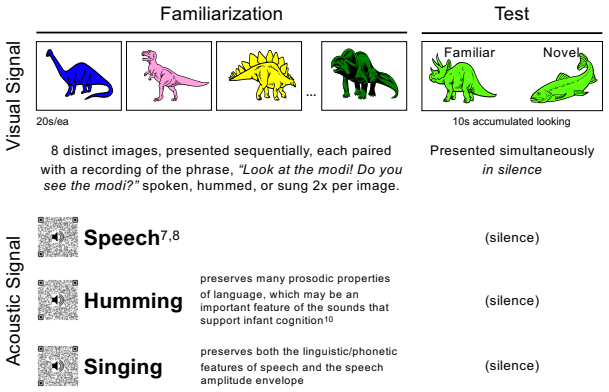
Prediction: Because music exaggerates the prosodic features of language and conforms to more regular temporal periodicity than speech, humming & singing will support infants' categorization.

Methodology

Participants: *N* = 123 full-term 2.0-7.9m infants whose primary language exposure was English (≥70%).

Procedure: Infants were seated on a caregiver's lap facing a screen, upon which visual images were projected. Recorded acoustic stimuli were presented in sound field. Infants' eye gaze was videorecorded and coded offline by coders blind to acoustic condition.

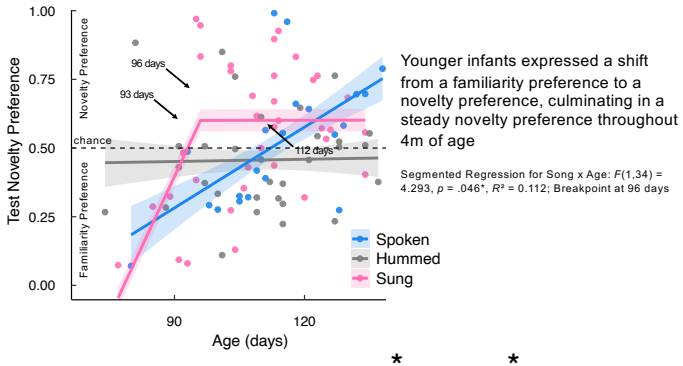
Object Categorization Task:



Dependent Measure: proportion of time spent looking at the Test novel image (total time looking to novel image / 10 sec of looking to test images). Proportions that differ from 0.5 (looking equivalently to the two objects) indicate successful object categorization.[11]

Results

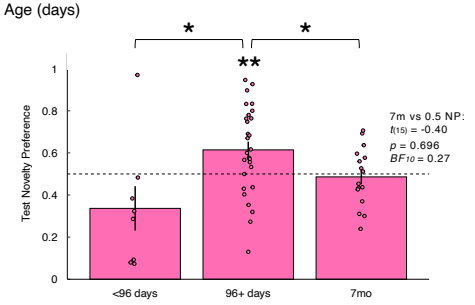
Speech supports object categorization throughout the first year[7,8]
Humming does not support object categorization
Singing initially supports object categorization **at 2-3m**



Younger infants expressed a shift from a familiarity preference to a novelty preference, culminating in a steady novelty preference throughout 4m of age

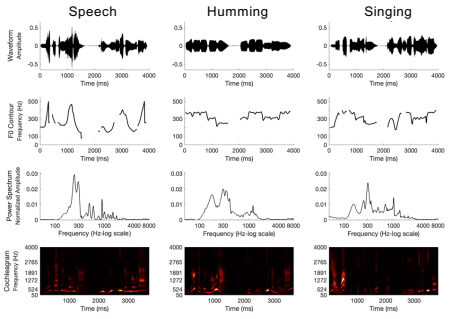
Segmented Regression for Song x Age: $F(1,34) = 4.293$, $p = .046$*, $R^2 = 0.112$; Breakpoint at 96 days

By 7mos, **Singing** no longer supports categorization



Stimuli Acoustics:

- Humming lacks fast spectrotemporal features, such as the rapid formant transitions of consonants that give rise to phonotactic information.
- Preliminary inspection of stimuli acoustics reveals that the Speech amplitude envelope is preserved more faithfully in Song than in Humming.



Musical Exposure:

- Parents' general music sophistication was assessed to quantify parents' readiness or interest in exposing their infant to music.[12]
- This measure did not correlate infants' looking preference at test.

Summary

Humming fails to support infants' object categorization

- While suprasegmental prosodic properties of the native language may be a *necessary* component of the sounds that support early infant cognition, they are *not sufficient*.

Song supports object categorization in infants at 2-3m

- Acoustic features such as articulatory characteristics and high-frequency formant transitions that speech and song share may be *required* features sounds that young infants link to cognition.

Song may increase infants' initial processing efficiency

- Infants more quickly shifted to a *novelty* preference by ~13 weeks old, which is ~3 weeks earlier than infants in the speech condition.
- Infants' looking preference for novel over familiar stimuli is thought to reflect improved processing speed and encoding efficiency.[11,13]
- This difference in looking preference might reflect an additional advantage of music (over speech) on cognition: temporal regularity in music may facilitate the perception of salient acoustic features in the Song condition.[14]

The cognitive advantage of listening to Song fades by 7m

- Unlike Speech, which supports categorization throughout the first year, Song no longer supports categorization at 7m. Perhaps infants have learned by this age that singing is not typically associated with object labeling.

Future Directions

- Acoustic analyses and systematic variation of acoustic features of stimuli are needed to complement these findings.
- More detailed analyses of infants' musical and linguistic experiences, and how such experiences might contribute to developmental outcomes, are needed.

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Acknowledgments

We thank members of the Northwestern University Infant and Child Development Center for their assistance with data collection and insightful discussions that supported this research. This work was supported by the Canadian Institute for Advanced Research (Catalyst Grant; S.R.W. and L.J.T.), the National Institute of Mental Health (T32MH126368; K.W.C.), and the Natural Sciences and Engineering Research Council of Canada (CREATE Postdoctoral Fellowship; C.M.V.B.d.N.). Special thanks to Dr. Elizabeth Kinghorn for lending her voice to create the hummed and sung stimuli.