Neural and behavioral drivers of successful early communication

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The role of neural coupling in communication

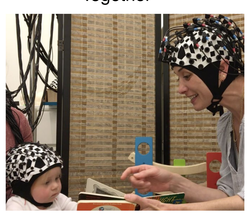
Previous work has shown that neural coupling between the brains of speakers and listeners relates to communication success.

To begin to understand its role in early communication, we compared the strength of coupling between 9-to-15-month-old infants and adults when they were interacting with each other versus with other individuals.

We used fNIRS because it is minimally susceptible to motion and allows participants to interact naturally.

Design

Together



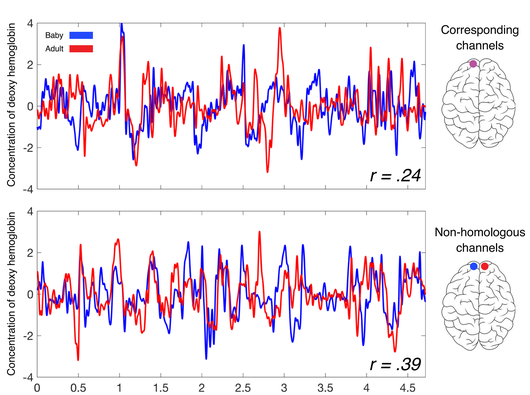
Apart

Pre-processing and analysis

Record at ~8 Hz with Shimadzu LabNIRS (57 channels/subject)

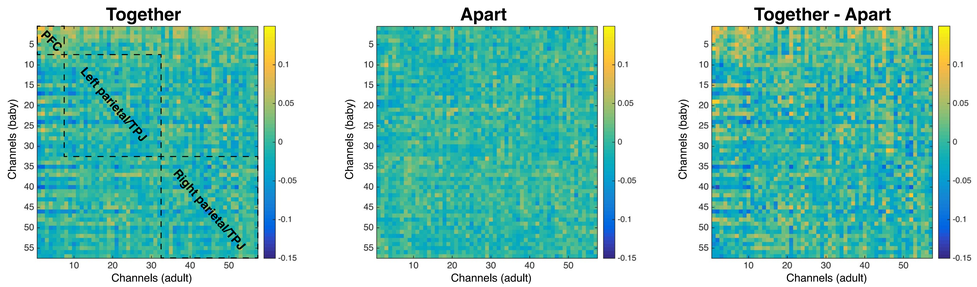
Remove motion artifacts using MARA; LPF (0.5 Hz); HPF (0.02 Hz)

ISC measure for each dyad (N = 18)



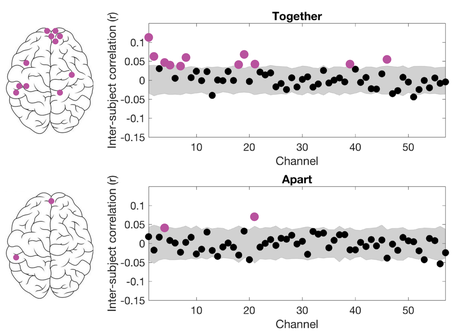
Results

Correlation matrices (averaged across 18 dyads)

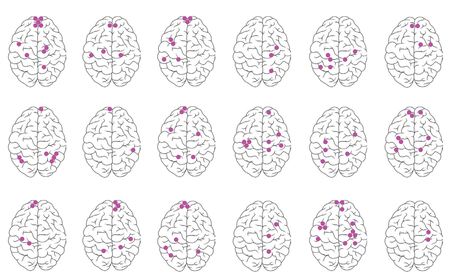


Phase scrambling control analysis

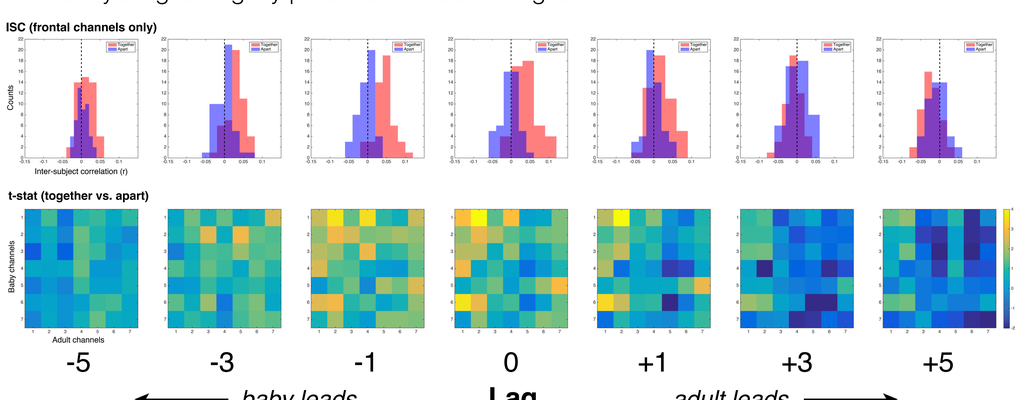
Group-averaged (N = 18)



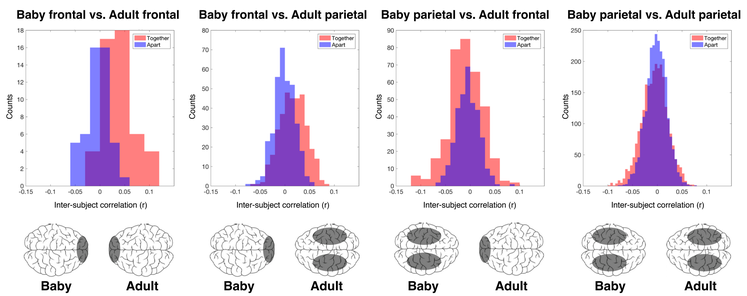
All dyads showed significant evidence of coupling in the "together" condition



The baby's signal slightly precedes the adult's signal in PFC



Coupling in homologous and non-homologous channel pairs



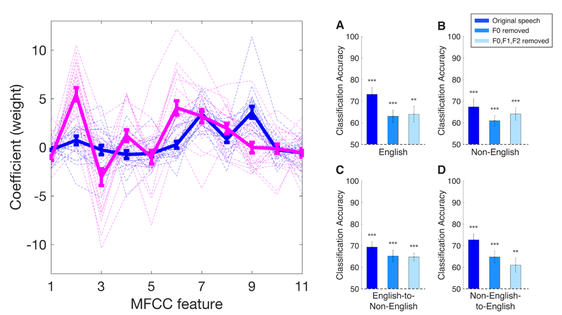
Conclusion: The brains of infants and adults are reliably coupled when they communicate with each other

Next step: How do features of speech drive coupling?

Infant-directed speech has unique pitch and rhythmic characteristics

We recently found consistent shifts in timbre that generalize across many languages

How do features of infant-directed speech, such as timbre, contribute to neural coupling between infants and their caregivers?



Adapted from *Piazza, Iordan, & Lew-Williams (in press, Current Biology)*

References

Piazza, E. A., Iordan, M. C., & Lew-Williams, C. (2017). Mothers consistently alter their unique vocal fingerprints when communicating with infants. ***Current Biology***, in press. Fernald, A., & Simon, T. (1984). Expanded intonation contours in mothers' speech to newborns. ***Developmental Psychology, 20***, 104-113. Stephens, G. J., Silbert, L. J., & Hasson, U. (2010). Speaker-listener neural coupling underlies successful communication. ***Proceedings of the National Academy of Sciences, 107***, 14425-14430. Liu, Y., Piazza, E. A., Simony, E., Shewokis, P. A., Onaral, B., Hasson, U., & Ayaz, H. (2017). Measuring speaker-listener neural coupling with functional near infrared spectroscopy. ***Scientific Reports***, 7. Hasson, U., Ghazanfar, A. A., Galantucci, B., Garrod, S., & Keysers, C. (2012). Brain-to-brain coupling: a mechanism for creating and sharing a social world. ***Trends in Cognitive Sciences, 16***, 114-121.

Acknowledgments

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