

Little hands, big reactions

Infants' arm movements around caregiver speech

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The Caregiver's voice is a primary channel for early social interaction, yet we know little about how infants' limb movements respond to it in real time. These moment-to-moment patterns reveal how multimodal synchrony — voice and movement coupled together — emerges in early development.

Question

How does caregivers' speech shape Infants' hand movements, and does this change across the first year?



Experiment

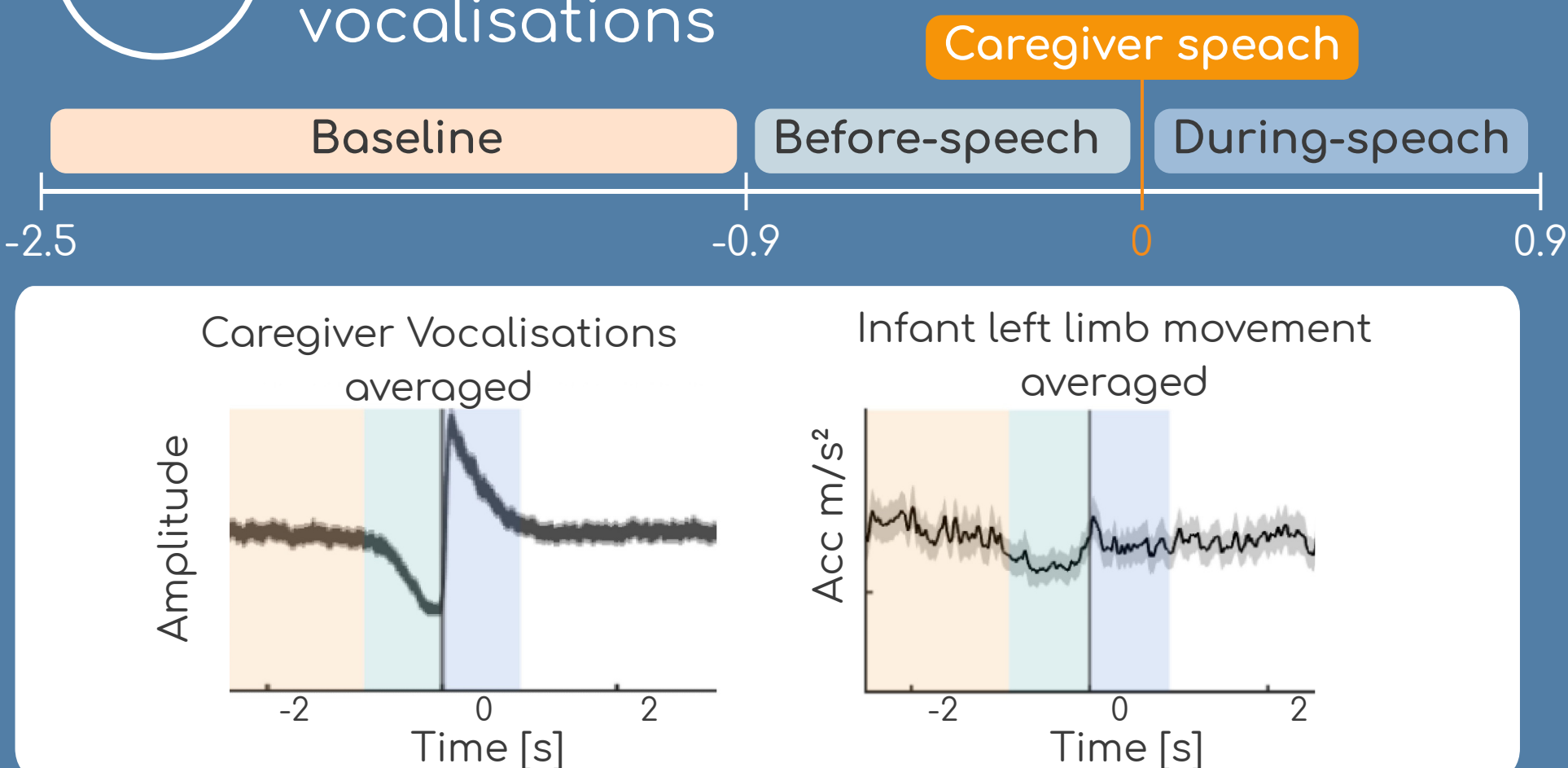
- Dyads: infant-caregiver pairs in free play with age-appropriate toys
- X-sens movement sensors (I2), 3-axis accelerometer, gyroscope, magnetometer
- Recording: three HD CCTV cameras + microphone (Sennheiser e914)
- Task (~5 min): manipulative toys (varied motor skills)



Figure 1. The objects used during tasks: Manipulative [2].



Anchors: the onset of the caregiver's vocalisations



Data statistics

Time Point	Infant's Age range [mo]	No. Dyads	No. Caregiver's Vocalisations
4 mo	3.90 – 5.20	61	5391
6 mo	6.00 – 7.80	74	5383
9 mo	8.20 – 10.02	71	4760
12 mo	11.00 – 14.50	73	4696



Results

Time Window

Movement is suppressed around speech

Infants' hand movements showed systematic, co-occurring changes around the onset of caregiver's vocalisations. Amplitude differed significantly between all time windows:

Contrast	Est.	t	p
before < baseline	-0.071	-9.15	< .001
during < baseline	-0.046	-5.85	< .001
during < before	-0.026	-3.31	.001



Quiet hands = attention. Infants damp their movement just before and during caregiver speech. Acceleration rose around caregiver vocalisations, peaking just before speech onset (baseline < during < before; all $p \leq .003$) — consistent with anticipatory coupling.

Time Point

Movement increases with Age

Hand acceleration increased across the first year, rising from 6 to 9 months ($p = .005$).

Limb

A right-hand preference decreases with Age

The right hand moved more than the left at 4–6 months. This asymmetry narrowed and lost significance by 9–12 months, tracking a shift toward more symmetric bimanual control.

Age	Est. (L-R)	p	Interpretation
4 mo	-0.079	< .001	R > L
6 mo	-0.091	< .001	R > L
9 mo	0.024	.07	n.s.
12 mo	-0.029	.03	small



Right-hand preference emerges early and attenuates over the first year.

Infant hands acceleration around caregiver vocalisation onset (manipulative-toy condition) was tested with Lmer

amplitude ~ TimePoint × Limb × TimeWindow

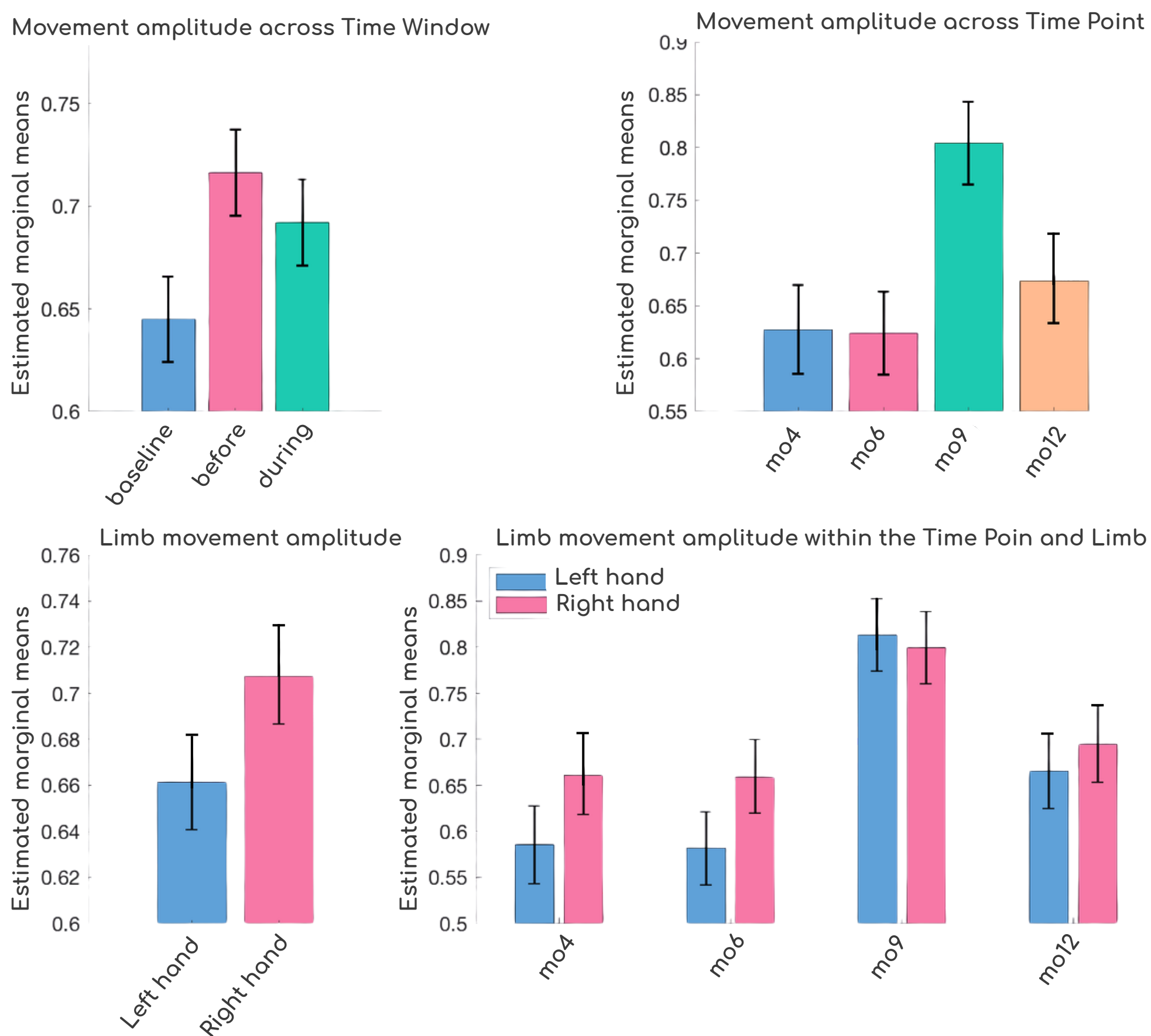


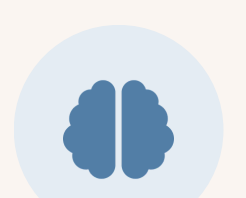
Figure 2 The results from the Manipulative task. Error bars comes from standard deviation

Note: Caregiver posture and infant orientation were not recorded; the movement asymmetry is interpreted as early manual lateralisation rather than stable handedness.



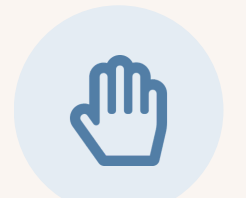
CONCLUSIONS

- Infants' hand movements vary systematically around the onsets of caregiver speech, with clear differences across time windows of analysis.
- Movement rises approaching and during the vocalisation, peaking just before the speech onset — consistent with anticipatory engagement with social cues.
- A right-hand preference at 4–6 months decreases and loses significance by 9–12 months.
- Findings illustrate the embodied, multimodal nature of early communication and motivate linking these patterns to the wider dynamics of caregiver–infant interaction.



Co-development

Neurocognitive processes in infancy



Movement

Whole-body communication



Interaction

Caregiver speech and infant response



Connection

The roots of social understanding



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Funded by the Polish National Science Centre, grants :
2018/30/E/HS6/00214 and 2022/47/B/HS6/02565 (PT).



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We thank all participating infants and their families.
The authors declare no competing interests.