



Left Hemisphere Cerebral Specialization for Babies While Babbling

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Introduction

Babbling is universally viewed as the precursor to speech production in humans and yet little is known about whether the neural determinants of this behavior are fundamentally linguistic^{1,3}, or reflects only oral-motor developments^{4,6}. In adults, right asymmetry in mouth opening during linguistic tasks as contrasted with left or equal mouth opening during non-linguistic tasks has been widely used as a key measure of left hemisphere cerebral specialization for language⁷⁻⁹. Given the non-invasive nature of mouth asymmetry studies, this technique is ideally suited to inferring whether functional cerebral asymmetries of babies' earliest productions exist. If babbling is fundamentally linguistic in nature, then left hemispheric specialization should be reflected in right mouth asymmetry while babbling. If babbling is fundamentally motoric in nature, then equal hemispheric participation should be reflected in equal mouth opening while babbling. The results will provide new insight into the neural basis of babbling, and hence into the origins of human language.

Methods

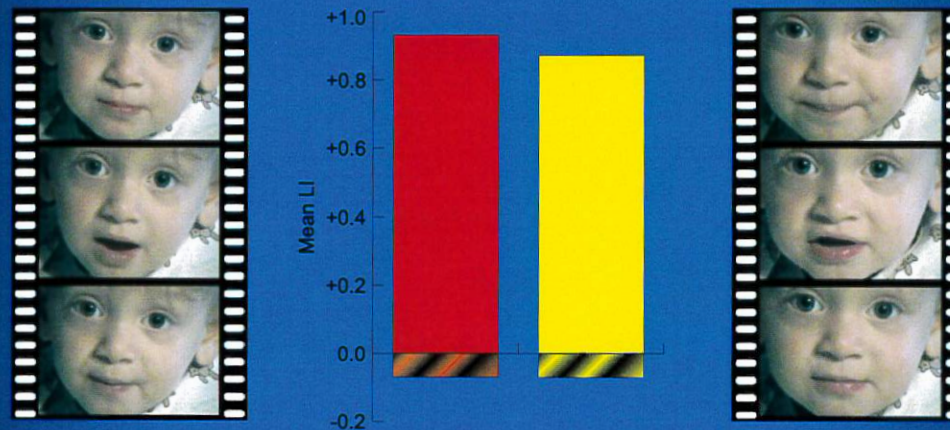
Mouth opening was videotaped in two groups of babies, 6-12 months: 3 acquiring English; 3 acquiring French

60 Babble (30 English, 30 French) and 60 Non-Babble (30 English, 30 French) productions were scored by two independent "blind" coders according to whether Greater Right, Left, or Equal mouth openings were observed

Standardly used Mean Laterality Indices (LI)¹⁰ were computed for Babbles and Non-Babbles: $LI = (R - L) / (R + L + E)$, where POSITIVE LI = RIGHT mouth asymmetry NEGATIVE LI = LEFT mouth asymmetry

Results

Consecutive frames from video recordings show one baby's
EQUAL mouth opening while producing a Non-Babble (LEFT image)
RIGHT mouth opening while producing a Babble (RIGHT image)



Mean LI for Production (Babble, Non-Babble) by Group (English, French)

English Mean LI

■ Babble = +0.93

▨ Non-Babble = -0.07

French Mean LI

■ Babble = +0.87

▨ Non-Babble = -0.07

Statistical analysis was performed using a two-way mixed ANOVA:
Production (Babble, Non-Babble) x Group (English, French)
A significant main effect was discovered for Production ($F=210.25$, $p<0.001$)
No significant effect of Group was detected ($F=0.25$, n.s.)

Summary

The origins of language in humans have remained elusive as a result of controversy over the neural basis of babbling. Using the non-invasive mouth asymmetry technique we asked whether the basis of babbling is neurally determined, either linguistically or motorically. Two groups of babies acquiring two distinct languages were studied, and we discovered that all babies had significantly greater right mouth asymmetry (indicating left hemisphere neural control) while babbling as compared to left or equal mouth opening during non-babble productions. Like adults, the right mouth asymmetry observed in babies suggests left hemisphere asymmetry for babbling, reflecting the human left hemisphere control of natural language. This discovery is also among the earliest demonstrations of left hemisphere lateralization for language functions in humans. Moreover, the cross-linguistic findings suggest that left cerebral laterality for babbling is a universal phenomenon. We thus conclude that babbling represents the onset of the productive language capacity in humans, rather than exclusive oral-motor developments.

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