

Abstract

We asked if N400m (aMEG) activity is detectable in an 18 month-old infant with significant language delay and risk for Specific Language Impairments. Electroencephalography (EEG) studies show the presence of N400-like event-related brain responses to auditory words as early as 12 months of age that appears to be related to infants level of language ability. Magneto- and electro-encephalography (M/EEG) studies show qualitative differences in N400-like event-related activity in children with Specific Language Impairments as compared to normal controls. Unfortunately, M/EEG is quite poor in determining the cortical sources of the N400 activity. Anatomically constrained magneto-encephalography (aMEG) is a new tool that integrates neurophysiological data having millisecond temporal accuracy with individual brain anatomy. Using aMEG, in the present study we demonstrate that it is possible to observe N400m activity to auditory words in an 18-month-old infant at risk for language disorders and compare this activity to a normal language peer. (This study was approved by IRB of UCSD and SDSU, informed consent was obtained for all infant and adult participants.)

References

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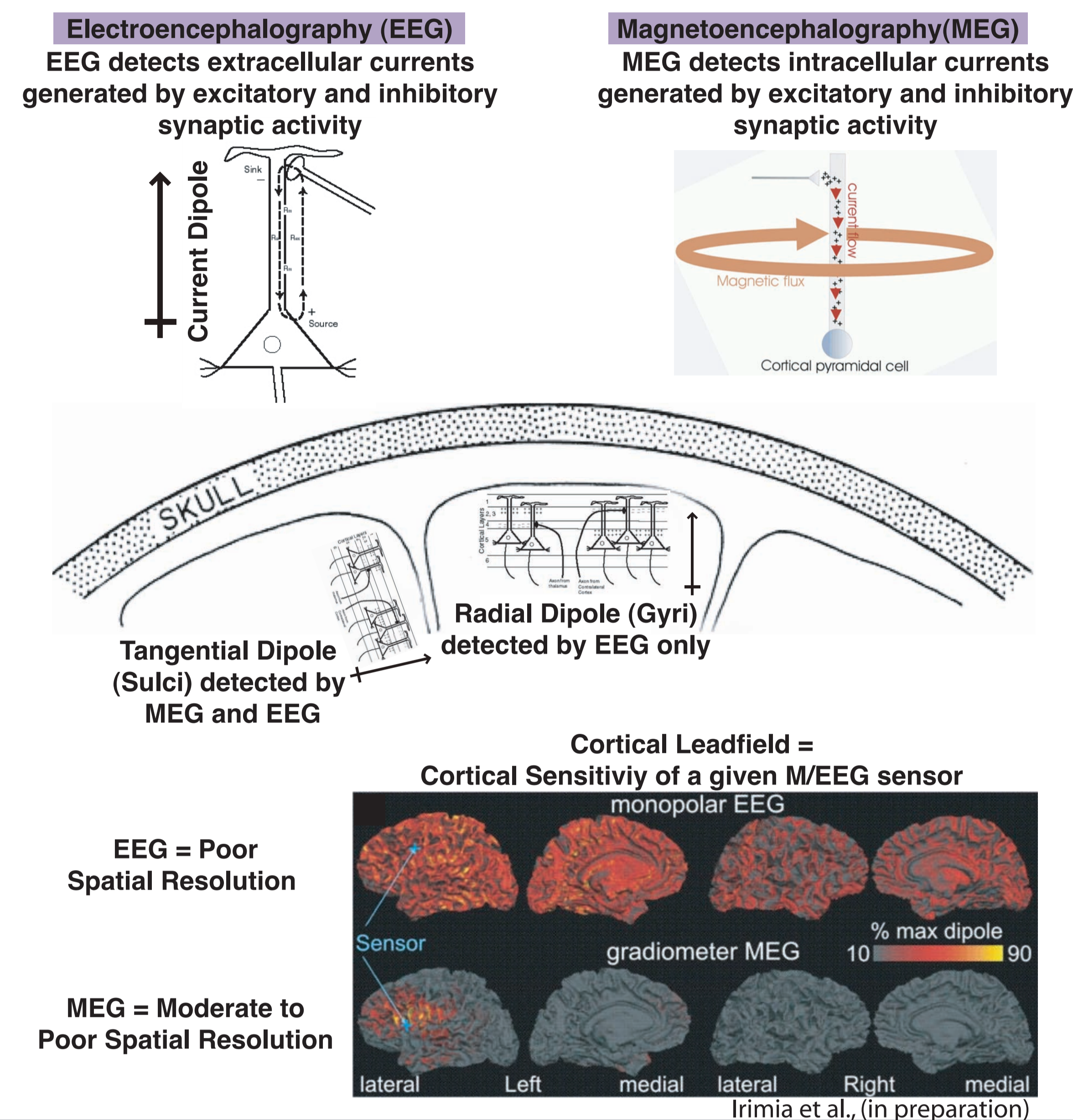
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Purpose Statement

Can we show evidence of N400m in an infant at risk for language disorder using words in his vocabulary?

Method: Anatomically Constrained MEG



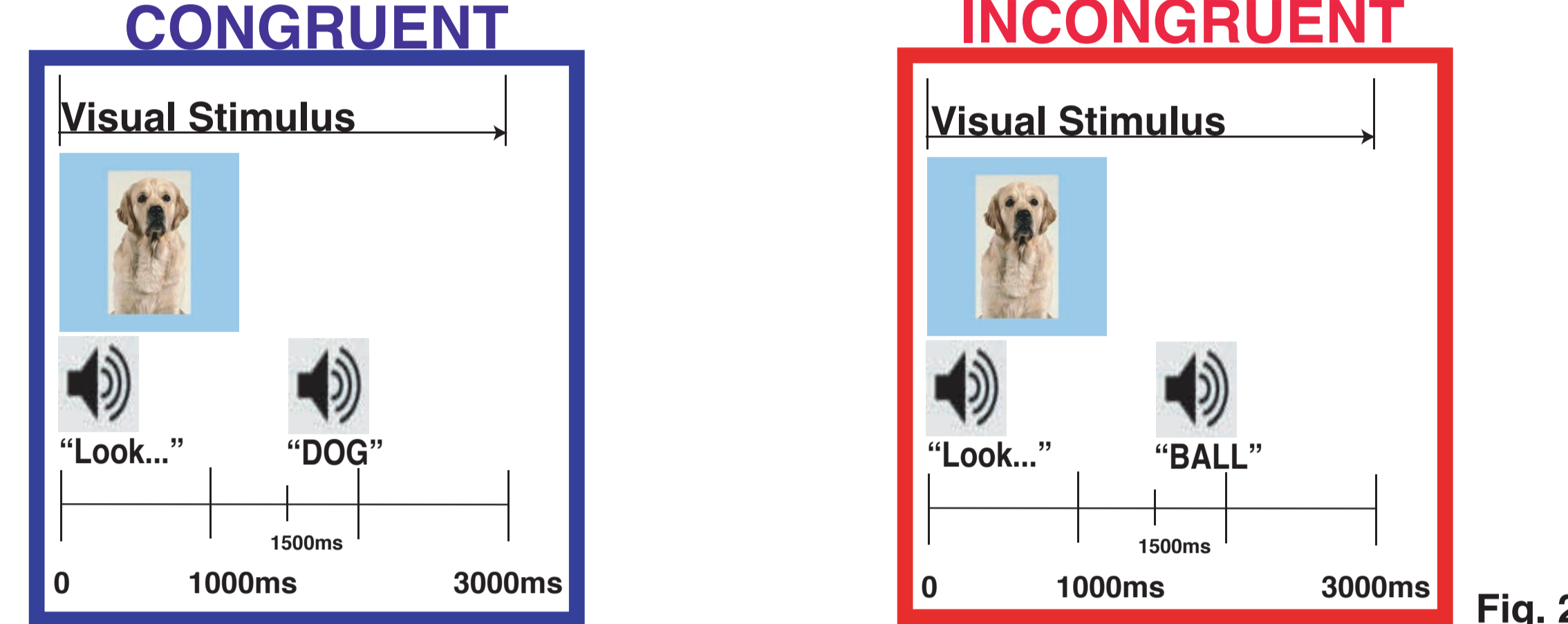
Experimental Methods

NEUROIMAGING PROCEDURES:

- Two visits to the Radiology and Imaging Laboratory, UCSD
- Visit One: MEG scan (Fig. 1 for MEG set-up) and Experimental Language task (Fig. 2)
- Visit Two: MRI scan
- Two T1-images acquired as infants slept naturally in MRI



EXPERIMENTAL LANGUAGE TASK:



Semantic Priming of Auditory Words with Picture Context (Frederich & Frederici, 2005):

To Ensure Infants were familiar with words:

- Prior to MEG, parents picked 30 most highly familiar words from a checklist of 100 words
- 5 days before MEG scan parents received a training booklet with experimental pictures corresponding to 30 most familiar words
- Parents practiced labeling the pictures each for 10mins/day

Participants and Tasks

- Two Infants (At-risk for SLI and Typical) and their mothers
- Monolingual English speaking
- Normal hearing, normal non-verbal intelligence and non-significant birth history

Infant Participant 1: At Risk (Male)

18 months (Visits 1 and 2)

Task: MEG/MRI Scans

19 months (Visit 3)

Task: 3-day Microgenetic Novel Word-learning study

20-24 months Therapy Sessions

2 sessions per week, for 20 weeks

24 months

Task: Statistical Word Learning study (Evans et al., 2009)

Infant Participant 2: Typical Language (Female)

18 months (Visits 1 and 2)

Task: MEG/MRI Scans

20 months (Visit 3)

Task: 3-day Microgenetic Novel Word-learning study

20-24 months

No therapy necessary

24 months

Task: Statistical Word Learning study (Evans et al., 2009)

Mother of Participant 1:

- Age 31
- Began speaking at age 3
- Leiter Repeated Patterns: 13
- Nonword Repetition: 1-3syllable 100%, 4-syllable 81%
- Task: Statistical Word Learning study (Evans et al., 2009)

Visits 3-6

Statistical Word Learning

Mother of Participant 2:

- Age 29
- Leiter Repeated Patterns: 8
- Nonword Repetition: 1-3syllable 100%, 4-syllable 95%
- Task: Statistical Word Learning study (Evans et al., 2009)

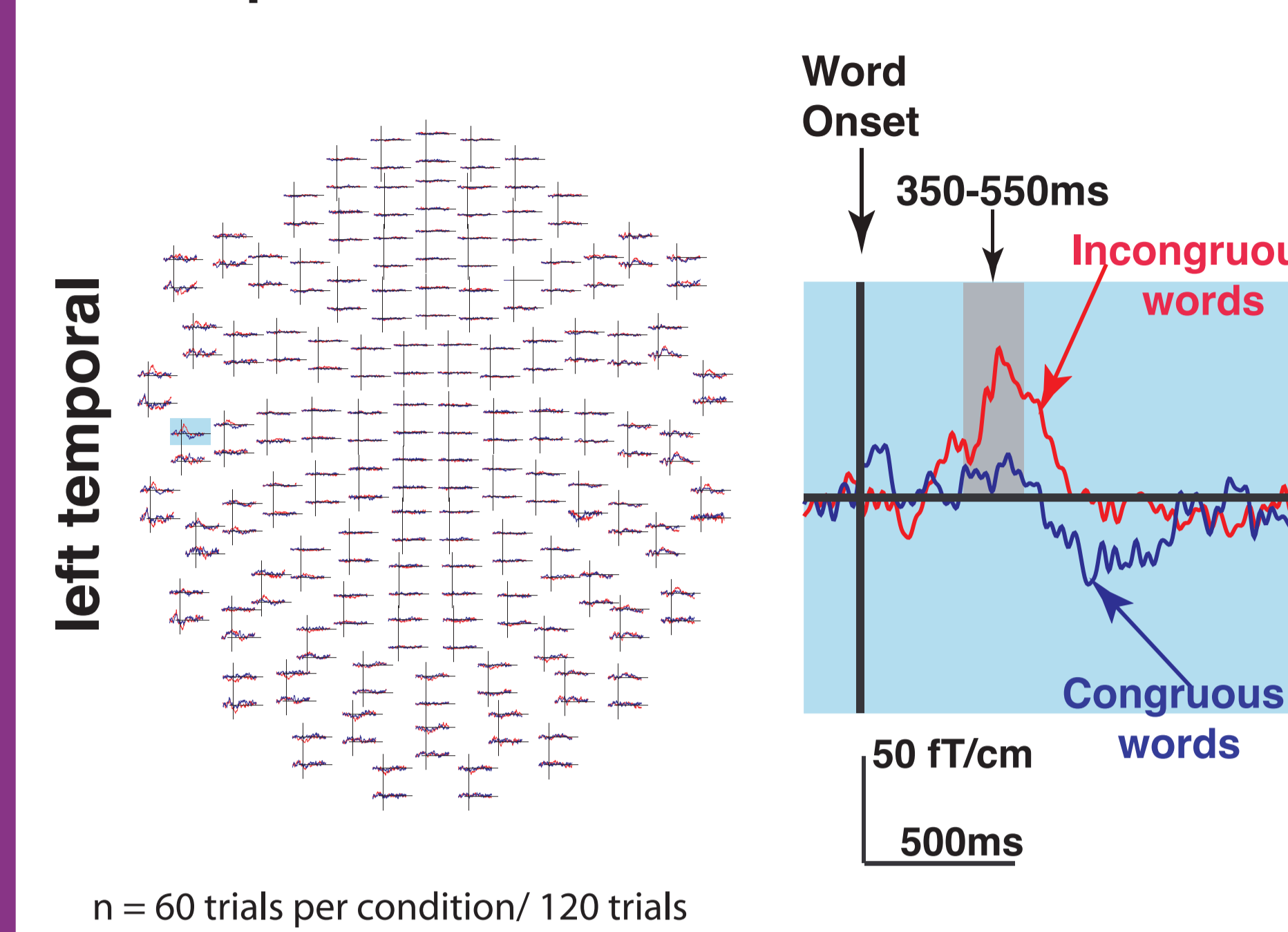
Visits 3-6

Statistical Word Learning

(Evans et al., 2009)

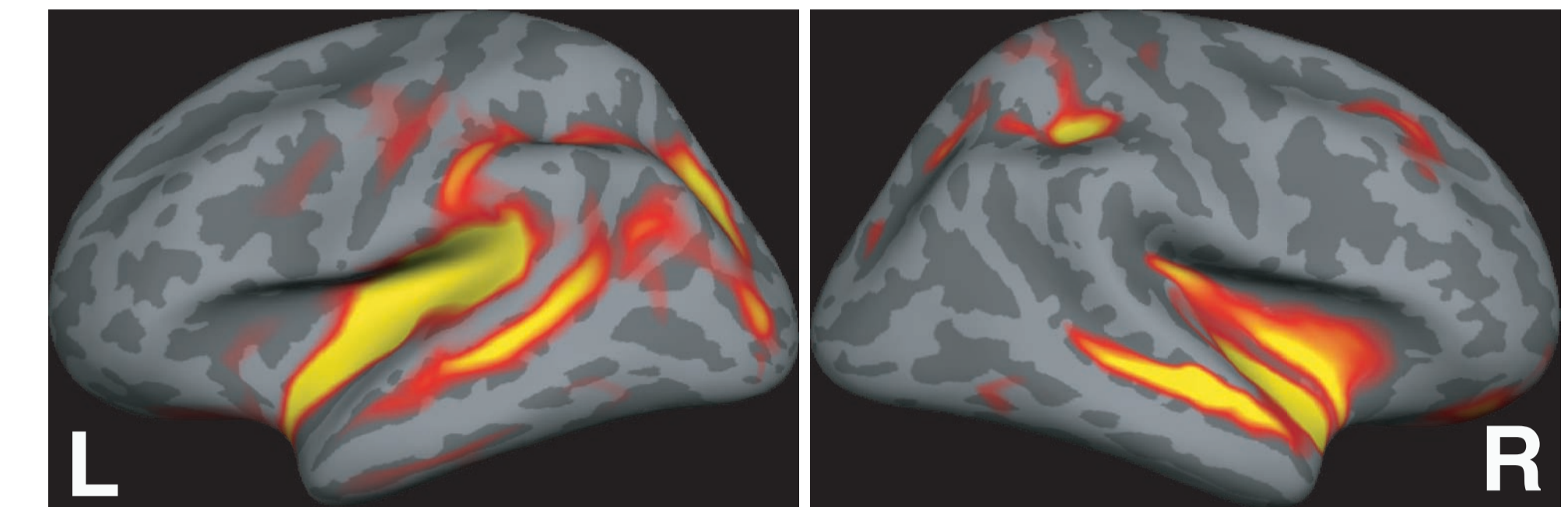
Results

Participant 1: At Risk

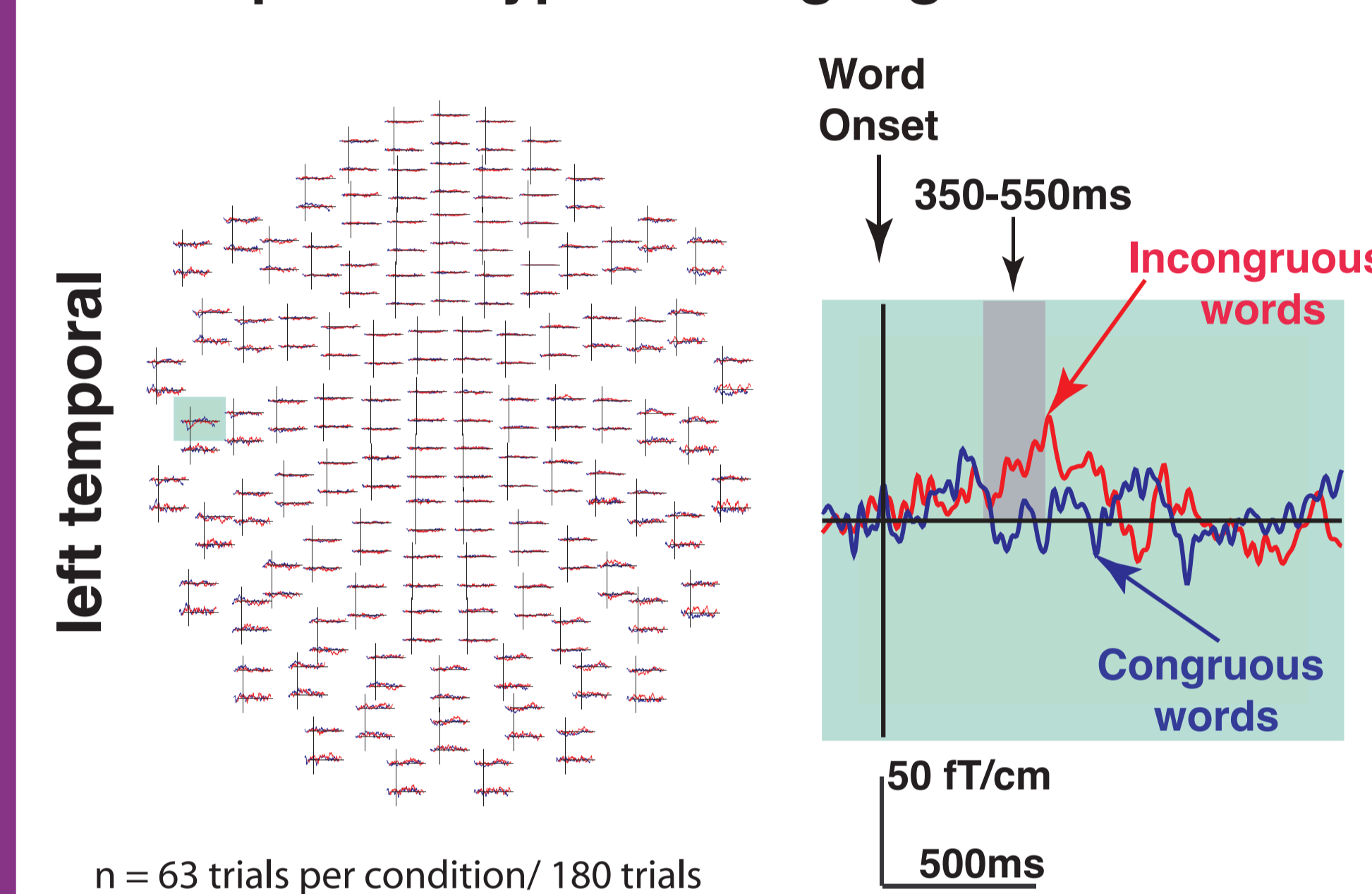


N400m Activity Observed in Infant At-Risk for SLI

Incongruent words - Congruent words 350-550ms

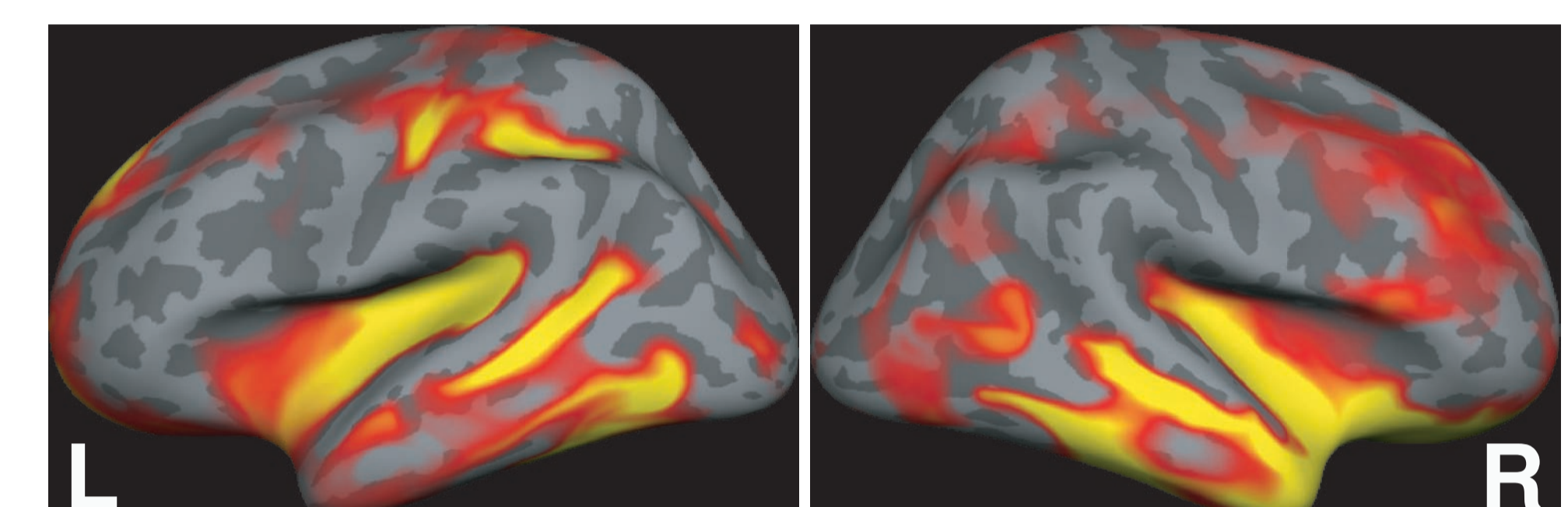


Participant 2: Typical Language

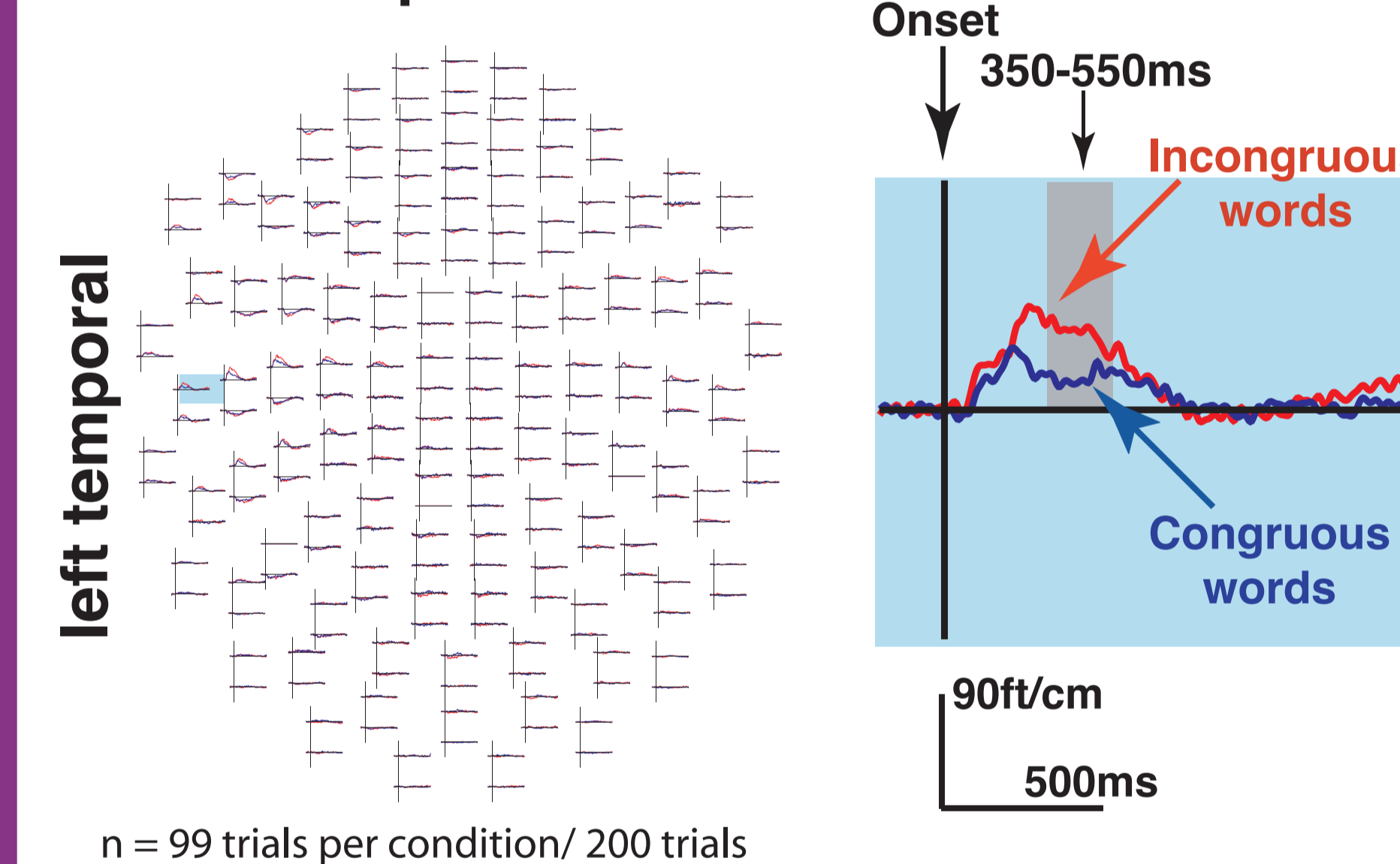


N400m Activity in Infant with Typical Language

Incongruent words - Congruent words 350-550ms

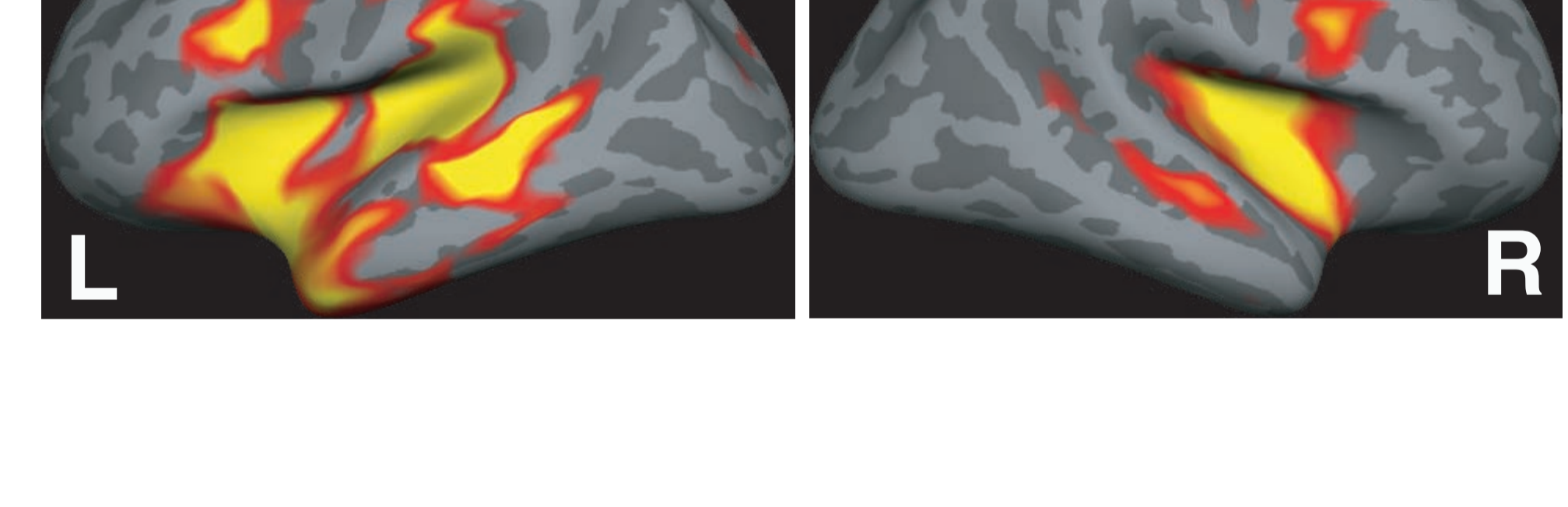


Adult Comparison



N400m Activity UCSD Undergraduate

Incongruent words - Congruent words 350-550ms



Conclusions

• When infants are familiar with experimental word stimuli, N400m activity shares similar latencies, cortical location and scalp topography as adult N400m activity (Halgren et al., 2002).

• N400m brain activity of infant at risk for SLI shares similar latencies, cortical location and scalp topography as age matched typical participant and adult N400m activity.

• In light of these qualitative similarities of N400m activity, future applications of Anatomically constrained MEG may be useful for:

- Quantifying spatial and temporal characteristics of N400m activity in typically developing children and those at-risk for developing SLI.
- Localizing the generators of N400m activity in adults with SLI which have been proposed to arise in different hemispheric regions (Helenius et al., 2009).
- Informing current understandings about the neural mechanisms that may be disrupted in developmental language disorders.