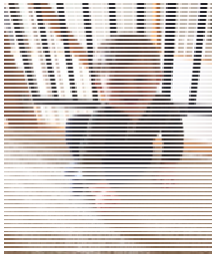

Development and Mechanisms of Language Impairment in ASD: Parallels with other Language Disorders

Helen Tager-Flusberg, Ph.D.

Research Symposium

ASHA, Orlando FL

November 22, 2014

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- NIH/NIDCD (RO1/R21)
- Simons Foundation for Autism Research
- Autism Speaks

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Overview

1. Autism spectrum disorder; language
2. Studying high risk infants in first year of life
3. Early concerns and language milestones
4. Mechanisms:
   - Neural underpinnings of domain general functioning
   - Neural underpinnings of speech perception and language;
   - Maternal contributions
5. Comparison to studies of early mechanisms in SLI
6. Conclusions

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1. Autism Spectrum Disorder

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Autism Spectrum Disorder: DSM 5

1. Impairments in **social communication**
2. Repetitive behaviors and restricted interests

Communication impairments include:

- Failure in back-and-forth conversation
- Deficits in nonverbal communicative behaviors
- Difficulties adjusting behavior to suit various social contexts

In addition need to specify whether ASD occurs with or without accompanying language impairment

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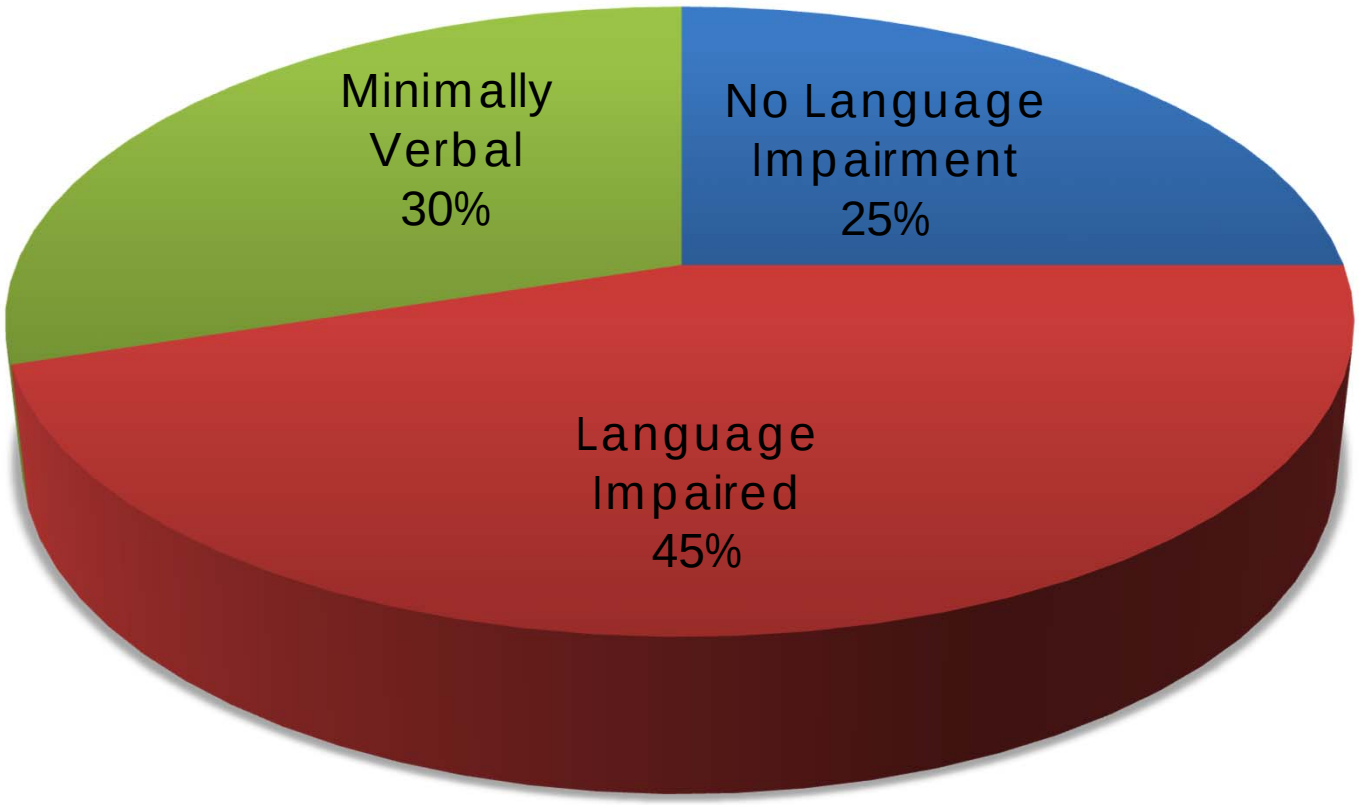
Language in autism



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Developmental profiles

- Over 90% delayed language milestones
- About 20 % language regression – loss of words, phrases in second year of life (unique to ASD)
- About 25% accelerated language growth in preschool years – catch up to peers (enrolled in EI)
- Most significant influence of early intervention: promotes language acquisition

Comprehensive behavioral programs(e.g., ABA; ESDM)
Target interventions (e.g., joint attention)

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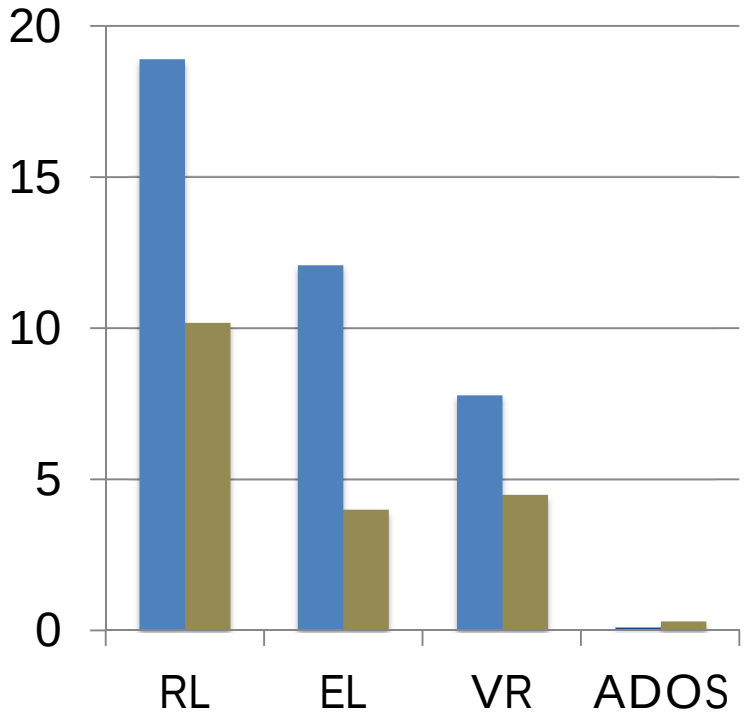
Early intervention: Language outcomes

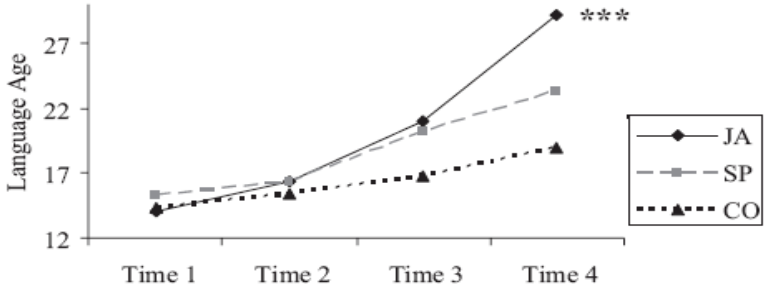
ESDM: Two year outcomes

Dawson et al. 2010



Joint attention

Kasari et al. 2008



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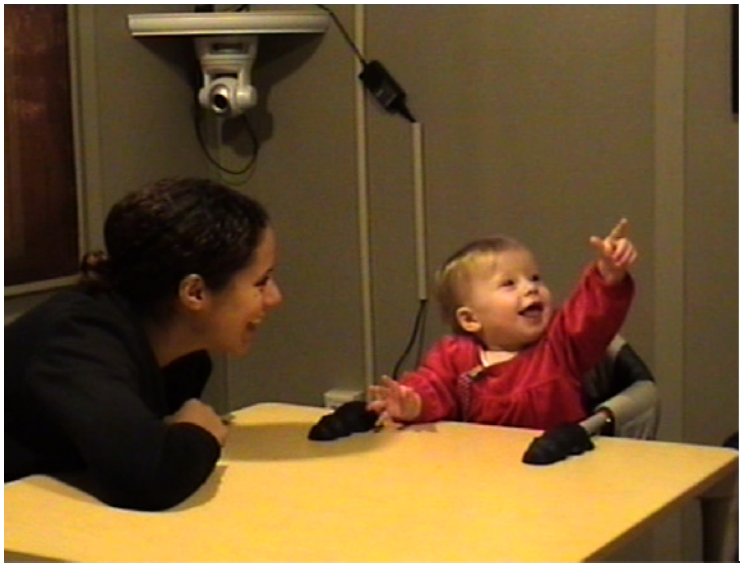
2. Studying High Risk Infants



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Studying early developmental trajectories

- Surge in interest during past decade in studying *infants at risk* for neurodevelopmental disorders –most extensive now for ASD
- 20+ groups from around the world, forming the Baby Sibling Research Consortium
- Compare infant with older sibling with ASD to low risk control
- *(And for us, an attempt to have group with an older sibling with SLI….)*

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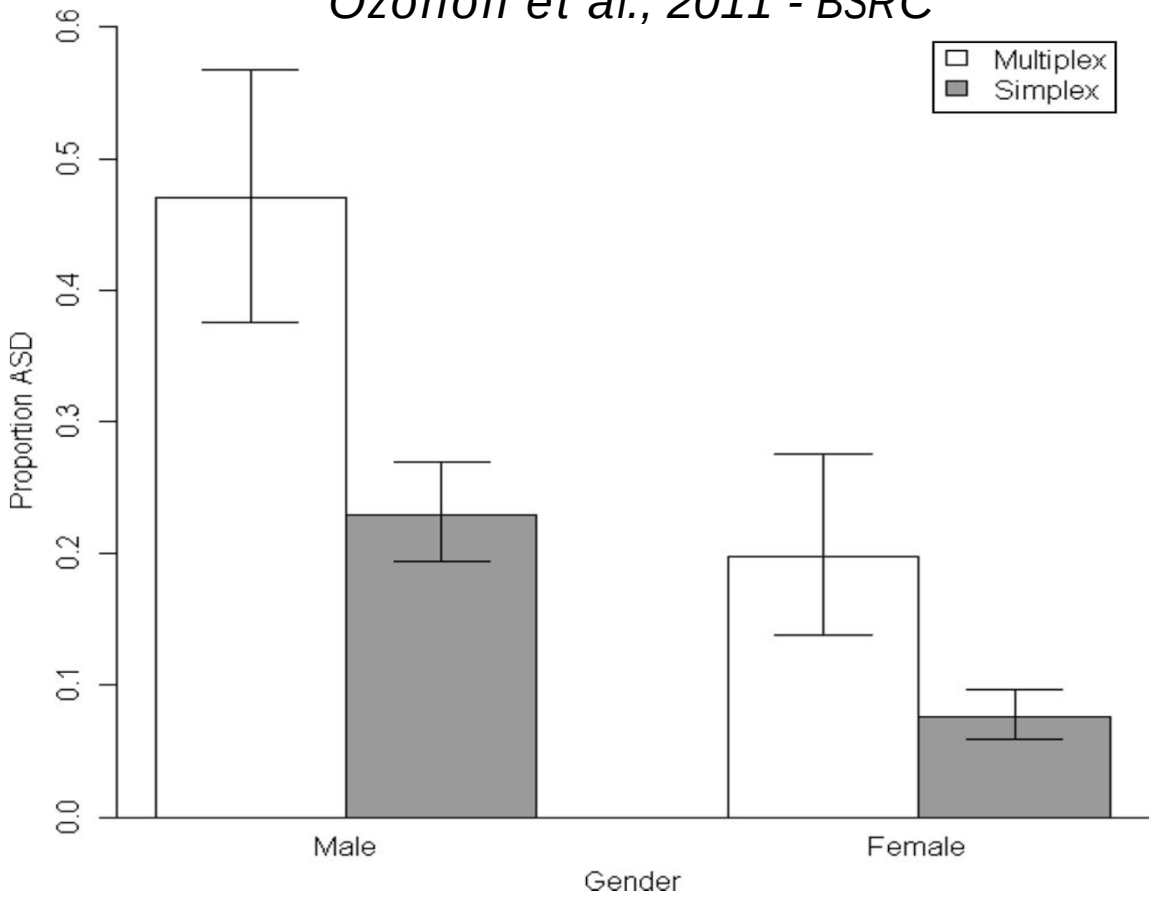
Recurrence rate: 18.7% overall

Ozonoff et al., 2011 - BSRC



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ASD demographic risk factors

1. Males > females
2. Family history/genetics
3. (Parental age)

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General findings from infant sibling studies

- ASD manifests as change in developmental trajectories (Ozonoff et al., 2010)
- Behavioral onset of ASD in the second year of life –declines in social engagement (eye contact, social smiles)
- Slowed cognitive development
- ***Delays in language and gesture at 12 months***

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Our Infant Sibling Project

infant sibling STUDY

- Collaboration between Boston University and Children's Hospital Boston – Charles Nelson
- Time points: 3, 6, 9, 12, 18, 24, and 36 months
- Include wide range of behavioral and observational measures; complement with home video diaries (6-18 months)
- Eye-tracking measures – face and language
- Brain measures –measures of brain *function*
  - Electrophysiology (EEG; ERP) – face & language
  - Near Infra-Red Spectroscopy (fNIRS)

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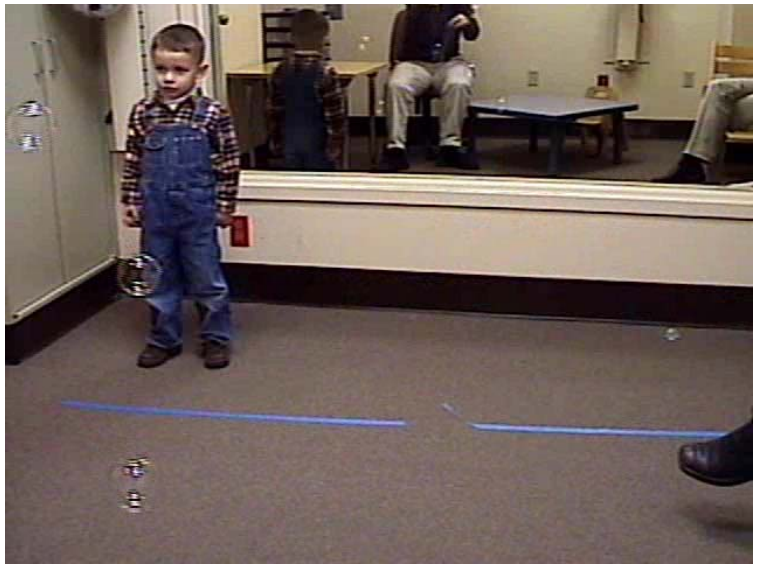
3. Early Concerns and Language Milestones



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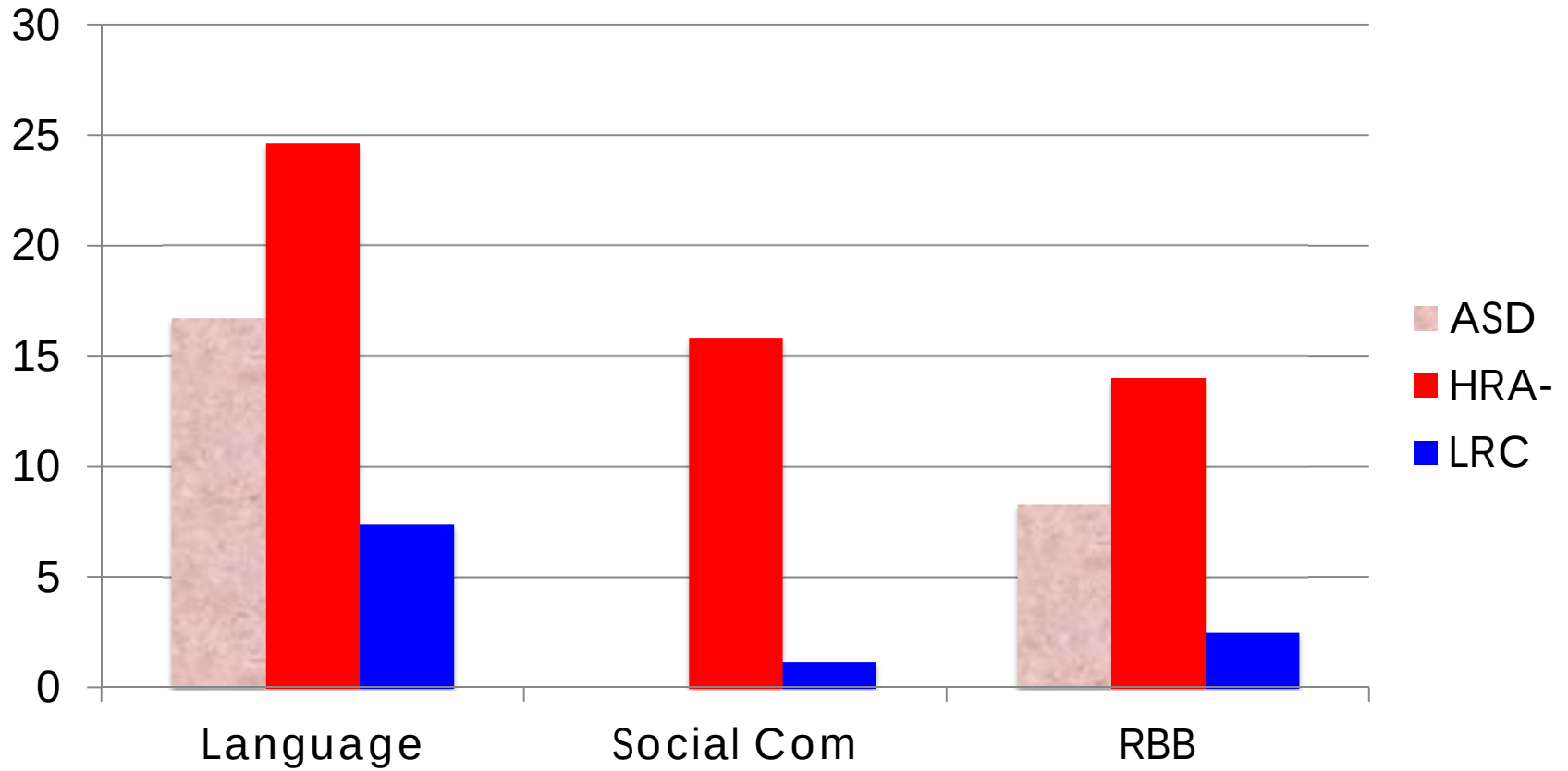
Concerns at 6 months



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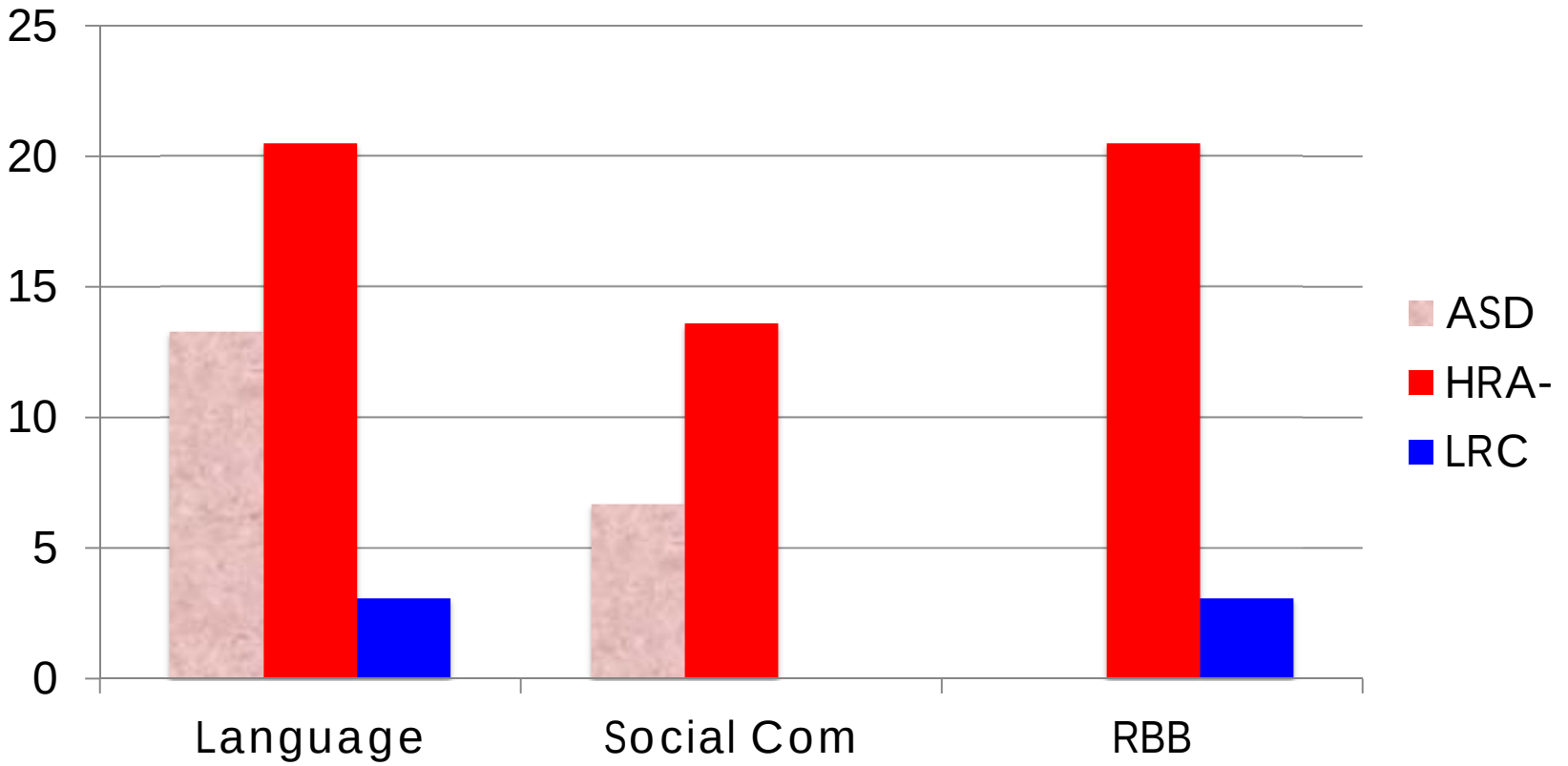
Concerns at 9 months



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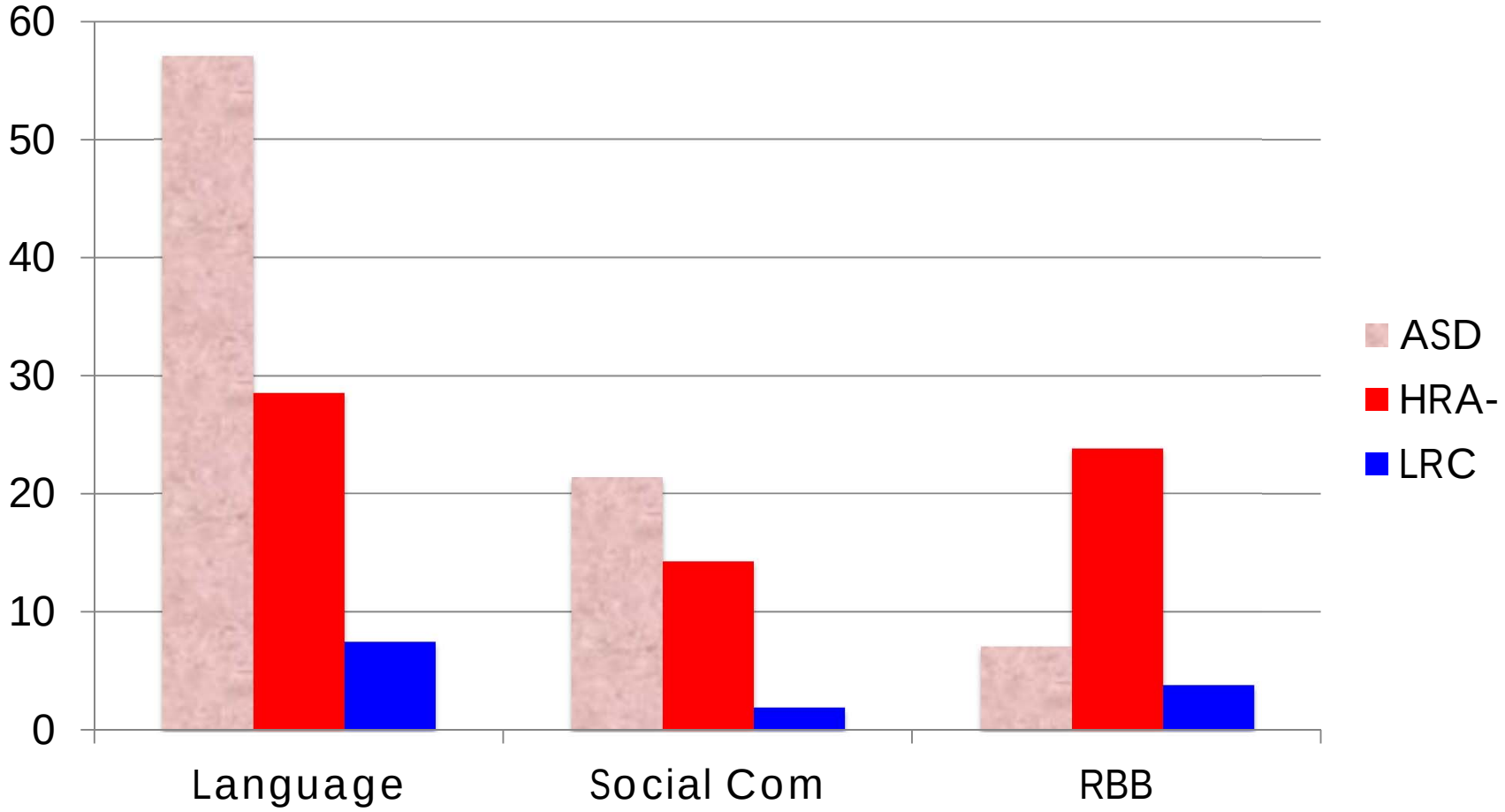
Concerns at 12 months



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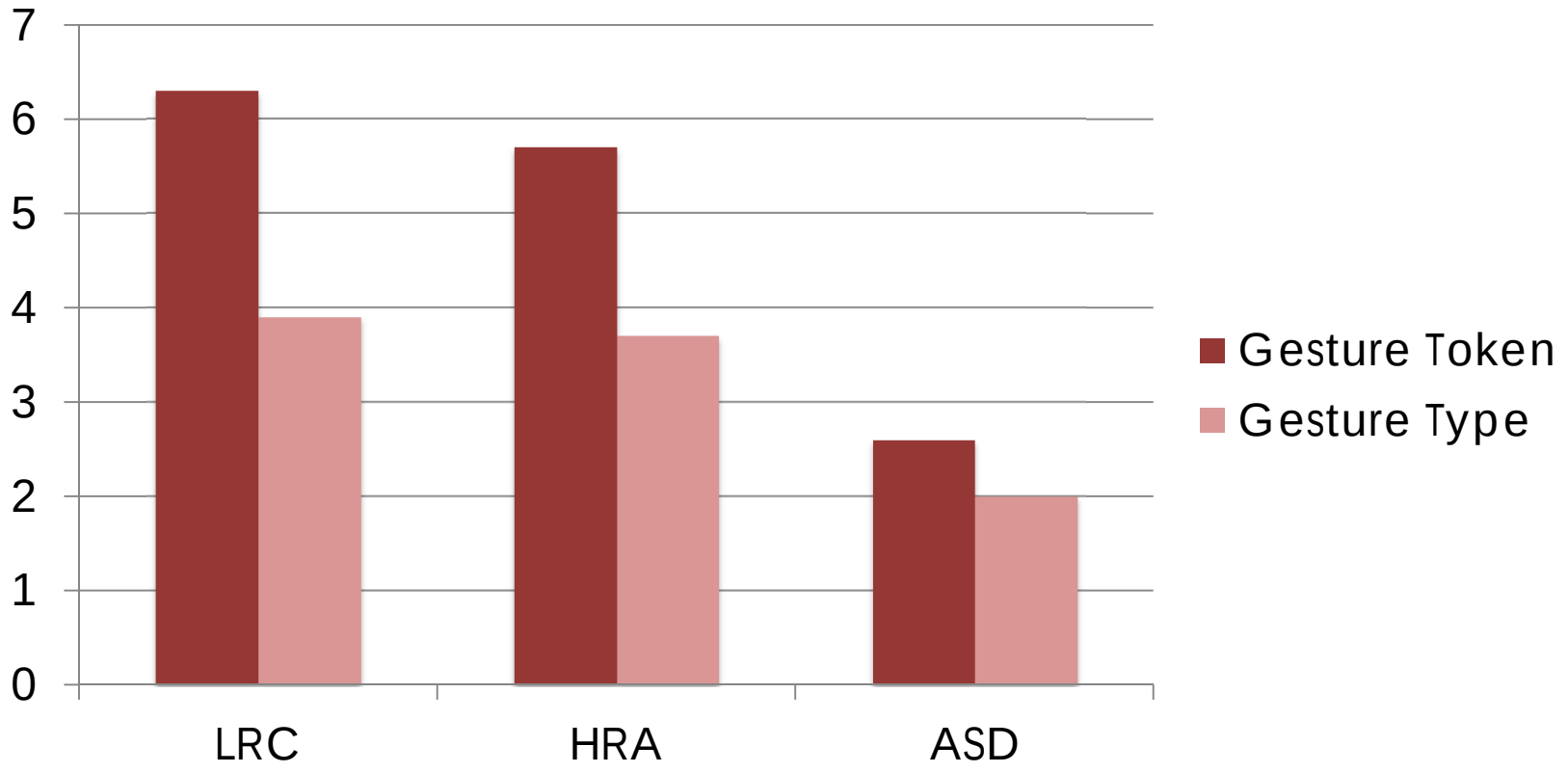
Infant 12 month gesture use



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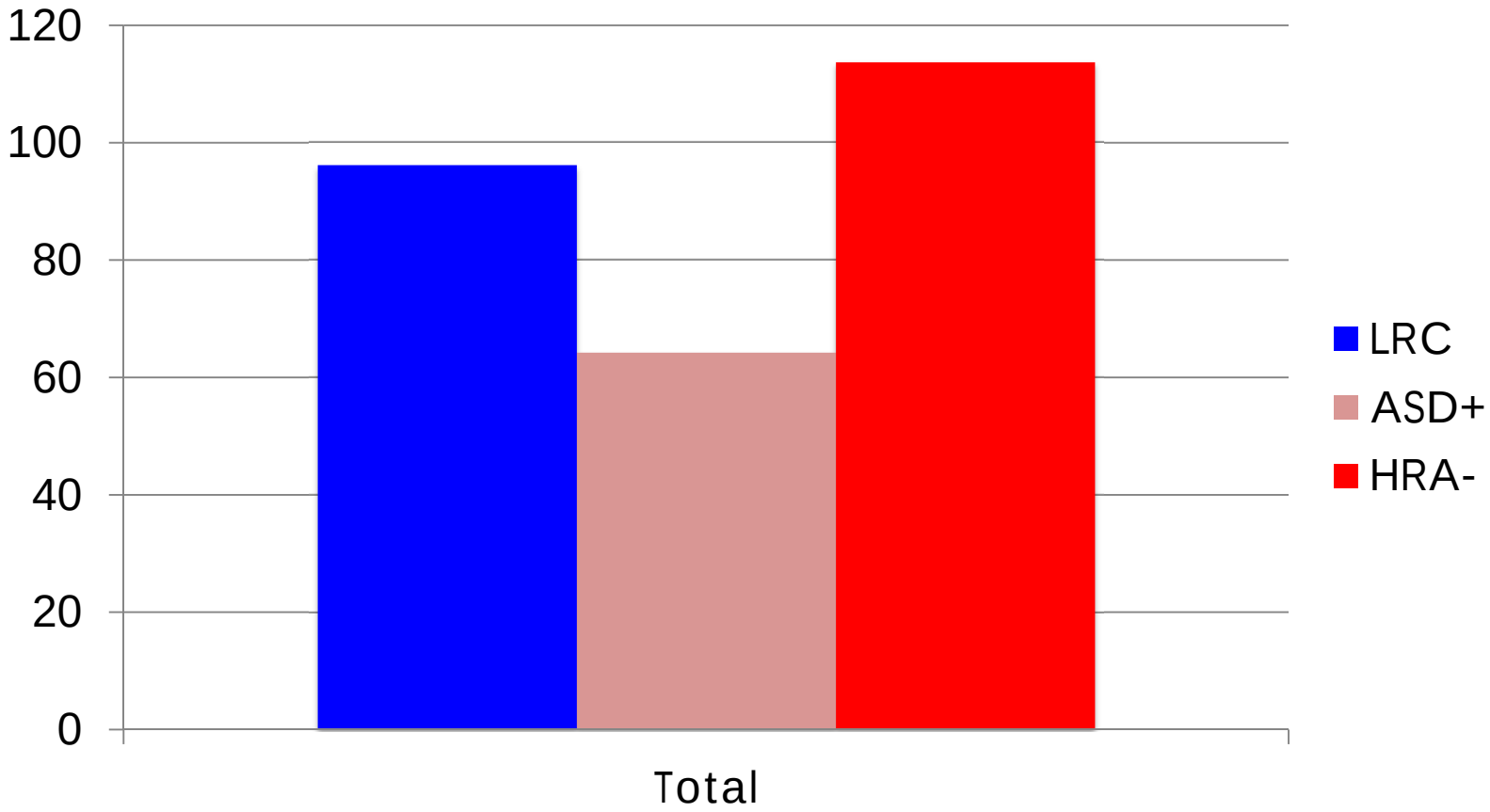
Early vocalizations @ 12 months



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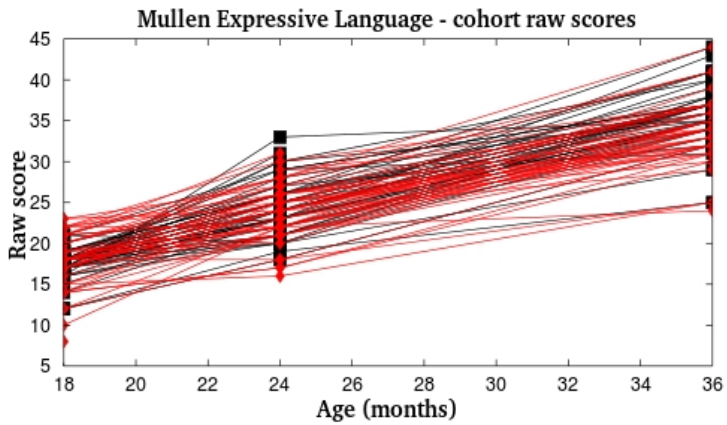
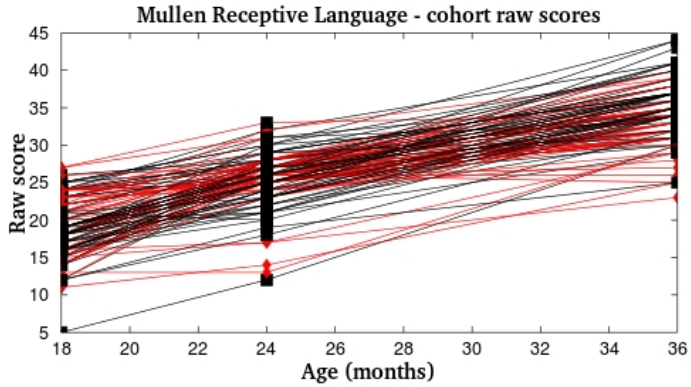
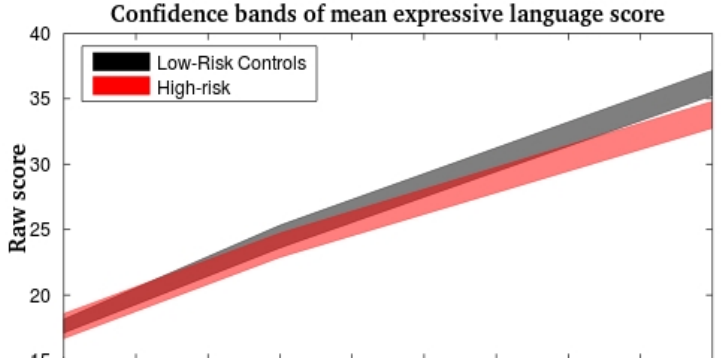
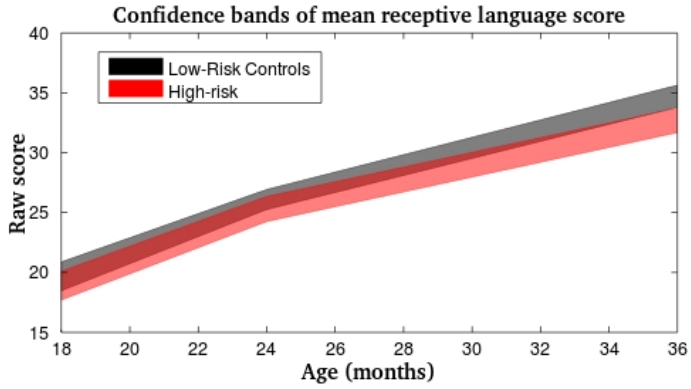
Growth curves: Mullen language scores









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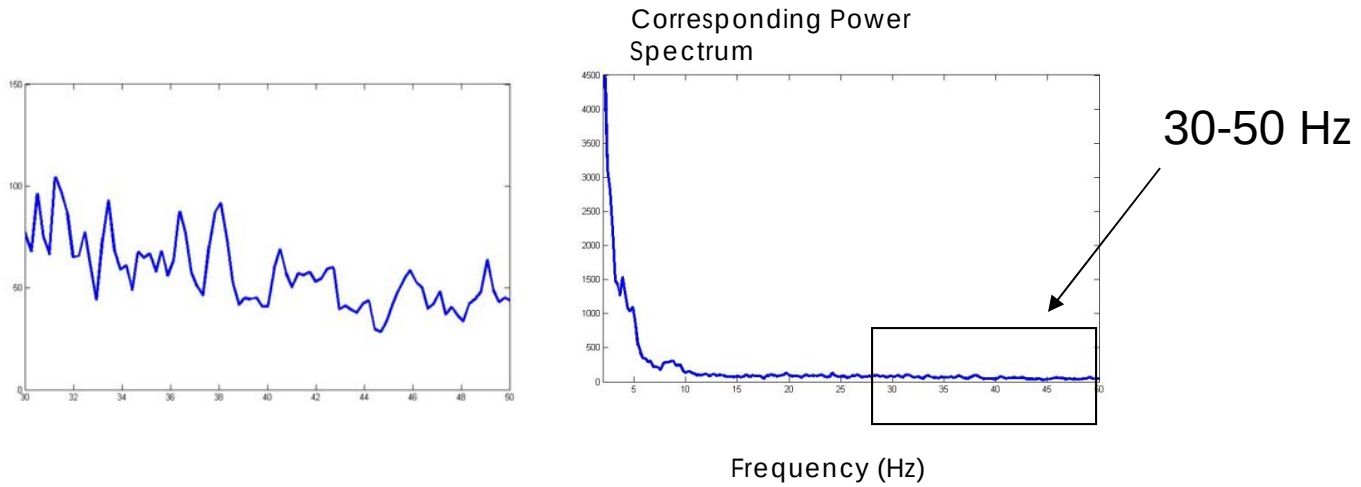
4. Mechanisms

Gamma frequency

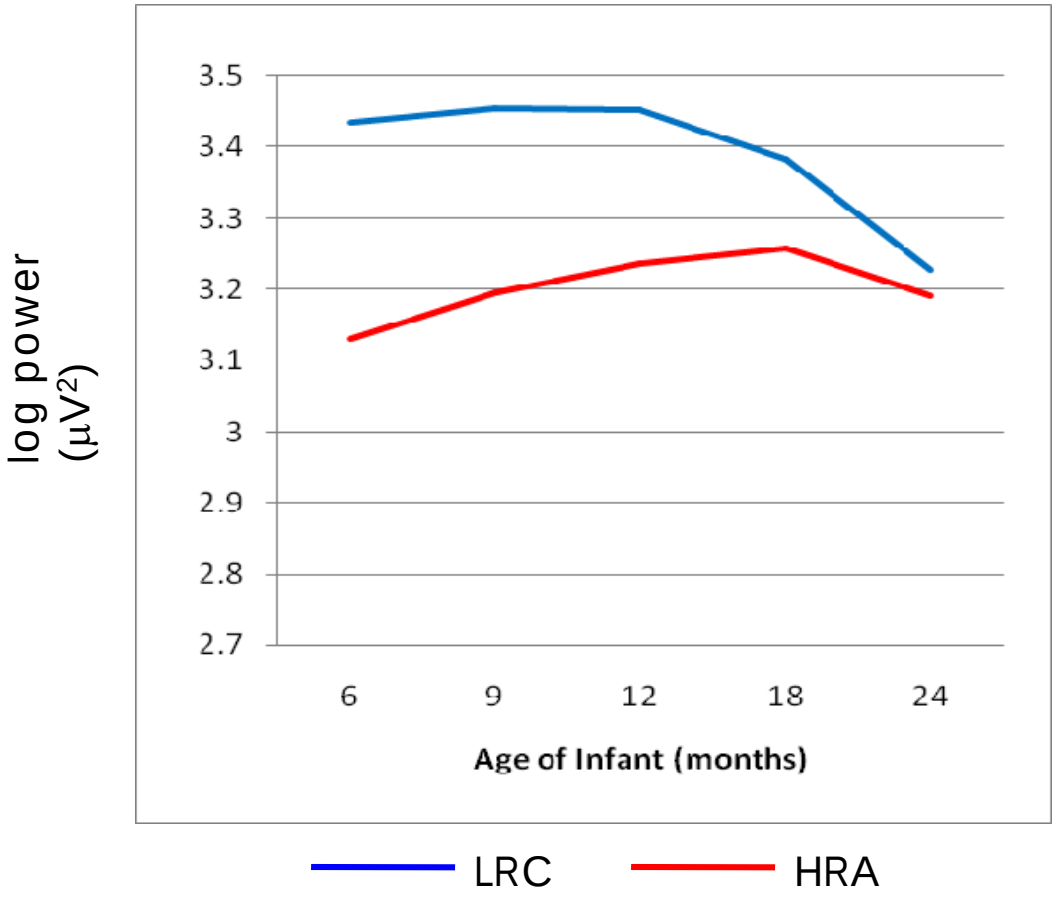


- Associated with cognition – attention, working memory, learning
- Involved in integrating information in different brain networks, which is required for complex skills

Development of EEG – spectral power

- Baseline/resting state EEG
- Collected at least 2 minutes over frontal regions 6-24 months

Group differences in frontal gamma power



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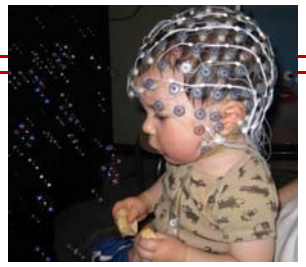
Speech perception

1. Perceptual narrowing at 9-12 months ---related to attending to the linguistic environment, *in social contexts*

Do infants later diagnosed with ASD fail to show perceptual narrowing?

2. Studies of children and adults with ASD (and their relatives) show *atypical brain asymmetry* – non left lateralized for language

Do infants at risk or later diagnosed show atypical lateralization to speech?



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Perceptual narrowing study

- Based on Pat Kuhl's research paradigm
- Double oddball procedure:
  - /da/ - 80% of time **standard**
  - /ɖa/ - 10% of time **non-native** contrast
  - /ta/ - 10% of time **native** contrast

Expect at 6 months infants differentiate standard and non-native contrast; by 12 months should not

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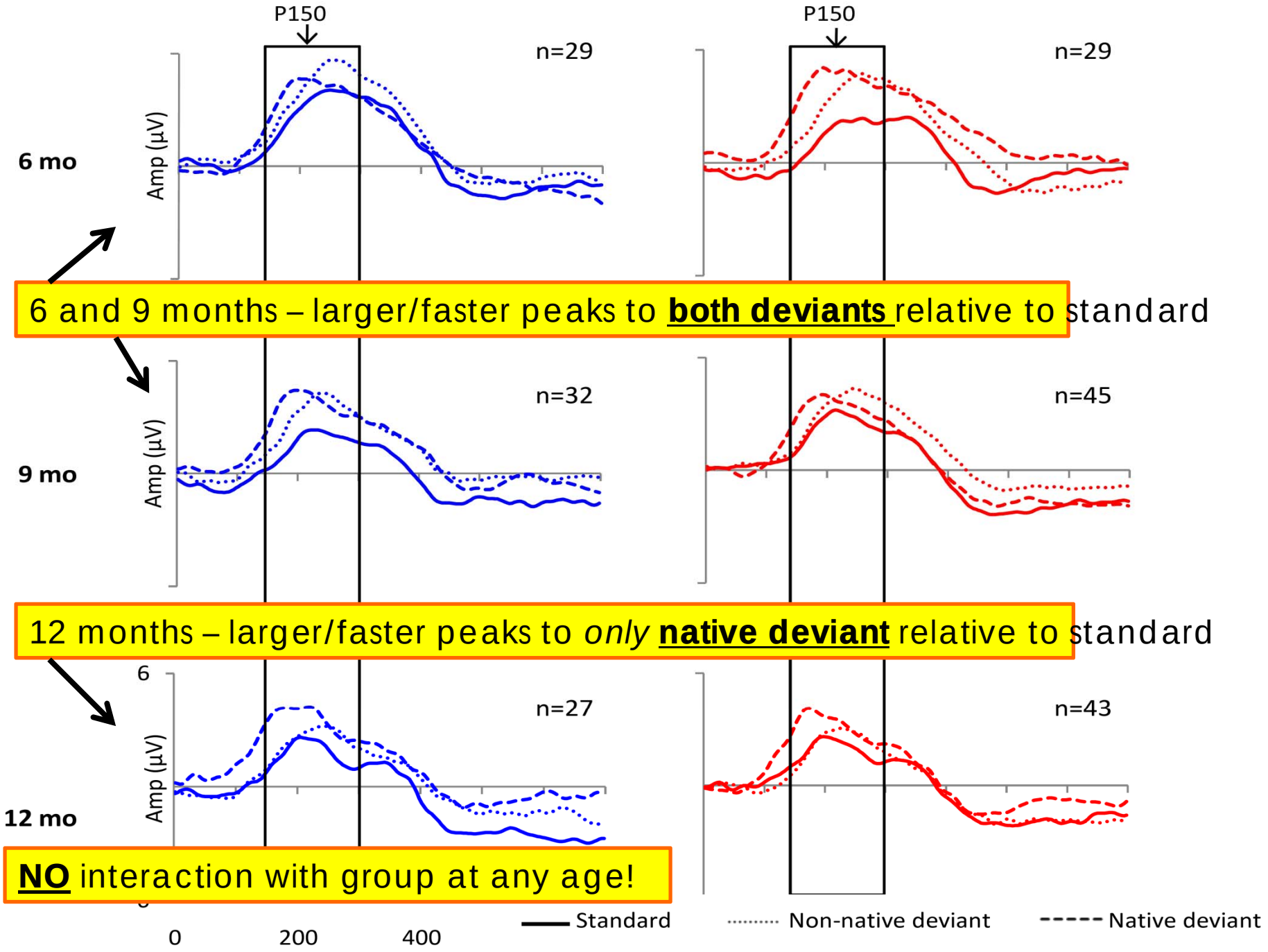
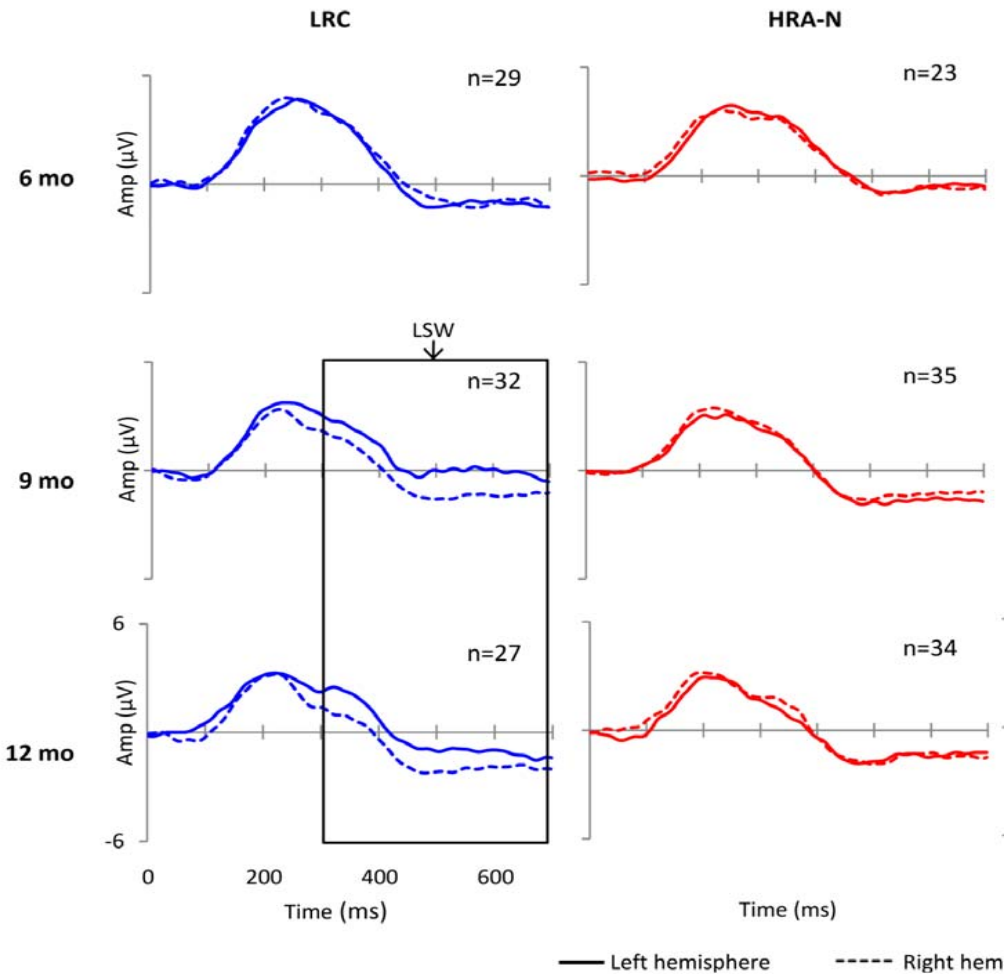


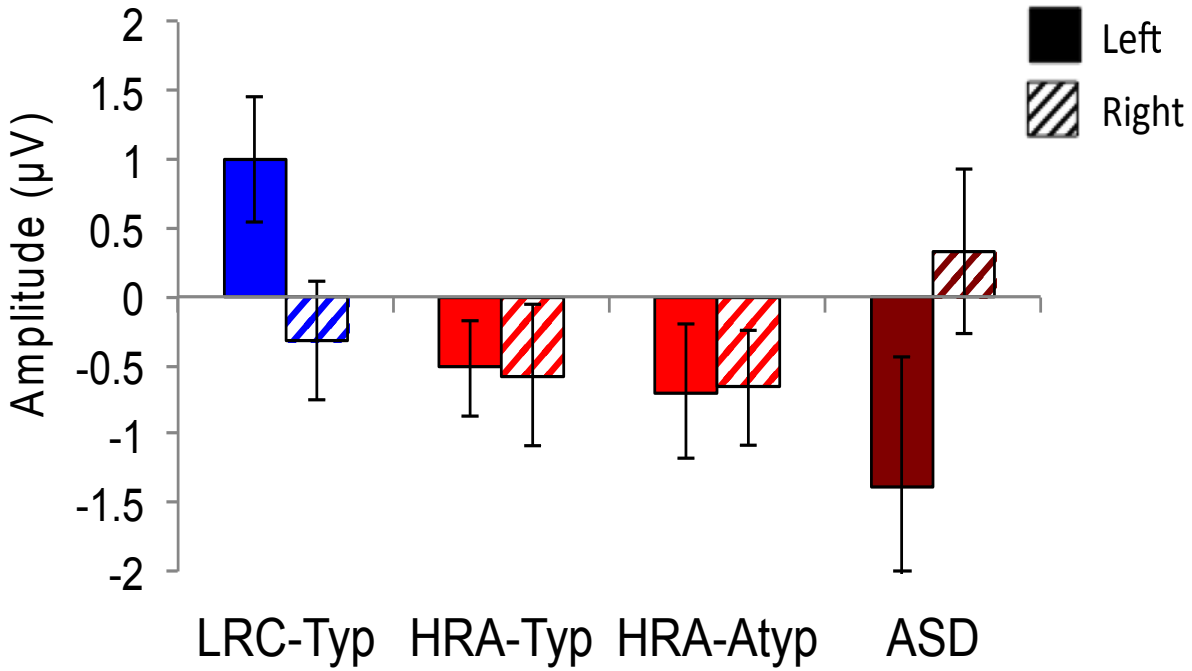
Late slow wave – sensitive to lateralization/asymmetry



Low risk:
Right more negative than left at 9 and 12 months

High risk:
No difference at any age

Lateralization of LSW @ 12 months by outcome



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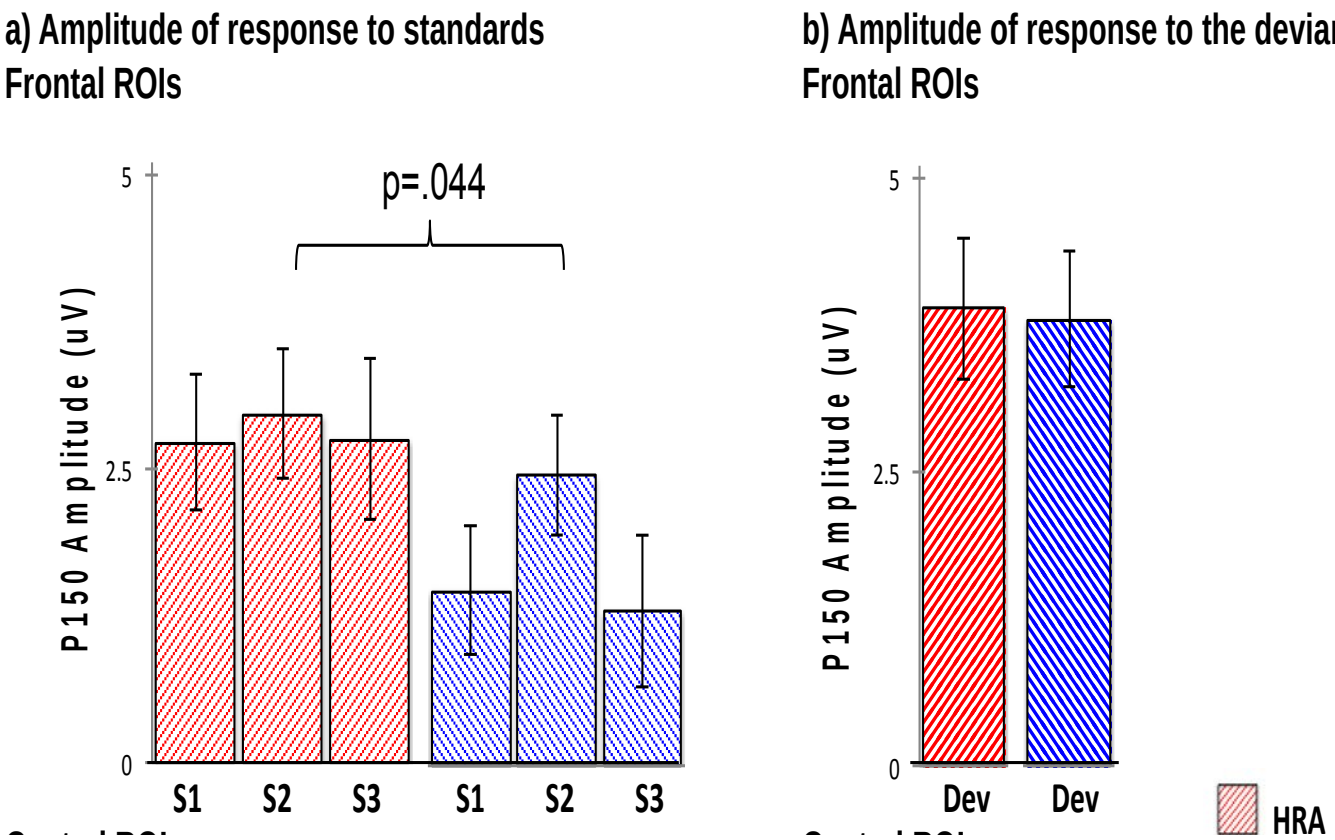
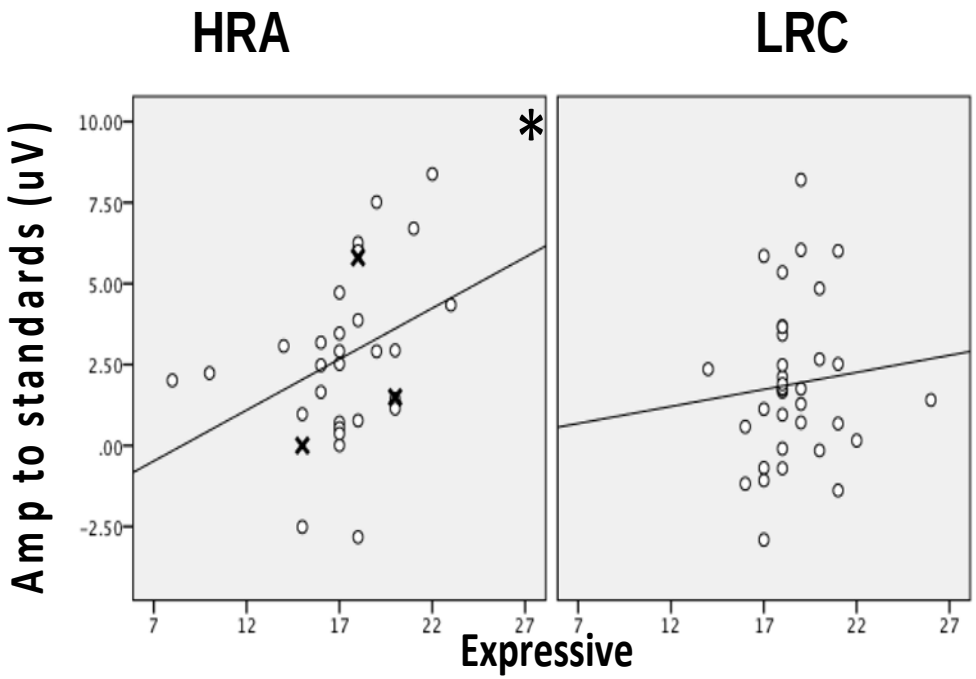
Enhanced P150 amplitude to standard */da/* @ 9 months in HRA



Correlation between amplitude of P150 Response @ 9 months and expressive language @ 18 months



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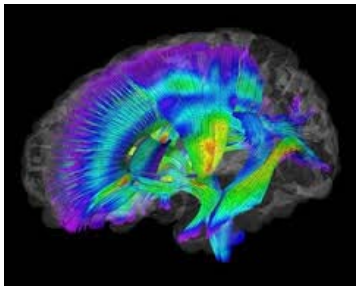
Brain connectivity in ASD



Anatomical connectivity: fewer long range connections (inter-regional) in children and adults with ASD

Functional connectivity is reduced in ASD, compared to controls - intra- and inter-hemispheric connectivity

How early do connectivity differences emerge?

Are they specific to ASD outcome infants?

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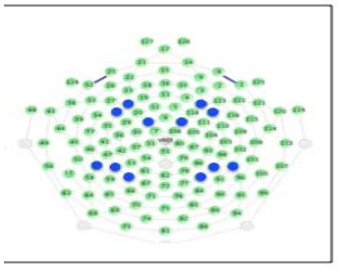
Functional connectivity in infants

- Measured connectivity during speech task
- Metric of functional connectivity was **event-related coherence in gamma**:
  - Measure of similarity between signals in different regions of the brain, which reflects strength of functional connection between two regions: frontal and parietal



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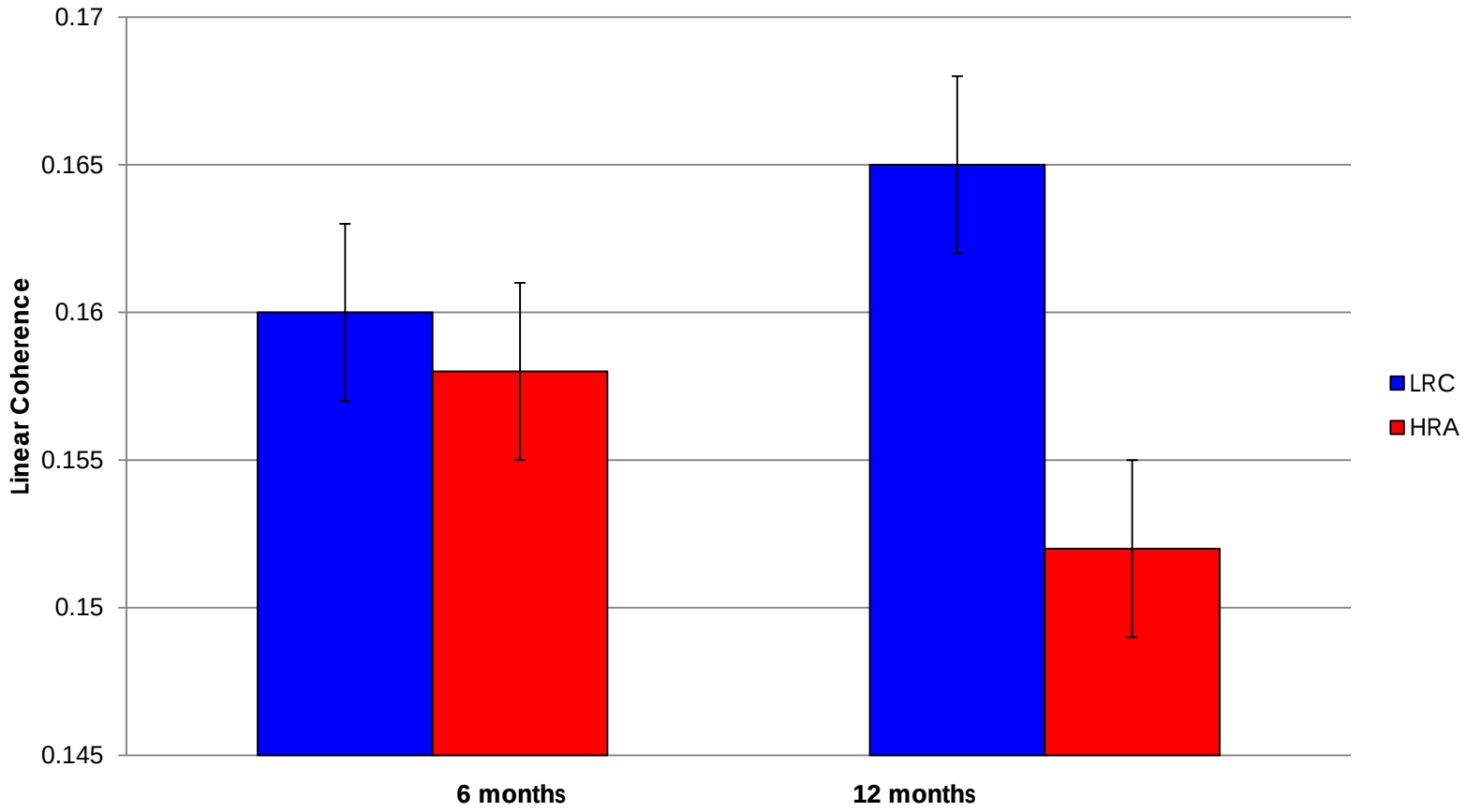
Linear coherence at 6 and 12 months



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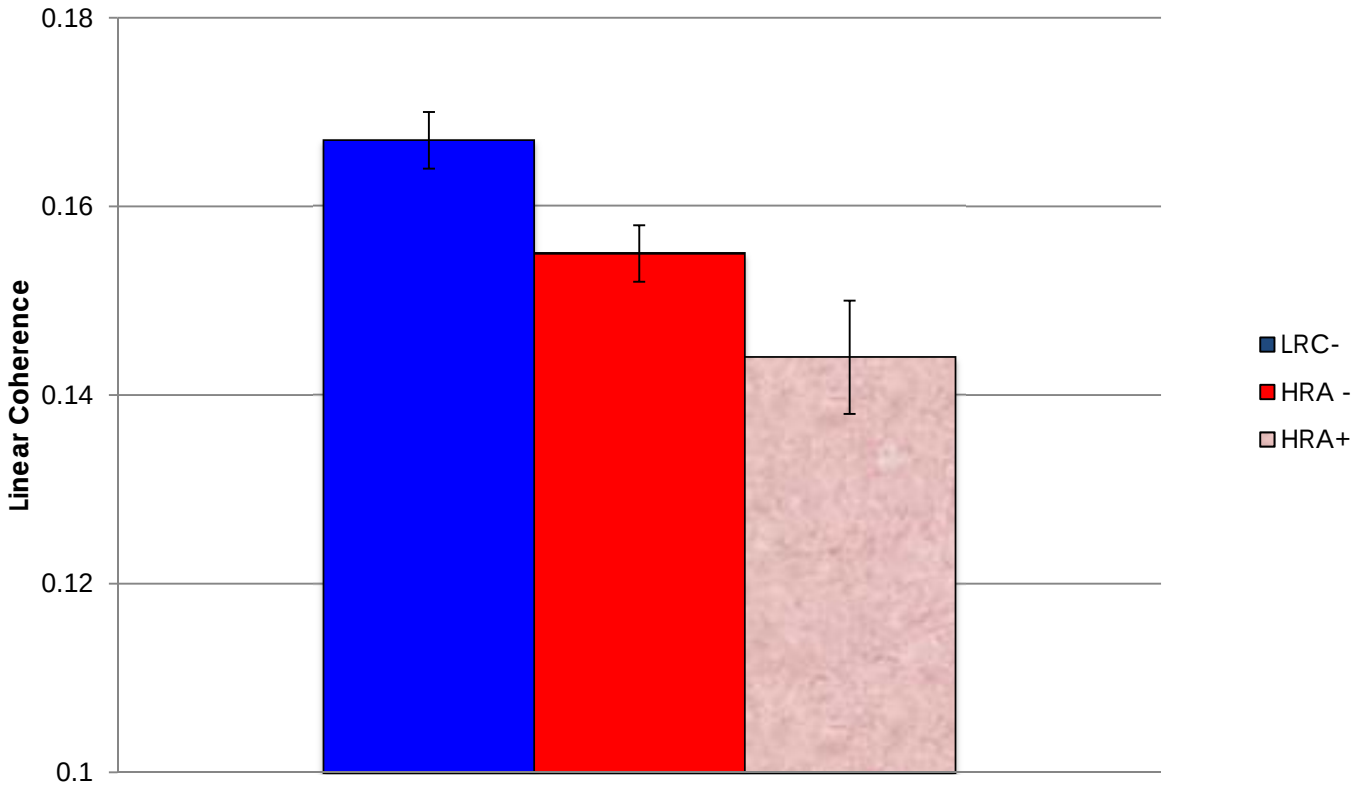
12 month data for ASD outcomes



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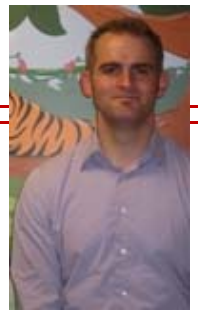
Connectivity analysis using fNIRS

- Auditory processing paradigm: ABB vs. ABC syllables
- Infants listened to 28 blocks of artificial "words" with syllables in either an ABB or ABC pattern (e.g., *penana* vs. *baloti*)
- Infants at high-risk (HRA) and low-risk comparison (LRC) infants were tested at 3-, 6-, 9-, and 12-months



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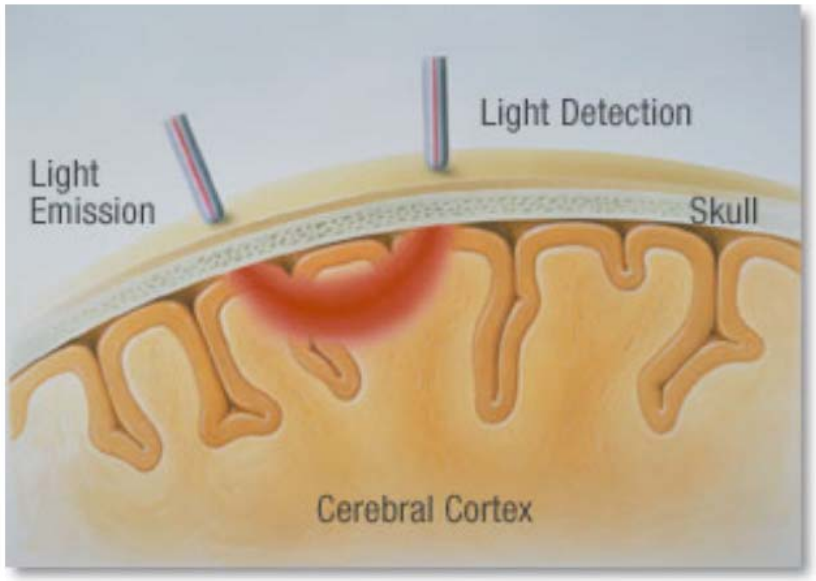
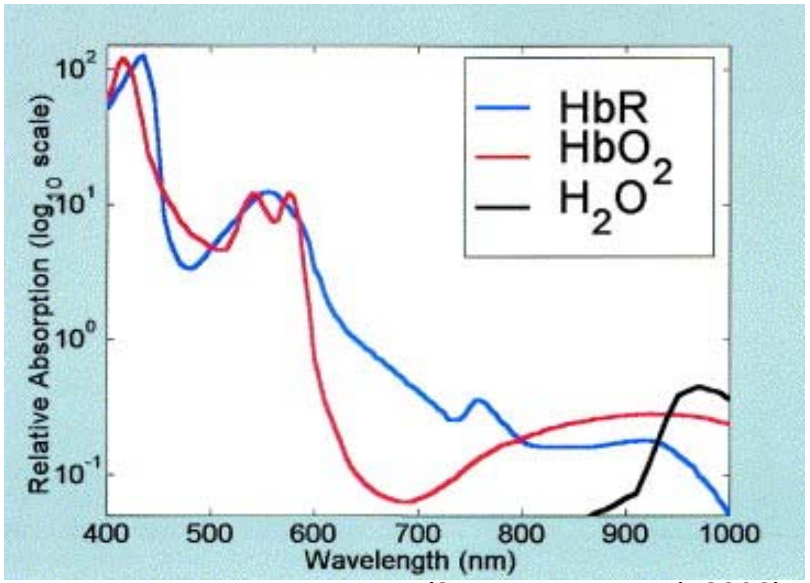
Near-Infrared Spectroscopy (fNIRS)



(courtesy of Aslin Lab, University of Rochester



(Strangman et al. 2002)

Same concept as pulse oximetry, but measure OxyHb and DeoxyHb separately

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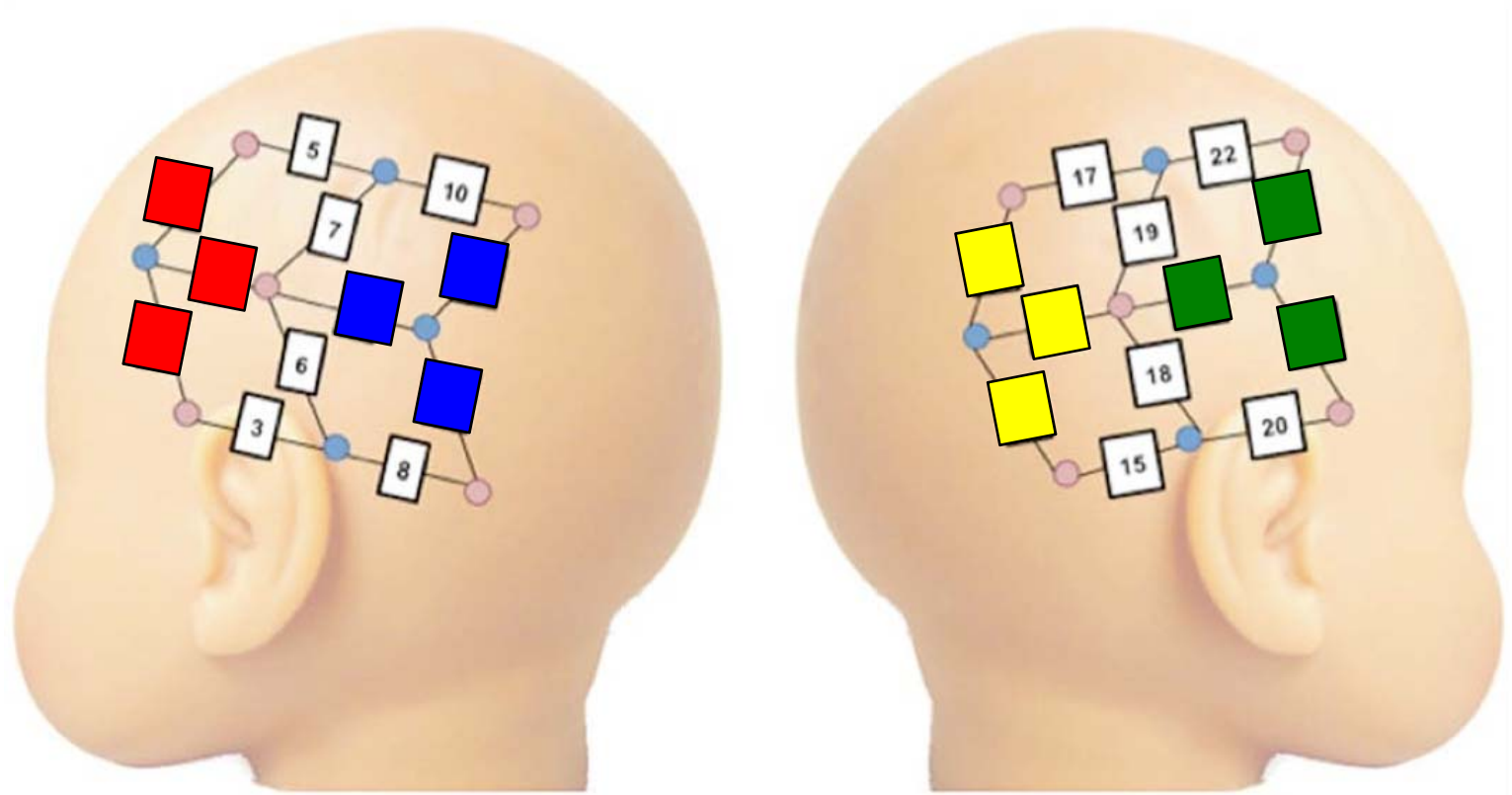
Regions of interest



Left Frontal | Left Parietal | Right Parietal | Right Frontal

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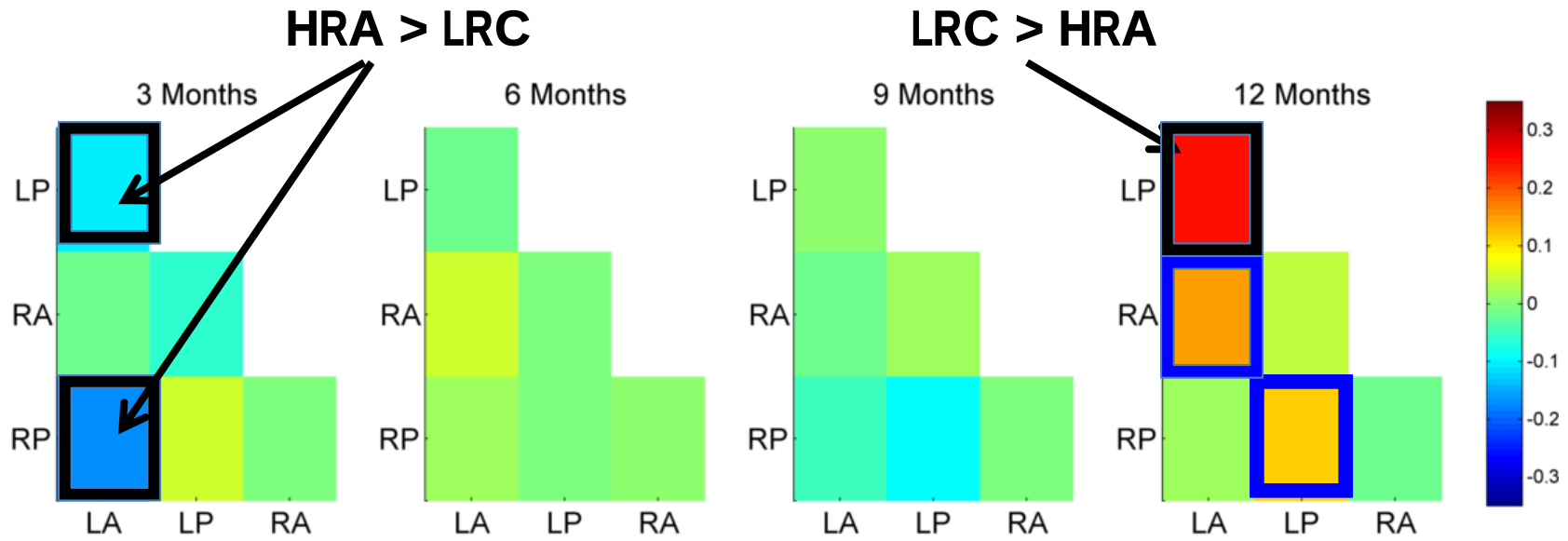
Findings

Differences in regional connectivity between low and high risk infants

Correlation matrices:



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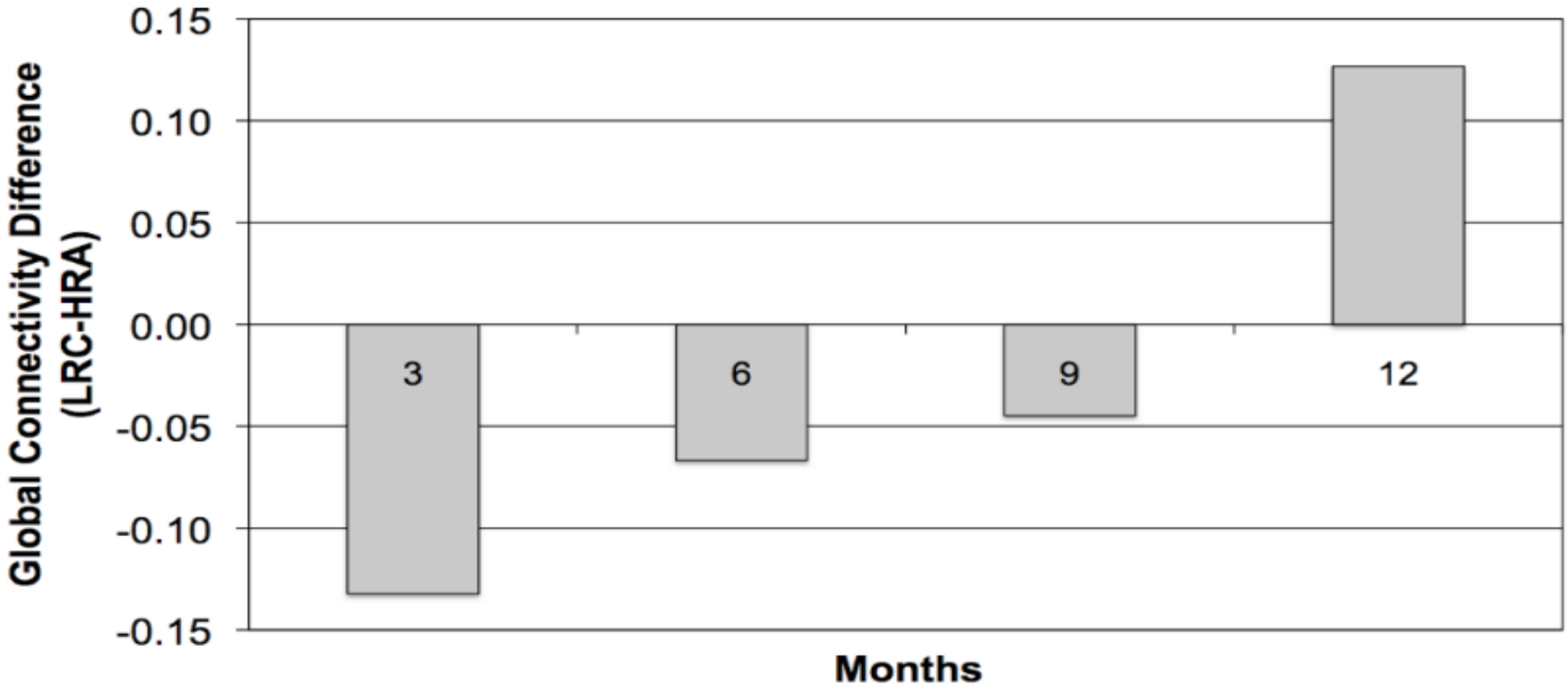
Global connectivity differences between LRC and HRA



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Home-based video diaries

- Between 6 and 18 months mothers recorded home videos on a monthly basis
- Recorded interaction with their infant in a series of vignettes (play with novel toys, book reading, toy drop event, social games)
- The videos complement data collected in the lab – naturalistic **mother-child** interactions

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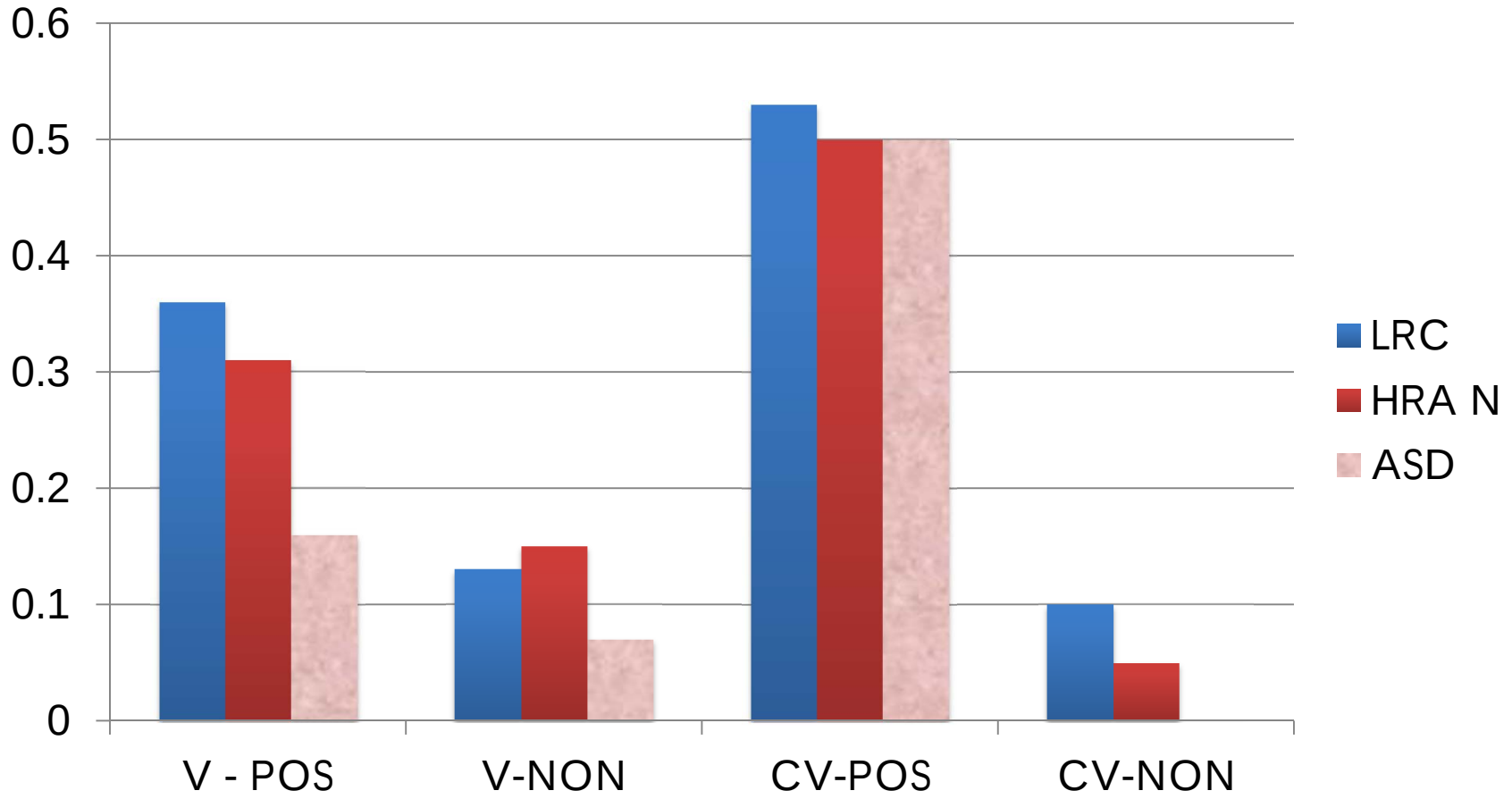
Maternal responses to infants' vocalizations @ 9 Months



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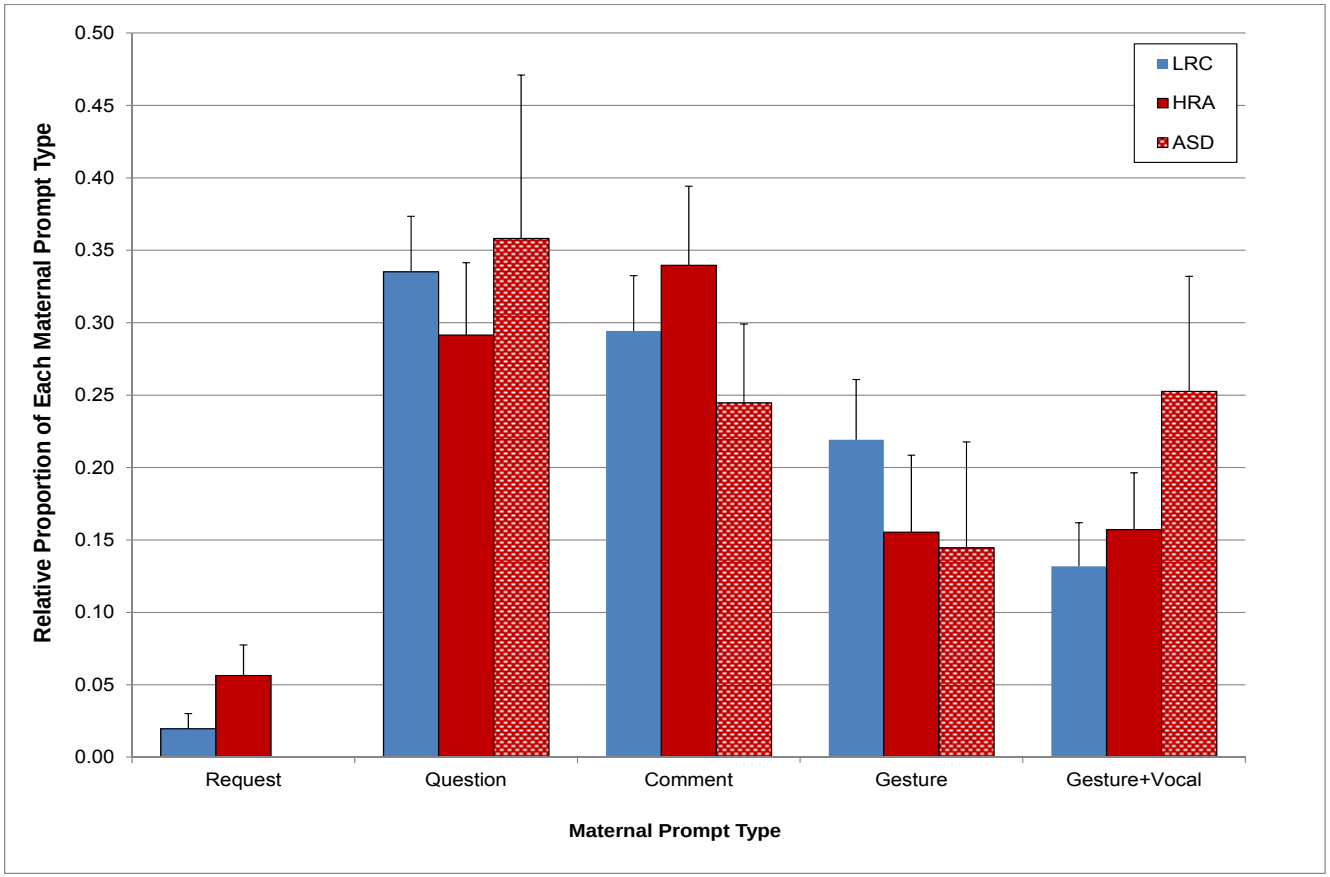
Maternal communication @ 12 months during toy drop



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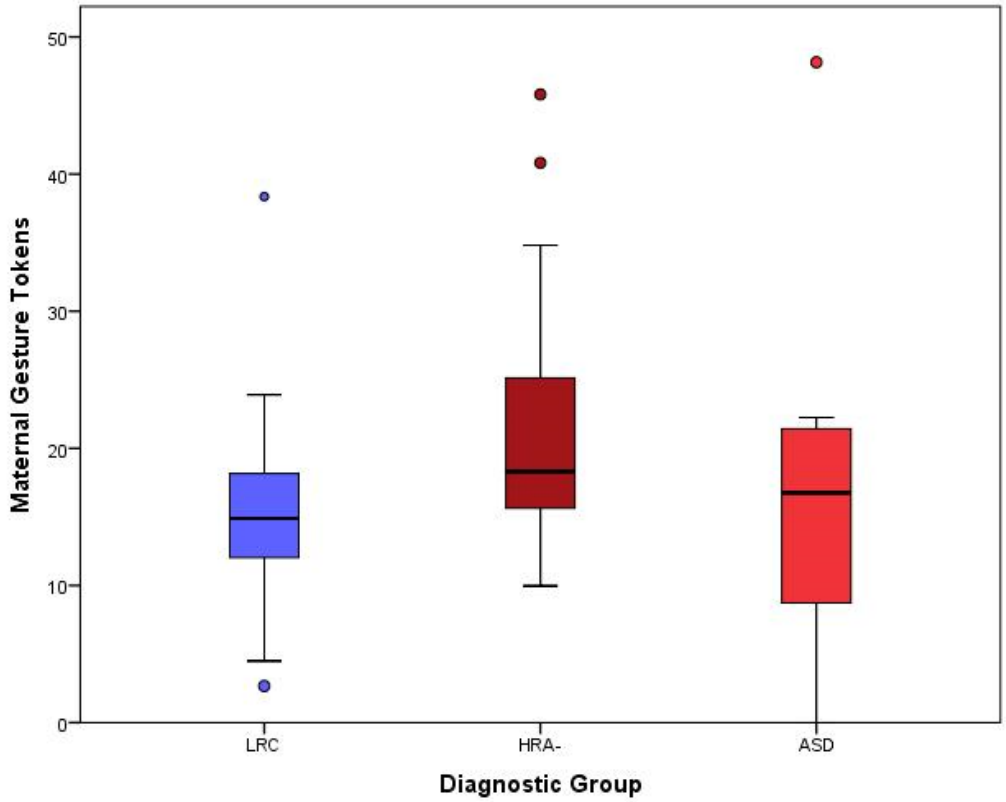
Maternal gesture at 12 months



LRC HRA- ASD+

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Summary

- Differences in the first year of life in frontal gamma power – related to risk, not outcome
- Atypical neural response cortical organization and reduced neural connectivity in neural systems underlying speech/language – extreme differences found in ASD outcome infants
- No differences in maternal linguistic or gestural behavior

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5. Comparisons to SLI

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SLI: Risk factors and early signs

1. Males > females
2. Family history
3. Parental concerns
4. Delays is early gesture use and language milestones
5. Slowed growth in language during preschool years

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SLI: Neural/cognitive mechanisms

1. Lower resting frontal gamma 16-36 months (Benasich et al., 2008)
2. Higher rapid auditory processing threshold to tones at 7 months (Benasich & Tallal, 2002)
3. Atypical lateralization of response to tone pairs 6-12 months (Choudhury & Benasich 2011)
4. Delayed mismatch response to changes in syllable length at 2 months (Friedrich et al., 2004)
5. Delayed mismatch response to changes in word stress 4-5 months (Weber et al., 2005)
6. Reduced mismatch response to tones at 6 months (Benasich et a., 2006)

6. Conclusions

Gaps and future research

- Many parallels between risk factors and mechanisms for language impairment in ASD and SLI
- Studies of brain development employ different paradigms and measures
- Longitudinal studies highlight developmental trajectories, which may differ across disorders
- Studies of risk may contribute to development and implementation of targeted early or preventive interventions

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Children and families participating in the projects!

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