Role of MEG in examining neural basis of ASD & Psychopathologies

Tal Kenet
Disclosures

Neither I nor my spouse/partner has a relevant financial relationship with a commercial interest to disclose.
History: Local functional connectivity in ASD

Review

Model of autism: increased ratio of excitation/inhibition in key neural systems

J. L. R. Rubenstein* and M. M. Merzenich*

Nina Ireland Laboratory of Developmental Neurobiology, Center for Neurobiology and Psychiatry, Department of Psychiatry and... is now evidence that the rate of occurrence is roughly 30/10000, and that its incidence is progressively increasing (Fombonne 2002; Yeargin-Allsopp et al. 2003). Autism

➢ Theory: Increased E/I ratio would result in increased local functional connectivity in ASD
Cortical activation and synchronization during sentence comprehension in high-functioning autism: evidence of underconnectivity

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Theory: Generalized reduced long-range functional connectivity in ASD
DUAL MODEL OF FUNCTIONAL CONNECTIVITY ABNORMALITIES:

- Reduced long-range functional connectivity, alongside increased local functional connectivity.

- Long-range functional connectivity is mostly found to be decreased in ASD, by most motion corrected fMRI studies, but there are also studies showing increased, mixed and sometimes normal connectivity in ASD.

- Local functional connectivity is still mostly thought to be increased in ASD, despite lack of direct evidence to support this claim.
Role of MEG: Cortical Time Scales!

From: State of the art Buzsaki Lab, 2012
Feedforward versus Feedback:

**Feedforward**
- Also referred to as “Bottom-Up”, inputs “upwards” into the cortex
- Defined anatomically, as inputs arriving into layer IV in the cortex

**Feedback**
- Also referred to as “Top-Down”, inputs “back” into lower cortical areas
- Defined anatomically, as inputs arriving into layers II/III in the cortex
Hypotheses

• Long-range feedback based functional connectivity is decreased in ASD

• Local feedback based functional connectivity is decreased in ASD

• Long-range feedforward based functional connectivity is increased in ASD
Hypotheses

• *Long-range* feedback based functional connectivity is *decreased* in ASD

• *Local feedback* based functional connectivity is *decreased* in ASD

• *Long-range feedforward* based functional connectivity is *increased* in ASD
Hypotheses

• *Long-range* feedback based functional connectivity is *decreased* in ASD

• *Local feedback* based functional connectivity is *decreased* in ASD

• *Long-range* feedforward based functional connectivity is *increased* in ASD
Functional Connectivity in ASD During Face Processing

Khan et al., PNAS, 2013
Finding the Fusiform Face Area (FFA)
Local Connectivity in the FFA

Phase Amplitude Coupling

Amplitude Frequency (Hz)

Time

TD

100ms

0.5

-0.5

Arbitrary Units
Local Connectivity in the FFA
Functional Connectivity in ASD During Vibrotactile Stimulation

Khan et al., Brain, 2015
Local Functional Connectivity
Local Functional Connectivity

- Decreased Local Functional Connectivity in ASD
- Increased Local Functional Connectivity in ASD
Local Functional Connectivity

Increased Local Functional Connectivity in ASD

Increased long-range Feedforward Connectivity in ASD
Hypotheses

• *Long-range* feedback based functional connectivity is *decreased* in ASD

• *Local* feedback based functional connectivity is *decreased* in ASD

• *Long-range* feedforward based functional connectivity is *increased* in ASD
Feedforward Functional Connectivity

Granger causality S1 → S2

Frequency (Hz)

Time (ms)

Granger causality

1.5e⁻²

6.5e⁻²
Correlation With Behavioral Measures

**ADOS**

Faces

**Statistical Classification**

Tactile
In Summary

Revisiting our hypotheses:

**Long-range feedback** connectivity is decreased and less efficient in ASD

**Long-range feedforward** connectivity is increased and more efficient in ASD

**Local feedback** (recurrent connectivity) connectivity is decreased in ASD
THANKS!!!!

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