Cognitive Event-Related Brain Potentials and MRI in Psychosis

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High-Resolution Measures of Brain Function and Brain Structure

Two techniques to examine the physiology of attention in schizophrenia

EEG – Millisecond temporal resolution of brain activity at the speed of thought. Poor localization of generator sources in isolation.

MRI – Millimeter spatial resolution of anatomy. Pure anatomy. Allows for measurement of the volume of gray and white matter in areas identified as EEG generator sites through invasive depth-recordings.
Temporal Lobe - STG

Auditory Processing

- **Heschl’s gyrus (HG)** Contains primary auditory cortex. Analysis of simple acoustic features (e.g., pitch)

- Moderate bilateral gray matter volume reduction in First-Episode Schizophrenia vs. Mania and Controls

- **Planum Temporale (PT)** Secondary and tertiary auditory cortex. Analysis of complex acoustic features (e.g., speech)

- Marked left hemisphere gray matter volume reduction in First-Episode Schizophrenia vs. Mania and Controls.

Hirayasu et al., *Arch Gen Psych*, 2000; 57: 692 -699
ERP Waveforms
FIRST EPISODE
PSYCHOSIS STUDY

Con [n=14]  
FE Sz [n=14]  
FE AFF [n=14]

Con [n=14]  
FE Sz [n=14]  
FE AFF [n=14]

Con [n=14]  
FE Sz [n=14]  
FE AFF [n=14]

Con [n=14]  
FE Sz [n=14]  
FE AFF [n=14]

Con [n=14]  
FE Sz [n=14]  
FE AFF [n=14]
Temporal Electrode Sites

FIRST EPISODE PSYCHOSIS STUDY

Time 1 P300 expanded samples

Omnibus midline sites test
Group: $F(2,165) = 5.3, p = .006$
Site: $F(2,165) = 236.7, p < .0001$
Group x Site: $F(4,165) = 4.2, p < .01$

Omnibus lateral sites test
Group: $F(2,165) = 6.1, p = .003$
Hemisphere: $F(1,165) = 2.5, p = .12$
Group x Hemisphere: $F(2,165) = 6.8, p = .001$
STG Volume & P3 are Related at First Episode

First Episode Schizophrenia (n = 15)

McCarley et al., Archives of General Psychiatry, 2002, 59: 321-331
Left posterior STG gray matter volume change over time

12/13 decrease (mean ~ 9%)

SCZ (N=13)  AFF (N=15)  NCL (N=14)

Kasai et al., Am J Psychiatry, 2003
P3 is not reduced further in the first few years after first hospitalization

Salisbury et al., Unpublished Data
Pitch Deviant Mismatch

MMN Amplitude Correlates with Left Heschl’s Gyrus Volume in First-Episode Schizophrenia

Salisbury et al., Archives of General Psychiatry, In Press
Follow-up MMN

Pitch Deviant Mismatch

Salisbury et al., Archives of General Psychiatry, In Press
% Change in Heschl’s Gyrus and Planum Temporale gray matter volume over 1.5 years

Kasai K et al., Archives Gen Psychiatry. 2003; 60:766-775
Reductions in MMN Amplitude Correlate with Reductions in Left Heschl’s Gyrus Gray Matter Volume at 1.5 Year Retest

Salisbury et al., Archives of General Psychiatry, In Press
Combined ERP & MRI measures allow one to target generator sites of physiological activity related to cognitive activation and their pathology.

In this example, abnormal physiology associated with structural brain changes during the early stages of schizophrenia. This finding, in turn, may identify new therapeutic targets.

ERPs associated with specific processing activity can be measured in other domains, such as facial affect identification, or lexical and semantic priming, gamma driving (20, 30, 40 Hz input) as a probe of local circuit integrity.