Understanding the Risk for Neuropsychiatric Disorders Using Functional Brain Imaging

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fMRI

• Functional magnetic resonance imaging

• Non-invasive recording of mental activity
  – Repeated scanning
Neuropsychiatric Disorders

- Chronic disorders, long-term disability
- Detection & prevention
Loss of Control

• Schizophrenia

• Drug addiction
Prefrontal Cortex (PFC)

- Biases processing in rest of brain
Brain Imaging and Prefrontal Cortex Dysfunction

- Can we detect before illness onset?
- Can it be caused by early substance use?
- How to treat?
PFC Deficit in Schizophrenia
PFC Deficit in Relatives

![Brain imaging with highlighted regions](image)

**Conflict Activity**

<table>
<thead>
<tr>
<th>Region of Interest</th>
<th>Beta Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACC</td>
<td>Controls: 4</td>
</tr>
<tr>
<td>DLPFC</td>
<td>Controls: 2</td>
</tr>
</tbody>
</table>

**Legend:**
- Controls
- Relatives
Schizophrenia Prefrontal Dysfunction

• Related to genetic risk

• Imaging research can detect increased risk
Schizophrenia Age of Onset

• Late adolescence and early adulthood

• Why this age of onset?
Adolescent Brain Development

• Late maturation of prefrontal cortex
Drug-Induced Brain Injury?

• Can insults to brain development help cause schizophrenia?
  
  – Extreme alcohol use?
Animal Alcohol Exposure

- Prefrontal damage
- Especially in adolescent/young adult rats
Human 21\textsuperscript{st} Birthday Drinking

- At least 21 drinks
  - 34\% of males
  - 24\% of females
21st Birthday Drinking

• Estimated BAC of 0.26 (medically serious consequences)
  – 49% of males
  – 35% of females
fMRI & 21\textsuperscript{st} Birthday Drinking

- People likely to extreme drink

- Scan at 3 time points
  - 2 weeks before 21\textsuperscript{st} birthday
  - 3 days after 21\textsuperscript{st} birthday
  - 5 weeks after 21\textsuperscript{st} birthday

- Will extreme drinking predict PFC dysfunction?
Preventing Extreme Drinking

• Normative information decreases drinking on 21\textsuperscript{st} birthday
  
  – All participants will be given this information
  
  – Expect them to drink less by being in our study
PFC Deficits

• How to treat?
Attention Shaping

• Monetary rewards

• Rewarding successive approximations
  – e.g., 30 seconds; then 45 seconds

• Increases attentiveness in schizophrenia
fMRI & Attention Shaping

• Does treatment increase PFC activity in schizophrenia?

• Or does it increase activity elsewhere in brain?

• Can this be used to refine treatment?
Brain Imaging and Prefrontal Cortex Dysfunction

• Detectable before illness onset

• Can it be caused by early substance abuse?

• How to treat?