Functional MRI Studies of Health Behaviors

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Health Behavior/Decision Making

- People make hundreds of health-related decisions every day
  - What and how much to eat
  - Whether to exercise
  - Whether to use drugs (e.g., nicotine, alcohol)
    - If so, how much
- How does the brain regulate health behavior?
Public Health Relevance: Obesity is an Epidemic

1990

No Data <10% 10%–14%

2008

No Data <10% 10%–14% 15%–19% 20%–24% 25%–29% ≥30%
Public Health Relevance: Health Impact of Obesity

- Obesity is associated with increased rates of
  - Type 2 diabetes - Insulin Resistance
  - Hypertension
  - Heart Disease
  - Hyperlipidemia
  - Stroke
  - Some types of cancer
  - Osteoarthritis
  - Sleep Apnea
  - Work Disability
Public Health Relevance: Economic Impact of Obesity

- Total costs in U.S. estimated at $147 Billion/year
  Finkelstein et al., *Health Affairs*, 2009
- Obesity is number one preventable cause of rising health care costs
- In era of national health care debate, preventable risk factors of disease are central
Causes of Weight Gain

Energy Balance

Energy Intake
High fat, high calorie diet

Energy Expenditure
Sedentary Lifestyle

Genetic Disposition

Choices made in eating and physical activity are the primary determinants of weight gain.
Causes of Obesity Epidemic

- **Societal changes**: urban sprawl, dependence on automobile, loss of exercise programs in schools
Causes of Obesity Epidemic
Causes of Obesity Epidemic

- **Changes in eating habits**: availability of fast, calorie-dense foods, larger portion sizes
The “Secret of Weight Loss”

- Eat less
- Exercise more

- So, why do we find it so difficult?
Obesity and the Brain

- Balance between “drive” and “control” processes in the brain
  - The ability to delay immediate gratification and make choices based on anticipation of long-term consequences
  - Impacts behavioral choices such as eating and exercise
Hippocampus
Amygdala
fMRI Paradigm

Food

Non-food

Baseline

B F B A B F B A B F B A B
Hyperactivation in Obese Adults

Martin et al. Obesity 2009

Medial Prefrontal Cortex
x,y,z, = -9,50,25

R$^2 = 0.415$

Average % Signal Change F-NF
r = 0.646, p < .05

TFEQ Hunger Scale
Hyperactivation in Obese Children

Bruce et al., under review

Left Orbitofrontal Cortex

x, y, z = -23, 38, -5

Average % Signal Change F-NF

\( r = 0.683; p < .05 \)
Failure to Normalize Post-Meal in Obese Children

Bruce et al., under review
Anticipation of Monetary Reward
Obese vs HW Adults

Martin et al., preliminary results

Amygdala

\[ x, y, z = -21, -7, -14 \]
Predictors and Outcome of Weight Loss and Maintenance

<table>
<thead>
<tr>
<th>Baseline Session (Scanned)</th>
<th>Post-Diet Session (Scanned)</th>
<th>Follow-Up (Not Scanned)</th>
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<tbody>
<tr>
<td>12-Week Diet</td>
<td>6-Month Maintenance</td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>Successful Dieters</td>
<td>Maintainers</td>
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<td>N=80</td>
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<td>Unsuccessful Dieters</td>
<td>N=20</td>
<td>Regainers</td>
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<tr>
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<td>N=27</td>
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Taco Bell

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