Introduction

- Obesity continues to be a problem for today’s youth:
  - One-third of children in the U.S. are obese or overweight
  - Today’s youth are expected to have a shorter lifespan than previous generations.
- Food marketing may be a one factor involved in obesity.
  - Companies spend $10 billion annually on food and beverage marketing toward children.
  - Product branding has a powerful effect on familiarity/preference.
- Advertising exposes children to unhealthy foods more often than healthy foods, particularly energy-dense, micronutrient-poor foods.
- We examined how obese and healthy weight children’s brains activate in response to common food and non-food logos using functional magnetic resonance imaging (fMRI).

Methods

Procedure

- Validation Study
  - Thirty-two children rated 239 common brand logos on the following dimensions using a 5-point Likert scale:
    - Familiarity
    - Emotional Valence (Happy/Sad)
    - Arousal (Exciting/Boring)
  - 60 food and 60 non-food logos rated highly on familiarity were selected and matched for familiarity and valence.
  - These 120 logos were used in the following fMRI paradigm.
  - Note: All trademarks are property of their respective owners.

- fMRI Study
  - Twenty children, 10 healthy weight ($M_{zelle} = 50.0$) and 10 obese ($M_{zelle} = 98.9$) were recruited from local pediatric clinics.
  - Children and parents completed informed consent, demographic, and self-control measures (e.g. 23-item Eysenck I6 Junior Questionnaire)
  - fMRI data were acquired with a 3-Tesla Siemens Allegra scanner.
  - A block paradigm was used to display the food logos, non-food logos, and Fast Fourier Transform blurred images.
  - Two 6:36 min functional scans; 3 blocks of stimuli presentation, 10 logos in each block.

Analyses

- Independent sample t-tests were conducted to compare impulsivity between weight groups.
- fMRI analyses conducted with Brain Voyager QX
  - Statistical contrasts using multiple regression with GLM and a random effects model
  - Corrected using Monte Carlo simulation for cluster threshold (9 voxels)

Participant Characteristics

- Validation Study
  - N = 32
    - Gender: 41% male (n=13), 59% female (n=19)
    - Mean Age: 11.5 years [range 9-16 years]
- fMRI Study
  - N = 20
    - Gender: 45% male (n=9), 55% female (n=11)
    - Mean Age: 11.9 years [range 10-14 years]
    - Ethnicity
      - Caucasian (n=10) 50%
      - African American (n=9) 45%
      - Hispanic (n=1) 5%

Obese vs. Healthy Weight Demographics

- No significant differences for age [$t(18) = .91; p = .38$], gender [$\chi^2 = 1.82; p = .18$], or parental income [$t(18) = 1.18; p = .26$]

Results

Behavioral Data

- Obese children reported significantly more impulsivity on the Eysenck Impulsivity Scale ($M = 13.2; SD = 3.65$) than the healthy weight group ($M = 8.4; SD = 5.62$), $t(18) = -2.27; p = .036$.

fMRI Data

- Group (HW v. OB) X Stimulus (F vs. Baseline)
  - HW showed greater activation than OB to food logos compared to baseline images in middle frontal gyrus and temporal gyrus.
  - OB showed greater brain activation than HW in post-central gyrus and midbrain.

- Group (HW v. OB) X Stimulus (NF vs. Baseline)
  - HW did not show greater activation than OB in any region.
  - OB showed greater brain activation than HW in thalamus, inferior frontal gyrus, insular cortex, and cuneus.

- Group (HW v. OB) X Stimulus (F vs. NF)
  - HW showed greater brain activation than OB in superior temporal gyrus, parahippocampal gyrus, and insula.
  - OB did not show greater activation than HW in any region (see Table below).

- HW showed greater bilateral activation in Brodmann’s area 10 of prefrontal cortex (image to the right).

<table>
<thead>
<tr>
<th>Contrast and Region</th>
<th>Coordinates</th>
<th>Contiguous Voxels</th>
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</thead>
<tbody>
<tr>
<td>Healthy Weight &gt; Obese</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Superior Temporal Gyrus BA 22</td>
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<td>5</td>
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<tr>
<td>Superior temporal gyrus BA 39</td>
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<td>Inferior frontal gyrus</td>
<td>36</td>
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<td>Parietal precuneus BA 7</td>
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<td>Superior parietal BA 7</td>
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<td>Parahippocampal gyrus BA 36</td>
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<td>Middle frontal gyrus BA 10</td>
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<td>-44</td>
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<tr>
<td>Insula BA 13</td>
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<td>-19</td>
</tr>
</tbody>
</table>

Obese > Healthy Weight

- None

Discussion

- Food logos activate brain regions known to be associated with food motivation and reward (i.e. prefrontal cortex, limbic system, and paralimbic cortex)
- Obese children demonstrated greater activation in reward regions than healthy weight children when shown food logos compared to baseline blurred images.
- When viewing food versus nonfood logos, the healthy weight children demonstrated greater brain activation in “control” regions than the obese children.
- Specifically, Brodmann’s Area 10 showed greater activation in healthy weight children bilaterally.
- Overall, obese children exhibit less brain activation in control regions when viewing food logos than healthy weight children.
- This suggests obese children may be more susceptible to the effects of food marketing and branding.