What you see is what you eat: An ALE meta-analysis of the neural correlates of food viewing in children

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Introduction

The prevalence of childhood obesity has increased dramatically all over the world. Understanding children's neural responses to food will provide insight in how to develop interventions effectively changing their eating behavior. Since brain regions involved in reward processing and decision-making are still developing throughout childhood (1), food-related brain activation in children is hypothesized to differ from that in adults.
We aimed to determine the most concurrent brain regions activated in response to viewing food pictures in children, and to determine how these relate to adult findings.

Methods

fMRI studies examining the response to food images were identified using online databases. Studies were eligible if they used standardized stereotactic coordinates to report whole-brain responses for a food vs. nonfood viewing contrast and were published in a peer-reviewed journal.

Two activation likelihood estimation (ALE; 2) meta-analyses were performed using the Brainmap GingerALE software (3): one on studies done in normal weight children (8 studies, age range 9-18 y, n = 132, 137 foci) and one on studies performed in normal weight adults (16 studies, age range 18-45 y, n = 241, 178 foci).

ALE uses reported peak coordinates to assess the overlap between foci by modeling them as probability distributions centered at the respective coordinates (2).

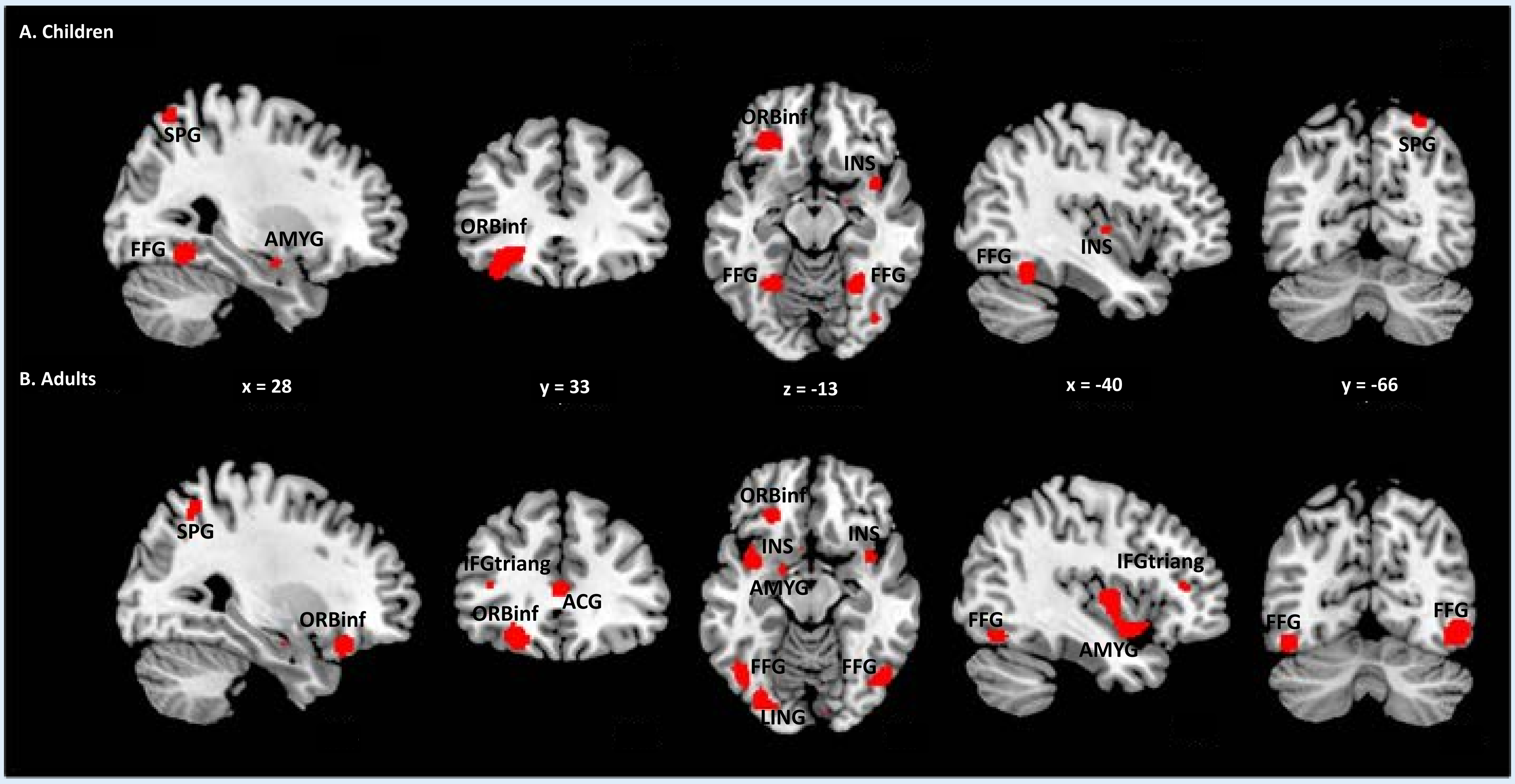

Figure 1. Selected results of the ALE meta-analyses showing clusters with significant ALE maxima (p<0.05, FDR-corrected for multiple comparisons, cluster size>100 mm^3; coordinates in MNI space), in children (A) and in adults (B) for the food vs. nonfood contrast.
SPG, superior parietal gyrus; **FFG**, fusiform gyrus; **AMYG**, amygdala; **ORBinf**, inferior frontal gyrus (orbital part; *OFC*); **INS**, insula; **IFGtriang**, inferior frontal gyrus (triangular part; *vlPFC*); **ACG**, anterior cingulate gyrus, **LING**, lingual gyrus.

Results

In children, the most concurrent clusters were in the left lateral orbitofrontal cortex (OFC; 75% of studies contributed), the bilateral fusiform gyrus, insula and amygdala and the right superior parietal lobule (37.5% of studies contributed; Figure 1A). In adults, clusters in similar areas were found (Figure 1B). In adults additional clusters were found, for example in the left ventrolateral prefrontal cortex (vlPFC; 2 clusters, 13% of studies contributed). In children, the number of studies contributing to the clusters ranged between 25-75% (2-6 studies), in adults between 13-44% (2-7 studies).

Discussion

The brain areas most consistently activated by food viewing in children are part of the appetitive brain network (4) and overlap with those found in adults. Our meta-analysis in adults also yielded areas not found in children, such as the vlPFC which is involved in cognitive control over appetitive regions and is among the last brain regions to mature. This could make children more vulnerable to tempting food cues, because they are unable to control appetitive impulses. However, only a small amount of studies contributed.

Overall, the number of studies that contributed to the significant clusters was moderate, in accordance with previous meta-analyses (5). The age range of the children studied was rather broad. Studies making a direct comparison between adults and children (in a sufficiently narrow age range) would likely yield more reliable conclusions.

Conclusion

- In response to food cues children activate areas similar to those found in adults.
- Children may not consistently activate areas important for cognitive control. However there are not enough studies in children to confirm this, therefore additional research is needed.

References
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