

# The Neural Correlates of Healthy and Unhealthy Food Viewing and Food Choice in Children and Adults



UMC Utrecht

Floor van Meer<sup>1</sup>, Nynke van der Laan<sup>1</sup>, Max Viergever<sup>1</sup>, Roger Adan<sup>2</sup>, Paul Smeets<sup>1,3</sup>

Contact: floor@isi.uu.nl

- on behalf of the I.Family consortium

<sup>1</sup>Image Sciences Institute, University Medical Center Utrecht, the Netherlands <sup>2</sup>Brain Center Rudolf Magnus, University Medical Center Utrecht the Netherlands <sup>3</sup>Division of Human Nutrition, Wageningen University and Research centre, the Netherlands

## Introduction

Chances of an obese child to become an obese adult are much higher than for a healthy weight child (1), making it crucial to investigate the eating behaviors and underlying brain mechanisms which lead to weight gain in children. Until now, neuroimaging research in children has primarily focused on food viewing, rather than on food choice (2). In a meta-analysis (3) we found little difference in food viewing between children and adults. In food choice however, we expect adults to have stronger activation in areas involved in cognitive control than children, since these areas are among the last brain regions to mature (4). These differences might be the most pronounced during food choices that demand self control, e.g. concerning highly rewarding, yet unhealthy food (5).

## Aim

Here, we aimed to examine the neural correlates of healthy and unhealthy food viewing and food choice in children and to compare them with adults.

## Methods

32 children (age 10-12y, mean SDS BMI 0.56, 21F) and 32 adults (their same-sexed parents, age 32-52y, mean BMI 25.2 kg/m<sup>2</sup>, 21F) were included. fMRI data was acquired during a food viewing and a food choice task and analyzed with SPM8. The 8-min food viewing task consisted of 8 blocks of healthy food pictures and 8 blocks of unhealthy food pictures with 8 pictures per block (see Fig. 1). 1 of the children did not complete the food viewing task.

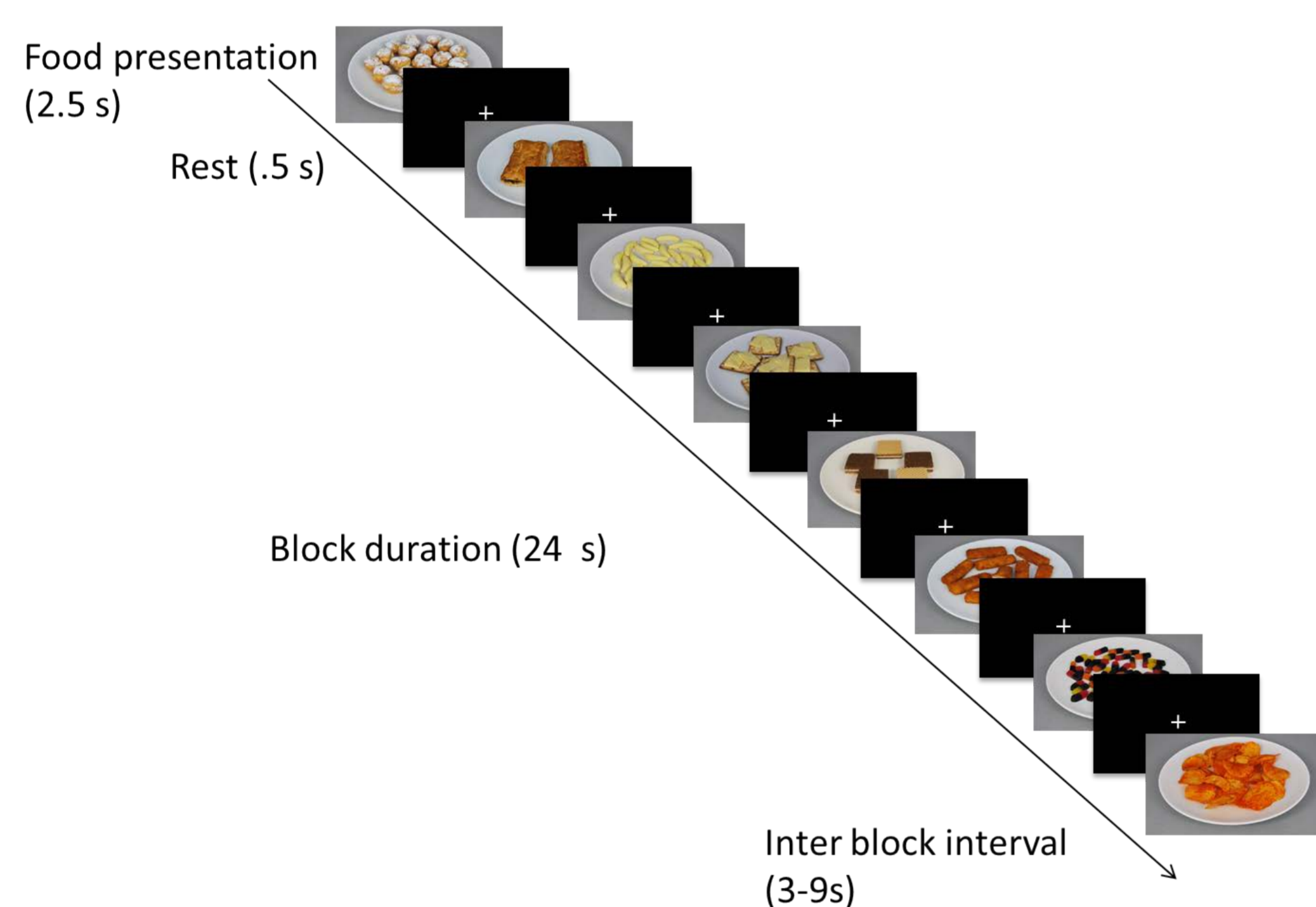


Figure 1. Example of an unhealthy block in the food viewing task.

As part of a 20-min food choice task (6) participants indicated for 25 healthy and 25 unhealthy foods whether they wanted to eat the presented food after the scan with 'yes' or 'no', divided over 5 blocks of 10 (see Fig. 2). For both tasks group differences were tested with one- and two-sample t-tests with a threshold of  $p < 0.001$  uncorrected,  $k \geq 10$ , controlling for within group differences in sex, age and (SDS)BMI.

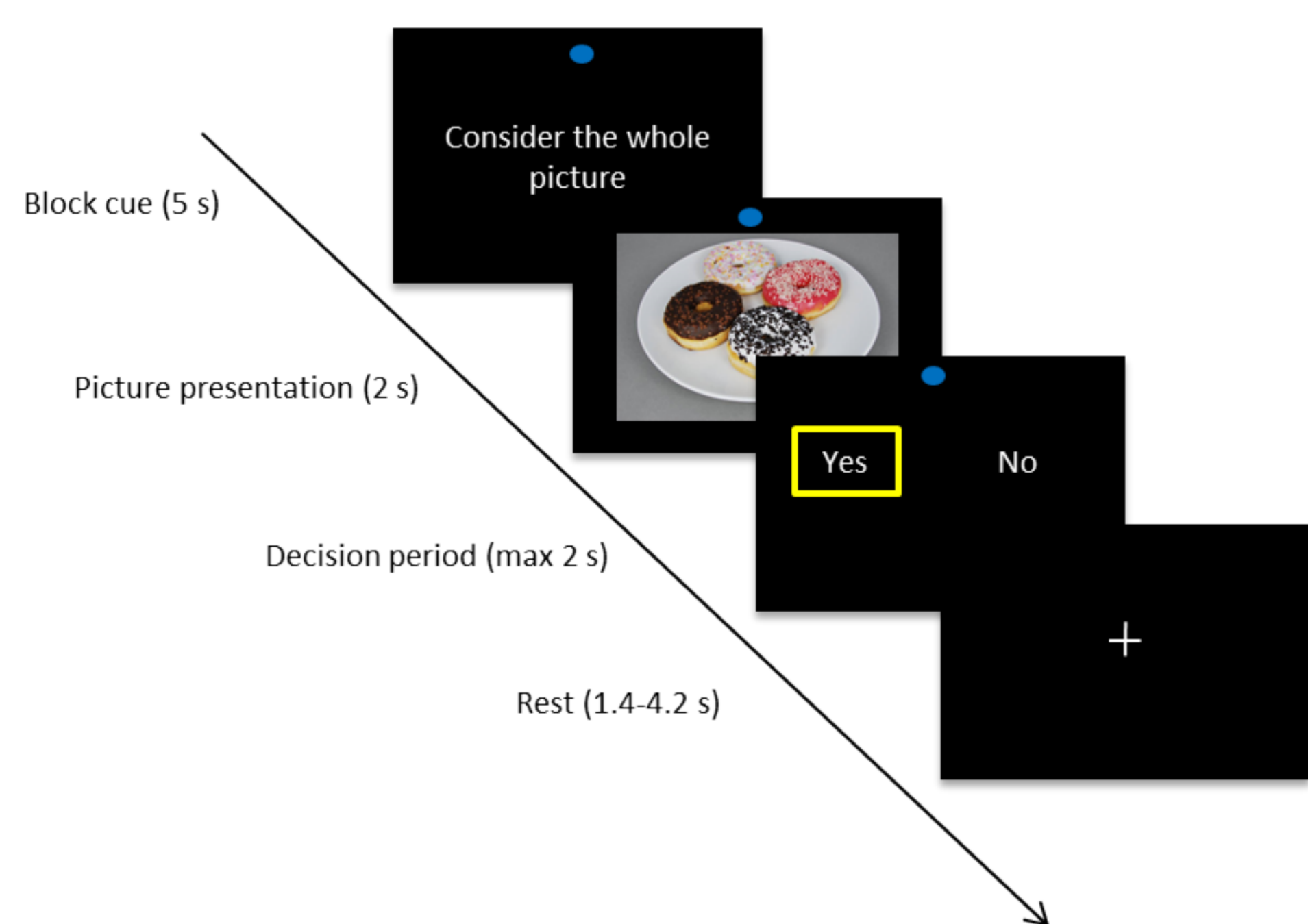


Figure 2. Trial structure of the food choice task.

## Results

### Food viewing task (Fig. 3 A):

- Children activated part of the left postcentral gyrus activated stronger when viewing unhealthy compared to healthy foods.
- Adults activated parts of the right middle occipital gyrus and the left inferior temporal gyrus stronger when viewing unhealthy compared to healthy foods
- Children activated part of the left pre/postcentral gyrus stronger than adults when viewing unhealthy compared to healthy foods.

### Food choice task (Fig. 3 B):

- In children there was no difference in brain response to healthy and unhealthy choice options
- During unhealthy choice options adults activated parts of the left medial superior frontal gyrus and the right middle cingulum stronger than during eat healthy choice options. During healthy choice options adults activated parts of the bilateral middle occipital gyrus, the left supramarginal/inferior parietal gyrus and the left precuneus stronger than during unhealthy choice options.
- Children activated part of the left pre/postcentral gyrus stronger than adults during healthy choice options compared to unhealthy choice options.

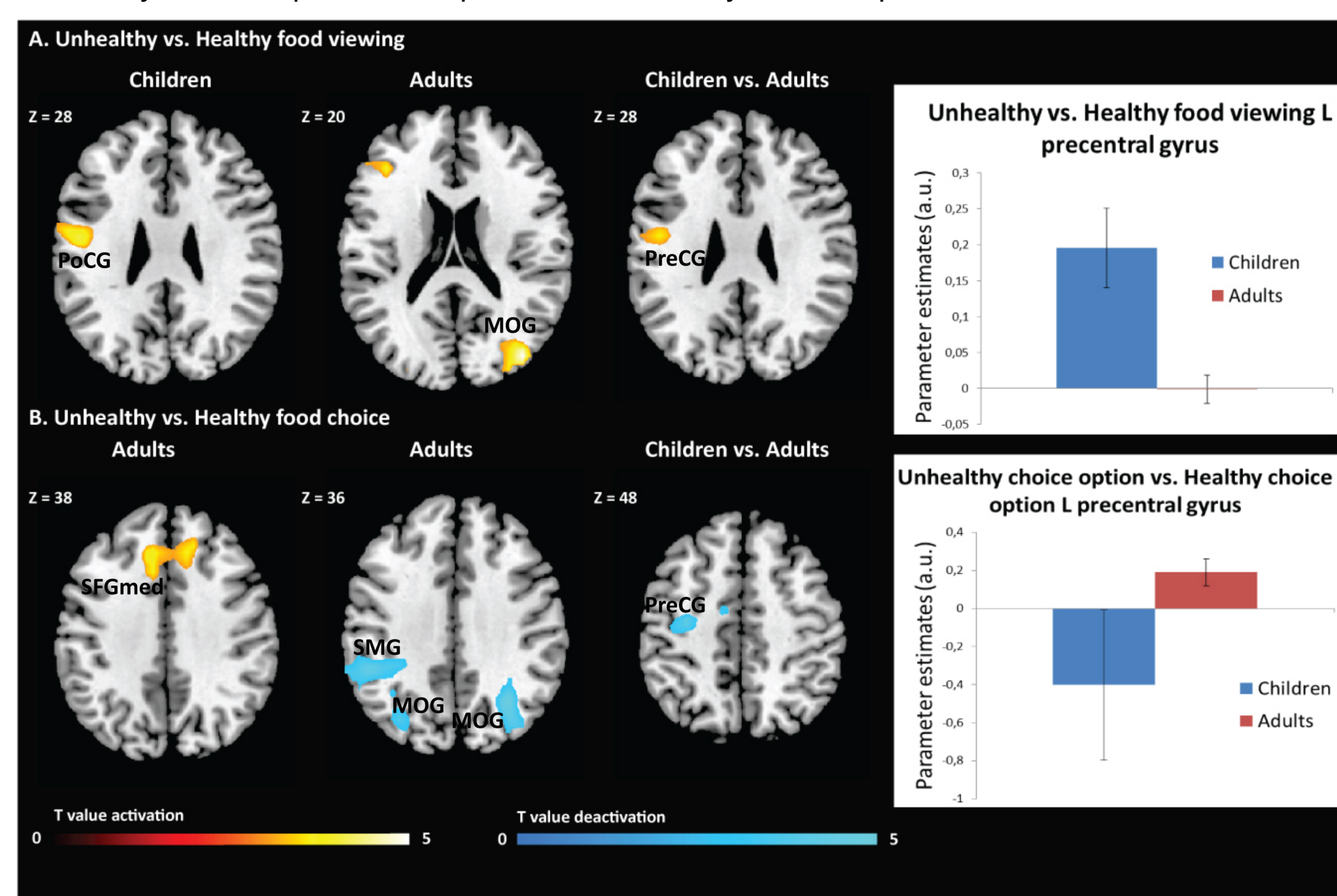


Figure 3. Healthy and unhealthy food viewing and food choice in children and adults (coordinates in MNI space). A. Selected results of the food viewing task. B. Selected results of the food choice task. PoCG, postcentral gyrus; MOG, medial occipital gyrus; PreCG, precentral gyrus; SFGmed, medial superior frontal gyrus; SMG, supramarginal gyrus.

## Discussion

- When viewing unhealthy vs. healthy food pictures children activated an area involved in sensory perception (postcentral gyrus), and adults activated areas involved in visual processing and perception (medial occipital gyrus, inferior temporal gyrus). This is in line with work in adolescents and adults (7). As hypothesized, there was little difference between children and adults. However, when viewing pictures of unhealthy food vs. healthy food children activated a sensorimotor area (pre/postcentral gyrus) stronger than adults, suggesting that children have a greater motivational/anticipatory reaction when viewing unhealthy foods (8).
- Children had no difference in neural activation between unhealthy and healthy choice options in the food choice task. During unhealthy choice options adults activated an area related to response inhibition (medial superior frontal gyrus and medial cingulum) stronger than during healthy choice options, in line with our hypothesis. Adults activated areas involved in visual processing (medial occipital gyrus) and decision making (supramarginal/parietal gyrus) stronger during healthy compared to unhealthy choice options.
- In contrast to our hypothesis there was no significantly greater activation in cognitive control areas in adults than children during the unhealthy vs. healthy choice options. Children had lower activation in a sensorimotor area (pre/postcentral gyrus) in response to unhealthy vs. healthy choice options than adults. The precentral gyrus is part of the motivational system and has been related to the saliency of food stimuli in a food choice task (9). Further analyses of the food choice task including the behavioral responses, healthiness and liking ratings of the food can shed further light on the interpretation of our findings.

## Conclusion

- Adults and children activated visual processing and (sensory) perception areas when viewing unhealthy foods. Children activated a sensorimotor area stronger than adults suggesting they may have a greater motivational response to unhealthy foods.
- Adults activated response inhibition areas during unhealthy choice options and visual processing and decision making areas during healthy choice options. Children deactivated a sensorimotor area during unhealthy choice options stronger than adults. This may reflect a difference in saliency, further analyses may elucidate this.

## References

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