

# HOW EMOTION REGULATION AFFECTS DIETARY CHOICE BY MODULATING VALUE SIGNALS IN THE VMPFC

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## Background

Many people eat specific foods to distract themselves from, or cope with, negative affect such as stress, anxiety, or fear, [1,2,3]. Most such “comfort” foods are indulgent, sweet, carbohydrate- and fat-rich and therefore provide immediate satisfaction. Negative emotions can also increase the salience of immediate, concrete goals, thereby increase preference for indulgent foods [4]. These dietary choices are difficult to control and can have severe consequences for people’s health. One intriguing countermeasure, however, could be to improve one’s emotion regulation.

## Research Questions

- 1) Does emotion regulation affect subsequent food choices?
- 2) Does down-regulation of negative emotions lead to less unhealthy food choices?
- 3) How does emotion regulation interact with the brain’s valuation and decision-making circuitry during decision-making?

## Methods

### Subjects

n=35 healthy participants (age=23.17±3.44 yrs; 29 female; fasted for 7h; no diet)

### Stimuli

- 140 negative IAPS pictures [5]
- mean valence = 2.26 SD=0.59
- mean arousal = 6.25 SD=0.52

### 140 food images [6] (Figure 1)

- 70 high caloric images and 70 low caloric images
- all items matched for arousal, recognizability, familiarity, complexity, palatability, craving and image characteristics
- only images high on valence, familiarity, recognizability were used



Figure 1. Food stimuli.

### fMRI

5 runs and 140 trials using a standard MRI sequence (3.0 T Magnetom TrioTim scanner).

## Methods

### Task Design

Event-related design (Figure 2) incorporating a standard emotion regulation task with 2 conditions [7] and a food choice task [8].

### Emotion Regulation Task

- **Look** (control condition): participants were presented with negative images and allowed themselves to experience any emotional responses without regulating;
- **Decrease**: participants reduced the intensity of the negative emotion by distancing themselves from the image.

### Food Choice Task

Participants were shown pictures of a food item and rated their preference for eating the food after the experiment. Food items were also rated on palatability/taste and healthiness before the experiment.

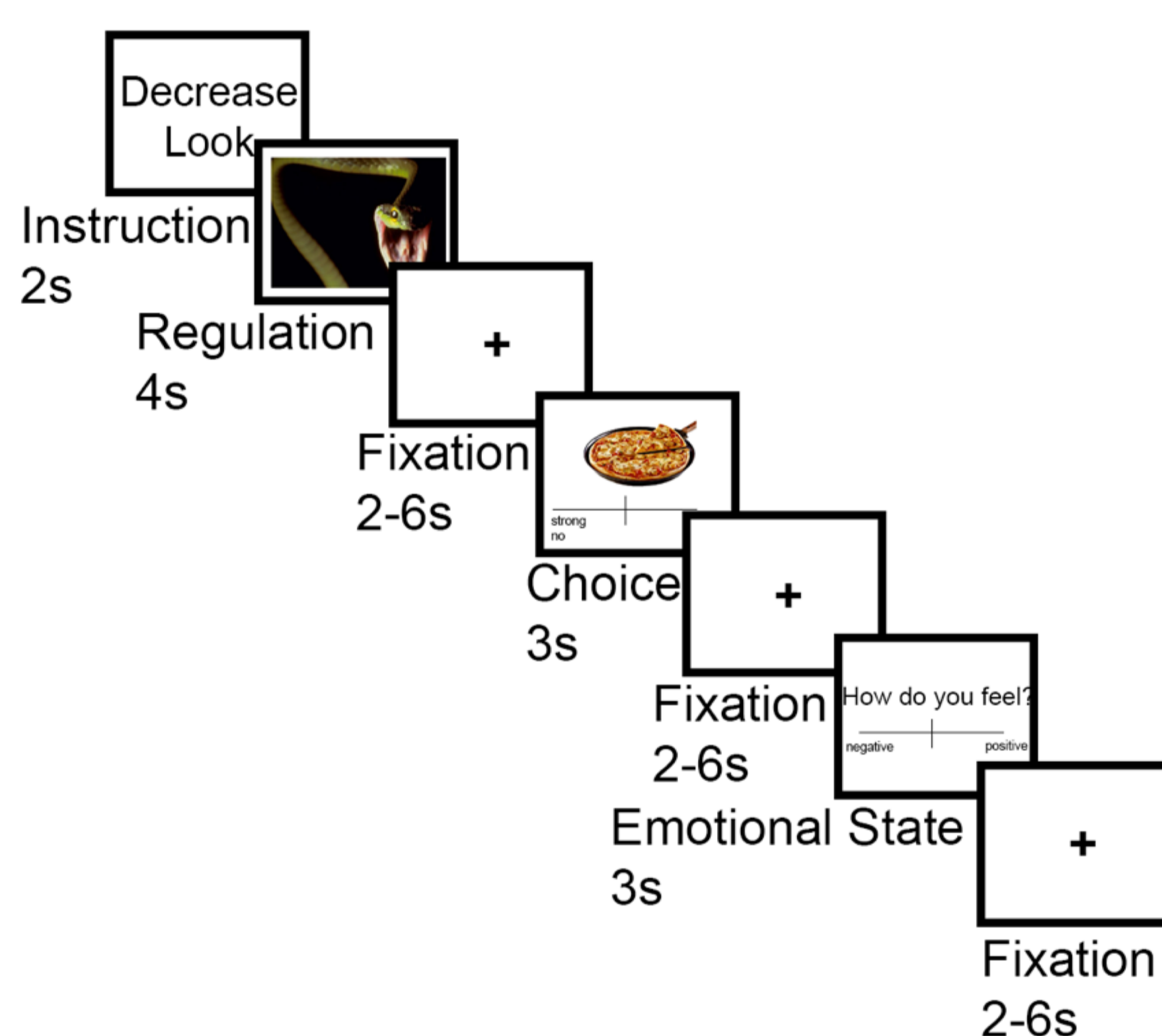


Figure 2. Trial Design.

## Results

### Pre-experiment Ratings (Figure 3)

- High caloric food items were rated unhealthy, while low caloric ones were rated healthy.
- Negative correlation between calories and healthiness ratings indicates that healthy food items were associated with low calories.

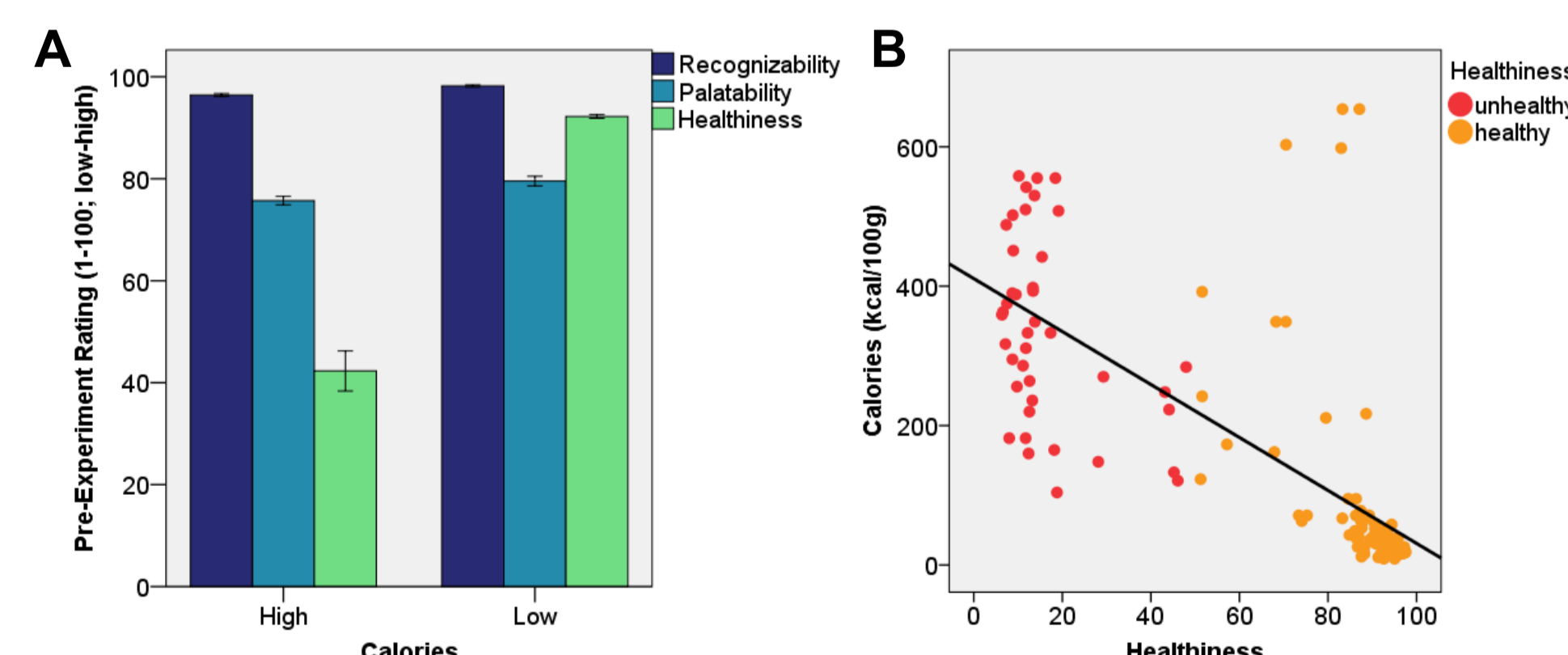


Figure 3. A Pre-experiment Ratings on recognizability, palatability and healthiness. B Correlation between calories and healthiness ratings.

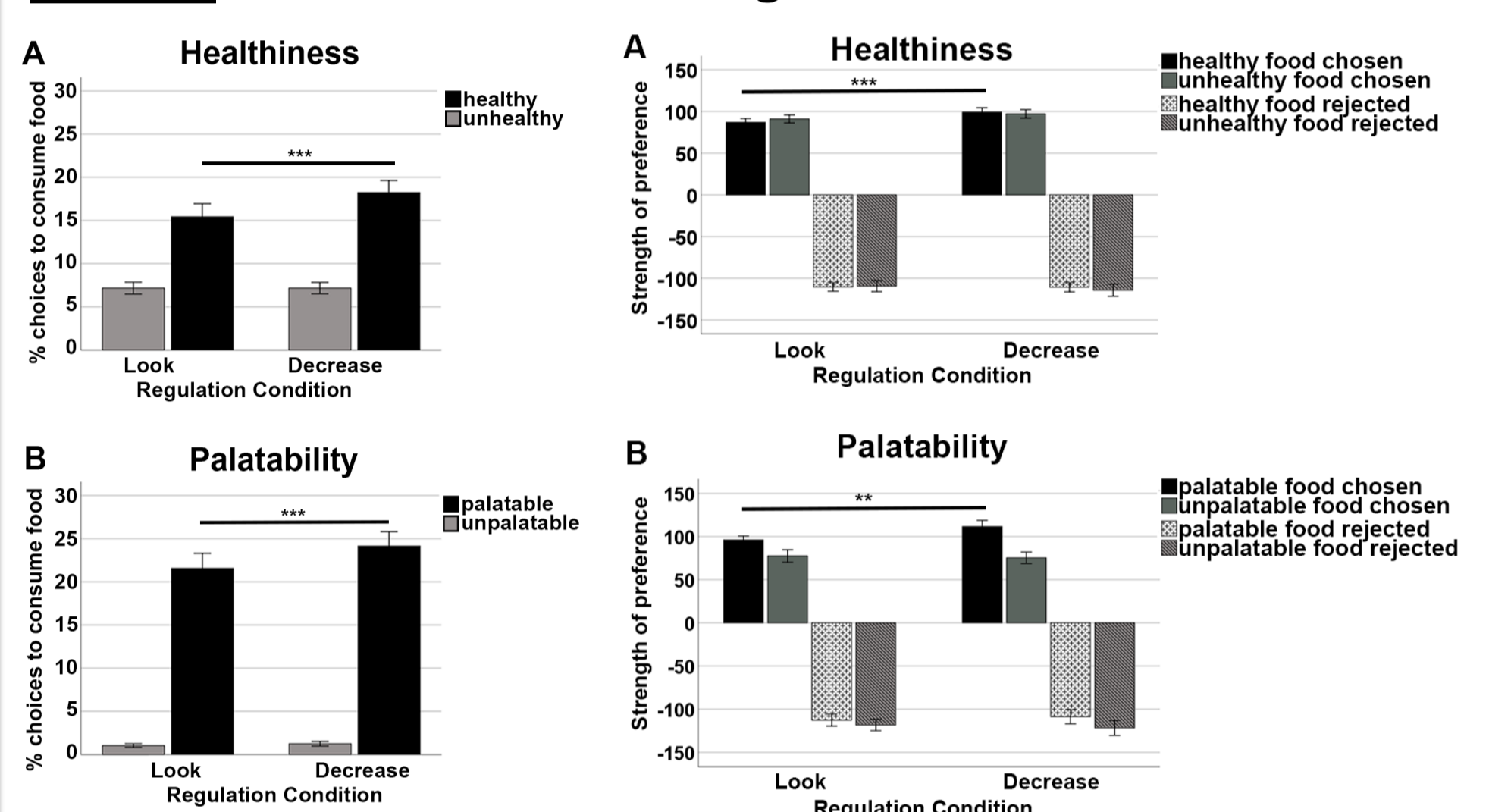
## Results

### Behavioral Results (Figure 4)

On average, participants...

- a) ...reported to feel less negative emotion after *Decrease*.
- b) ...wanted to consume items more often after *Decrease*.
- c) ...preferred healthy and palatable food after *Decrease*.
- d) ...rejected healthy and palatable food more strongly after *Look*.

### Figure 4. Emotional State Ratings & Choice Behavior.



### fMRI Results

Figure 5. Emotion regulation network. Contrast between *Decrease* > *Look* during emotion regulation ( $p < 0.05$  FWE corrected).

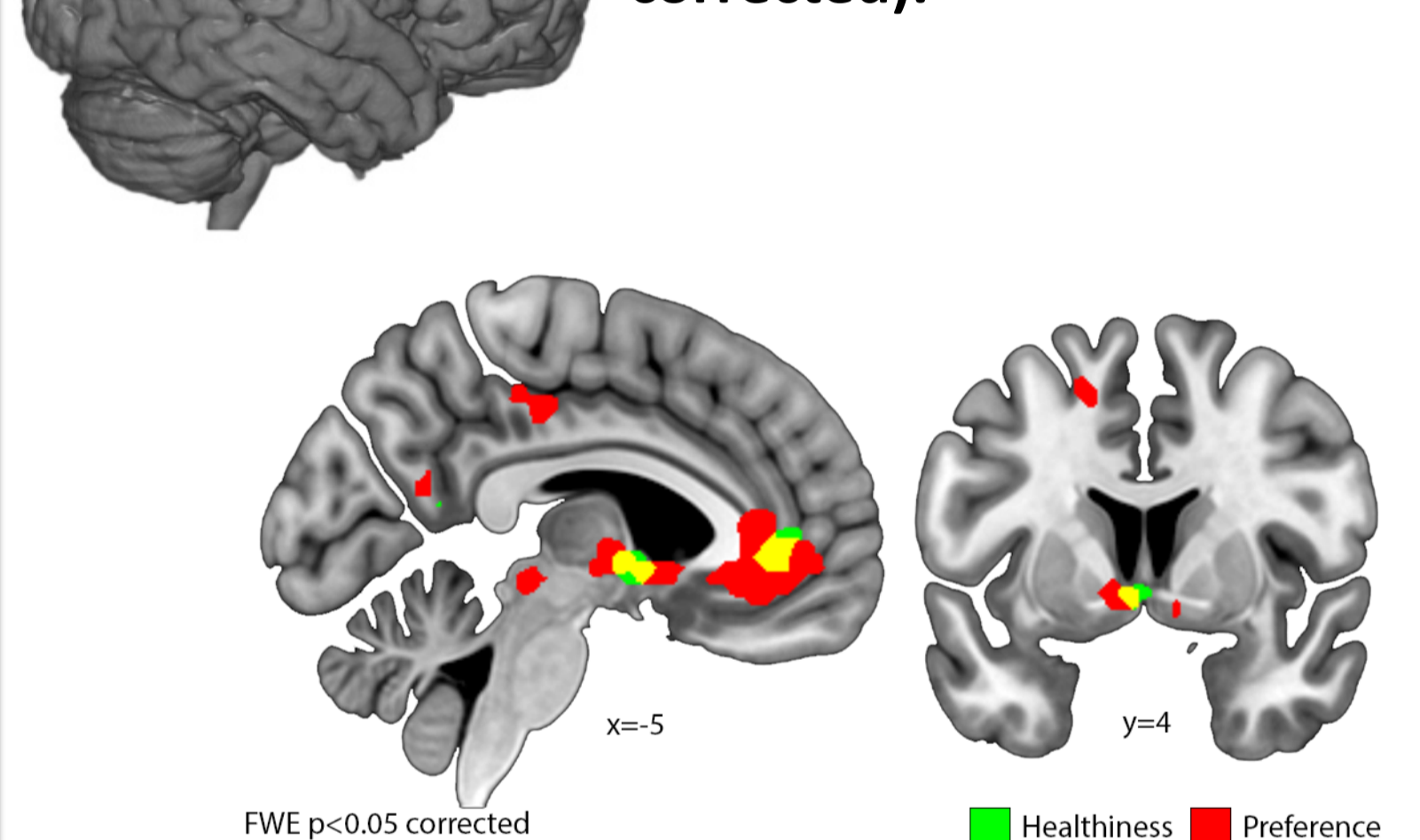


Figure 6. Activity in vmPFC correlated with preference (red) and health (green) ratings. Overlap is indicated in yellow.

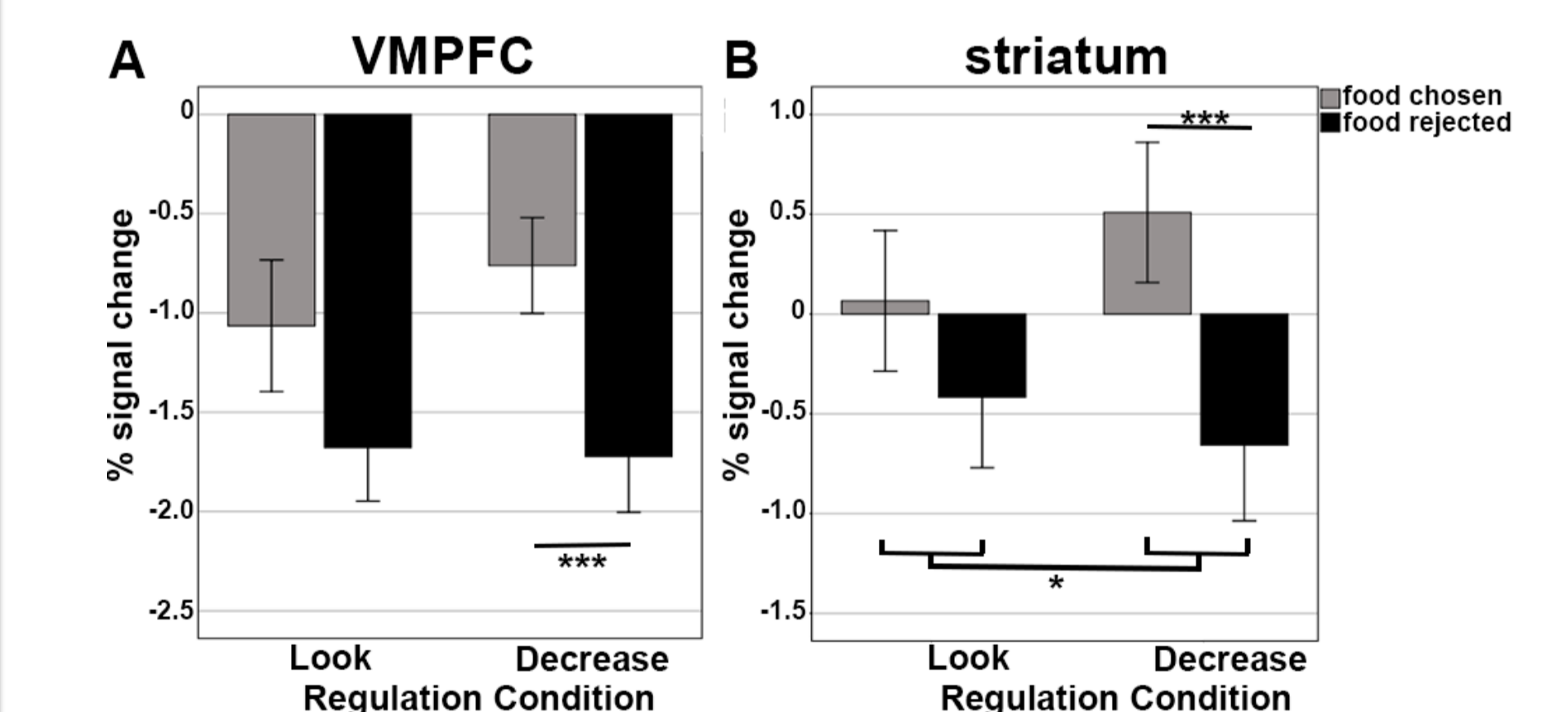


Figure 7. Mean activation of the vmPFC (A) and striatum (B) ROIs for chosen versus rejected food items during the choice phase as a function of preceding regulation condition. Displayed are parameter estimates (percent signal change) for each decision following *Decrease* and *Look*.

## Conclusions

- I. We found that while our participants preferred healthy foods overall, the **regulation of negative emotions led to a reduction of preferences for indulgent foods**, similar to effects reported in studies that showed improved dietary choices after directing attention to the healthiness of foods [8,9].
- II. **Emotion regulation most likely counteracted the effect of negative emotions**, buffering the shift to comfort foods that might be triggered by negative emotions. This interpretation is supported by the finding that in **vmPFC**, which reflected preference [8], the **overall signal strength was further modulated by emotion regulation**.
- III. This suggests that **the modulatory effect of emotion regulation on choosing less comfort food might be moderated, or potentially implemented, by vmPFC**.