

Effects of eating rate on satiety, meal enjoyment and memory for recent eating: An fMRI study

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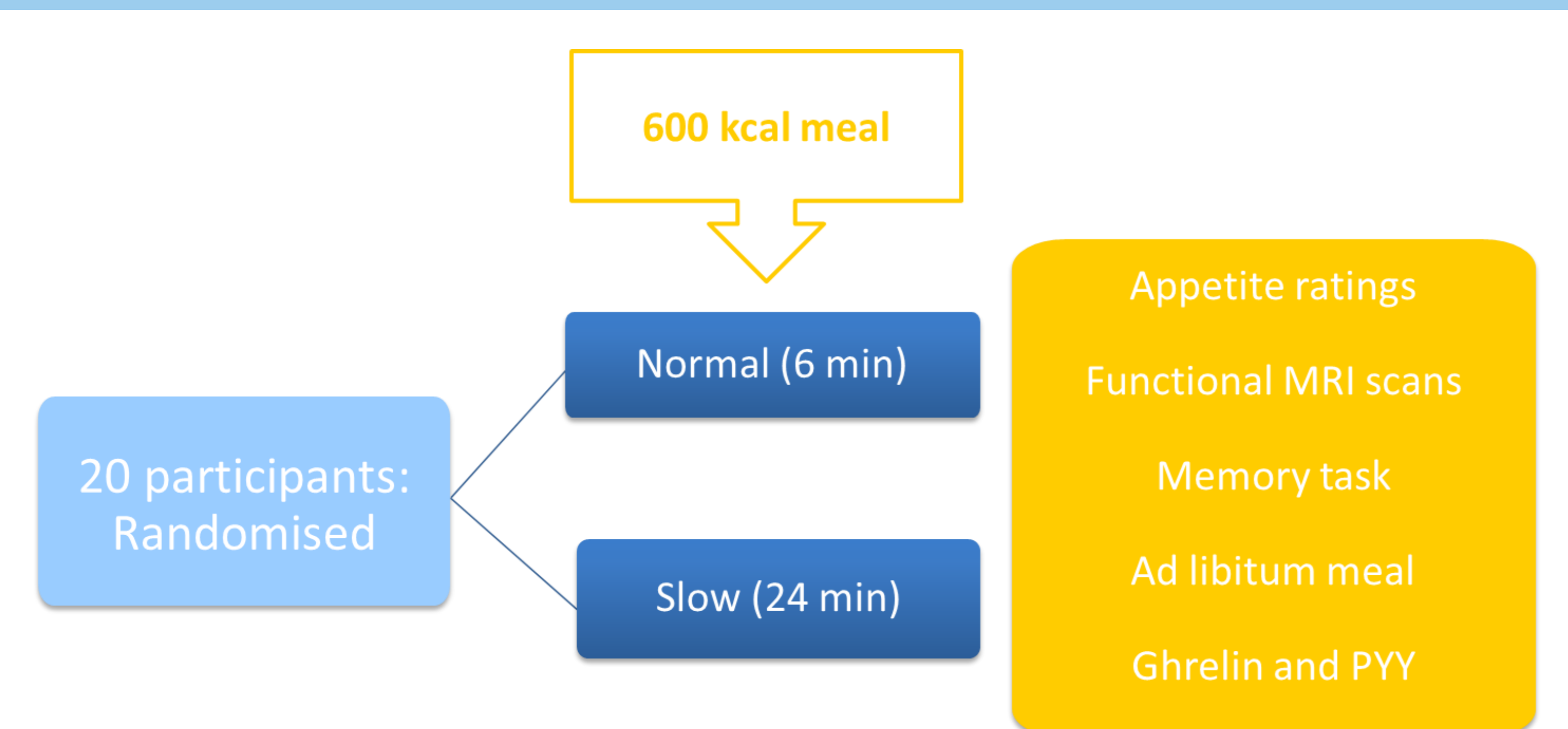
Background

- Controlling eating rate may be a mechanism for reducing total calorie consumption (Robinson et al 2014, *Am J Clin Nutr*)
- Further research is needed to understand mechanism
- Need to understand physiological basis to design effective weight loss interventions
- Aim: To examine whether the brain's response to a meal differs according to how fast that meal is consumed

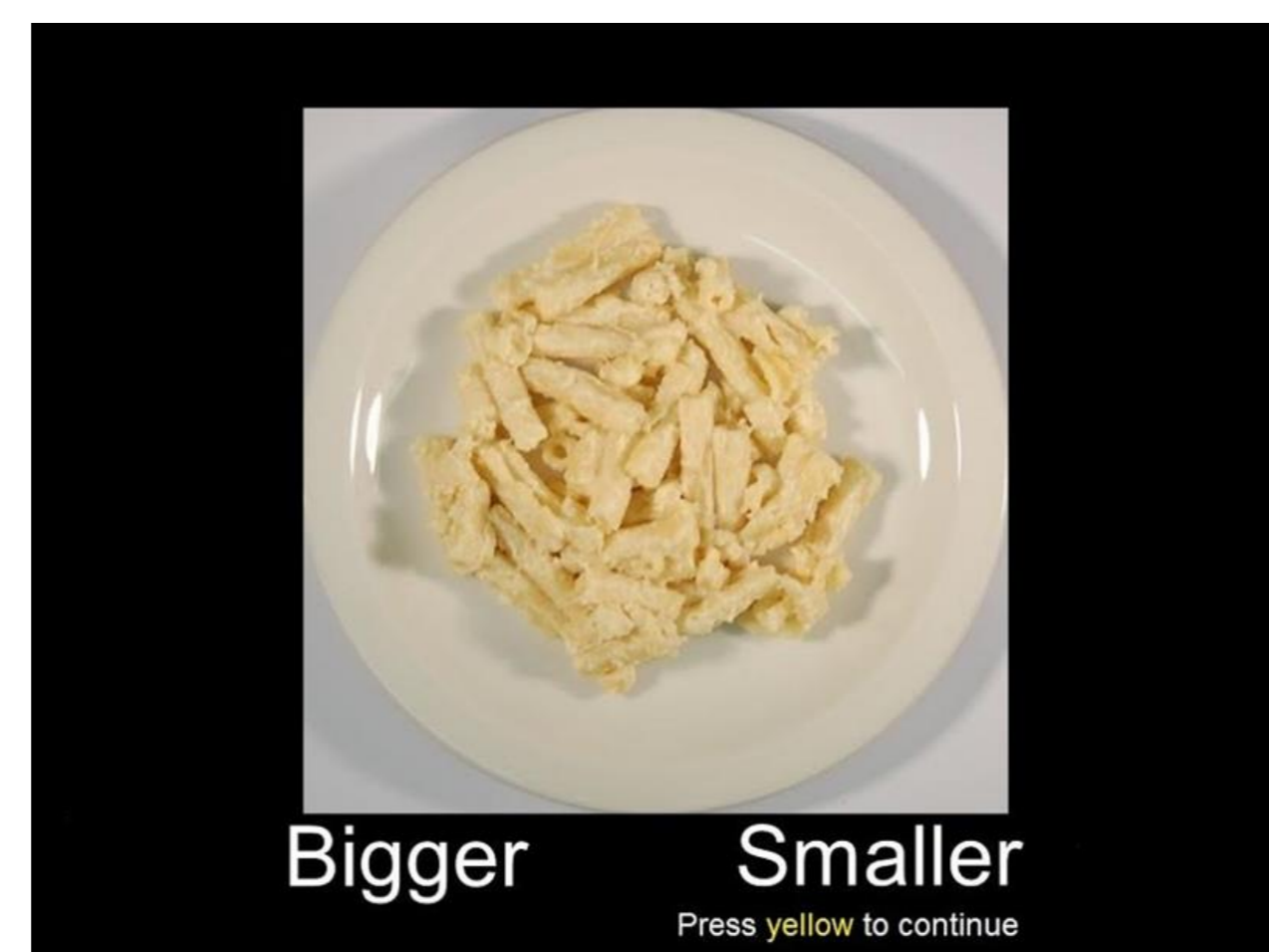
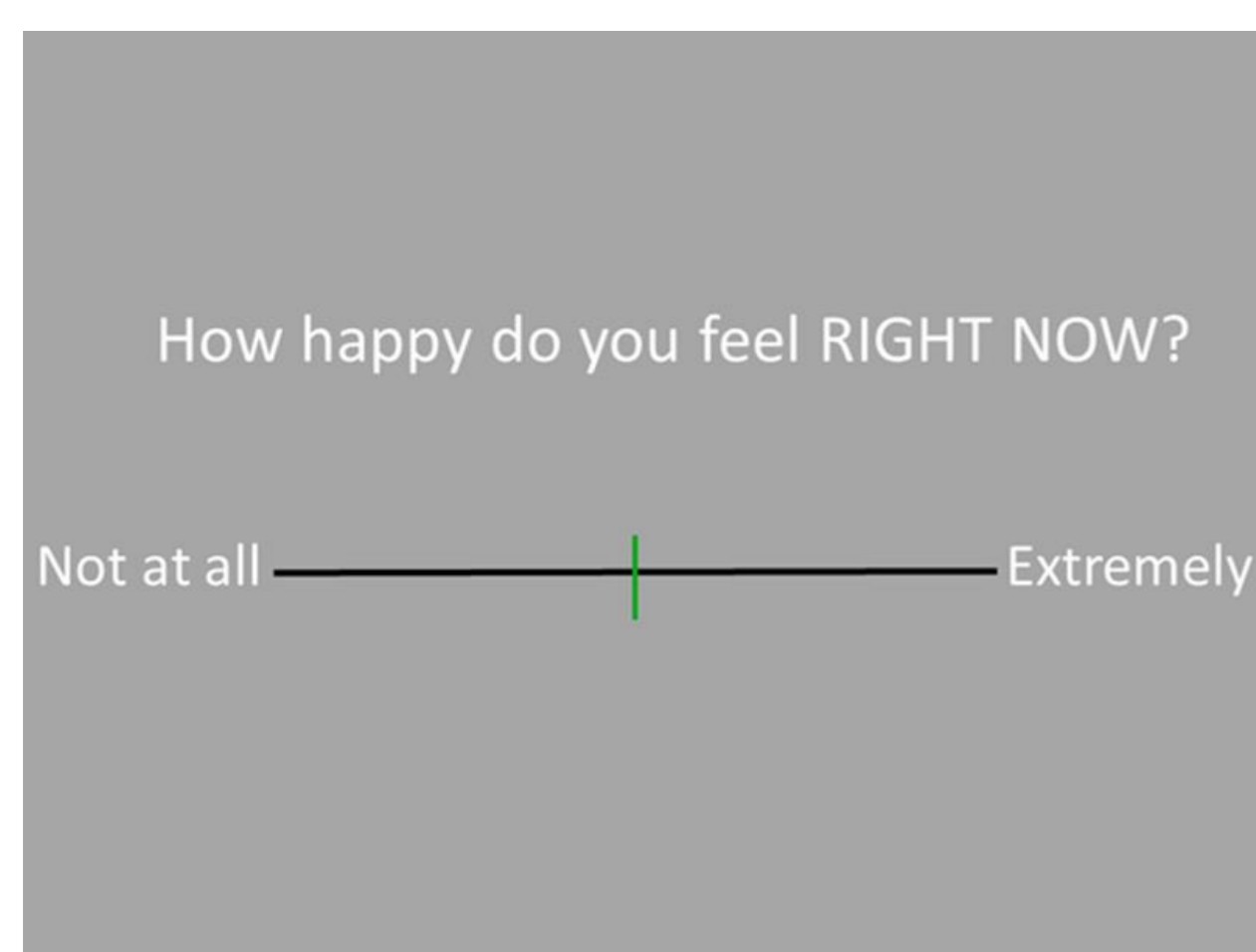
Hypothesis

- Experimentally slowing eating rate will lead to:
 - Greater signal change in satiety-responsive brain areas
 - Increased ghrelin suppression and increased PYY secretion
 - Reduced enjoyment and satisfaction
 - Greater feeling of fullness post meal
 - Improved memory of the meal
 - Reduced subsequent food intake

Methods



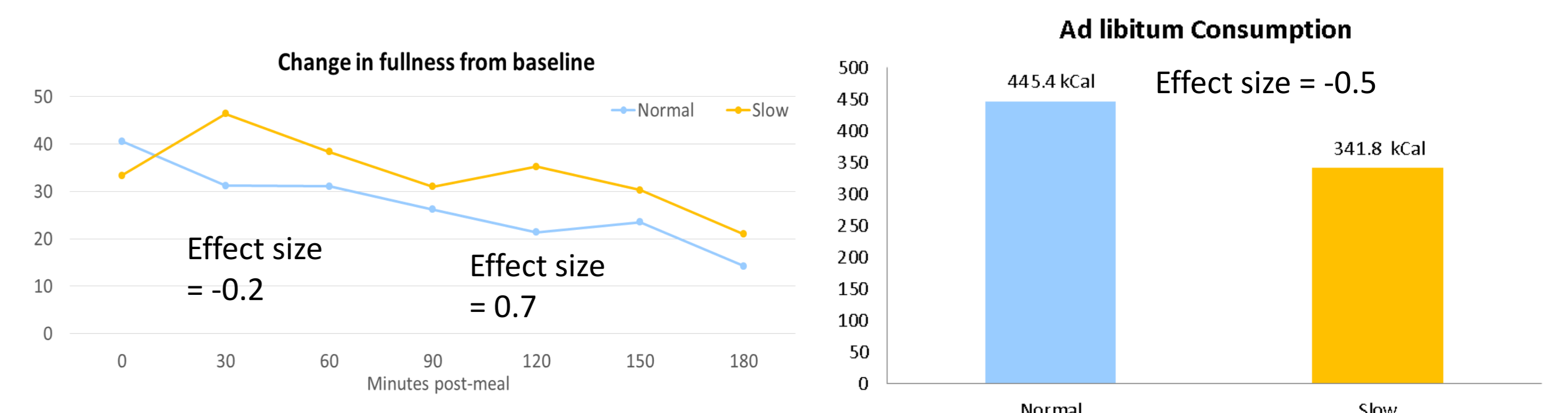
- Normal BMI, aged 18-35 years
- 20 participants randomised age, gender, BMI, DEBQ restraint score
- Fasted for 12 hours overnight
- fMRI scan at baseline and 2 hours post-meal (with memory task)
- Randomised to consume meal in 6 min (normal) vs 24 min (slow)
- 600 kCal meal of macaroni cheese
- Mouthful of specified size taken each time computer beeped



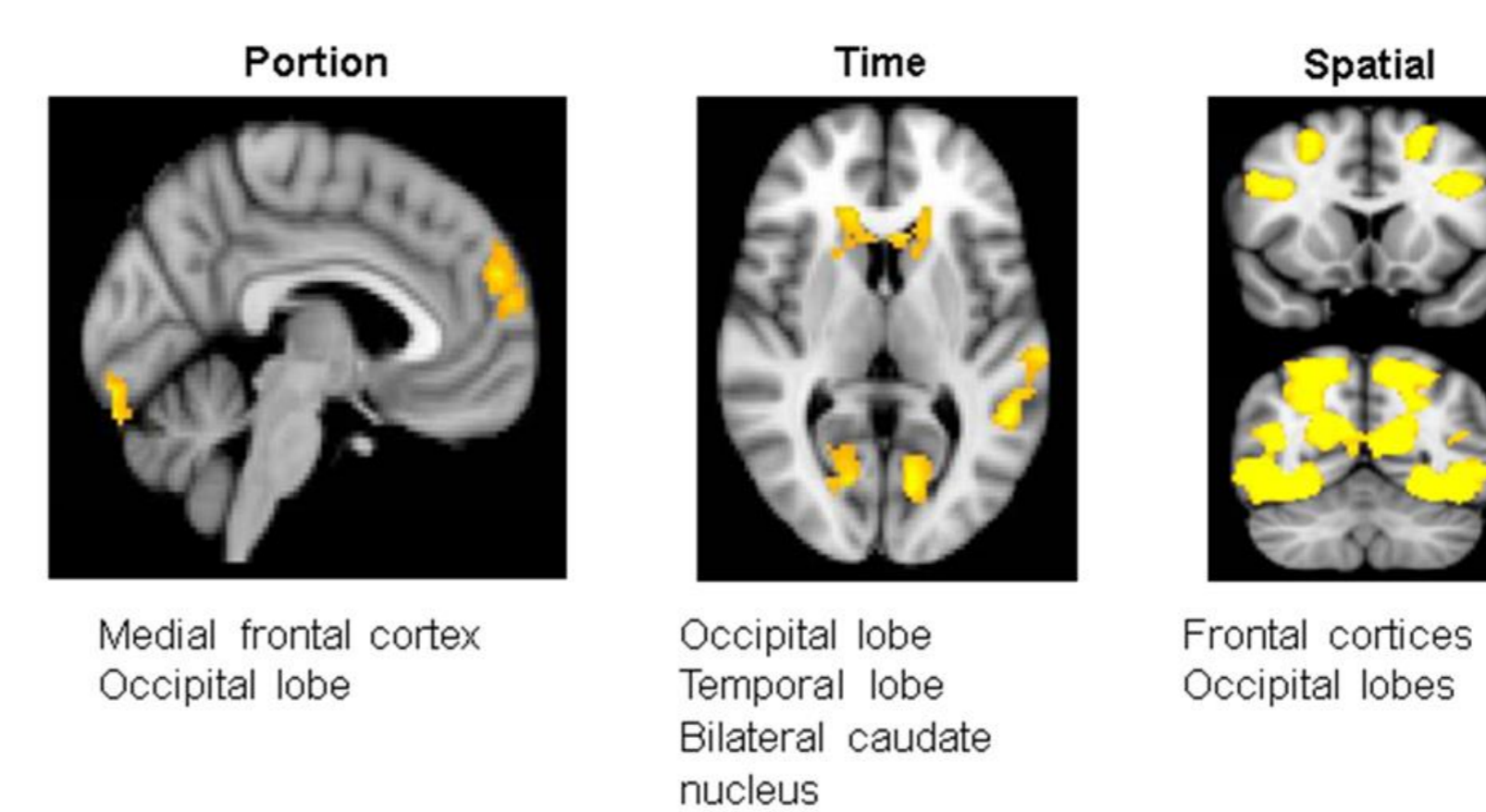
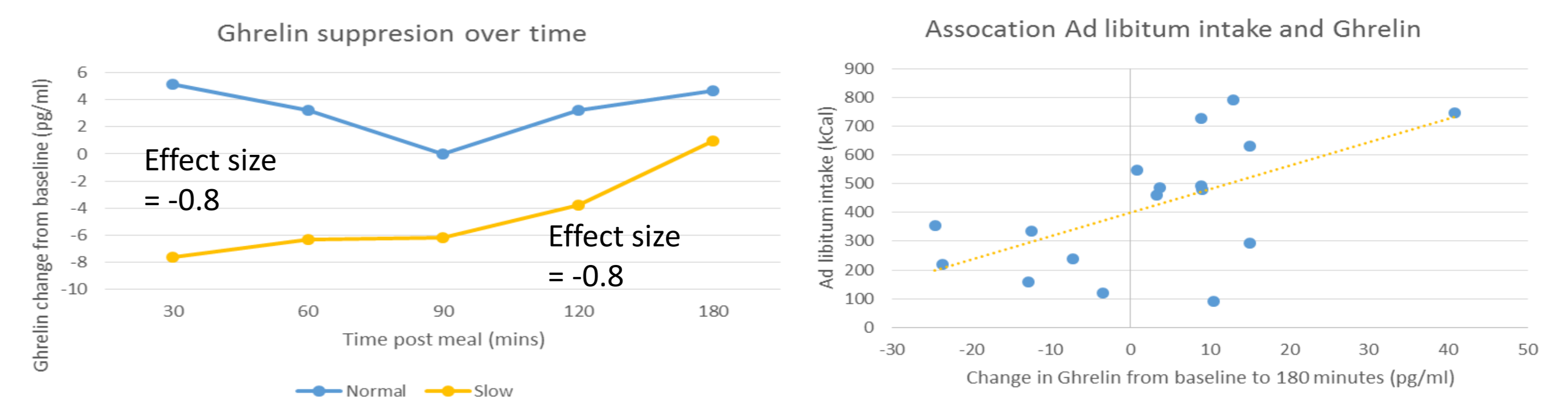
- Appetite ratings recorded every 30 minutes for 3 hours post-meal
- Bloods tests (PYY, Ghrelin) every 30 minutes for 3 hours post-meal
- Task based on imaging study of memory (Kwok et al, 2015, *Hum Brain Mapp*) with 3 aspects of episodic memory tested: 1) spatial (room trials), 2) temporal (interval trials), 3) recognition (portion trials)
- Ad libitum snack meal 3 hours post meal: 1000 kCal snacks (cookies and crisps) with 10 minutes to eat until comfortably full
- fMRI data processed using FEAT (fMRI Expert Analysis Tool) v 6.00

Results

- No differences between groups in randomisation criteria, baseline mood/ appetite ratings, or pleasantness ratings in the taste tests.
- Enjoyment and satisfaction higher in normal group (effect size = -0.5)

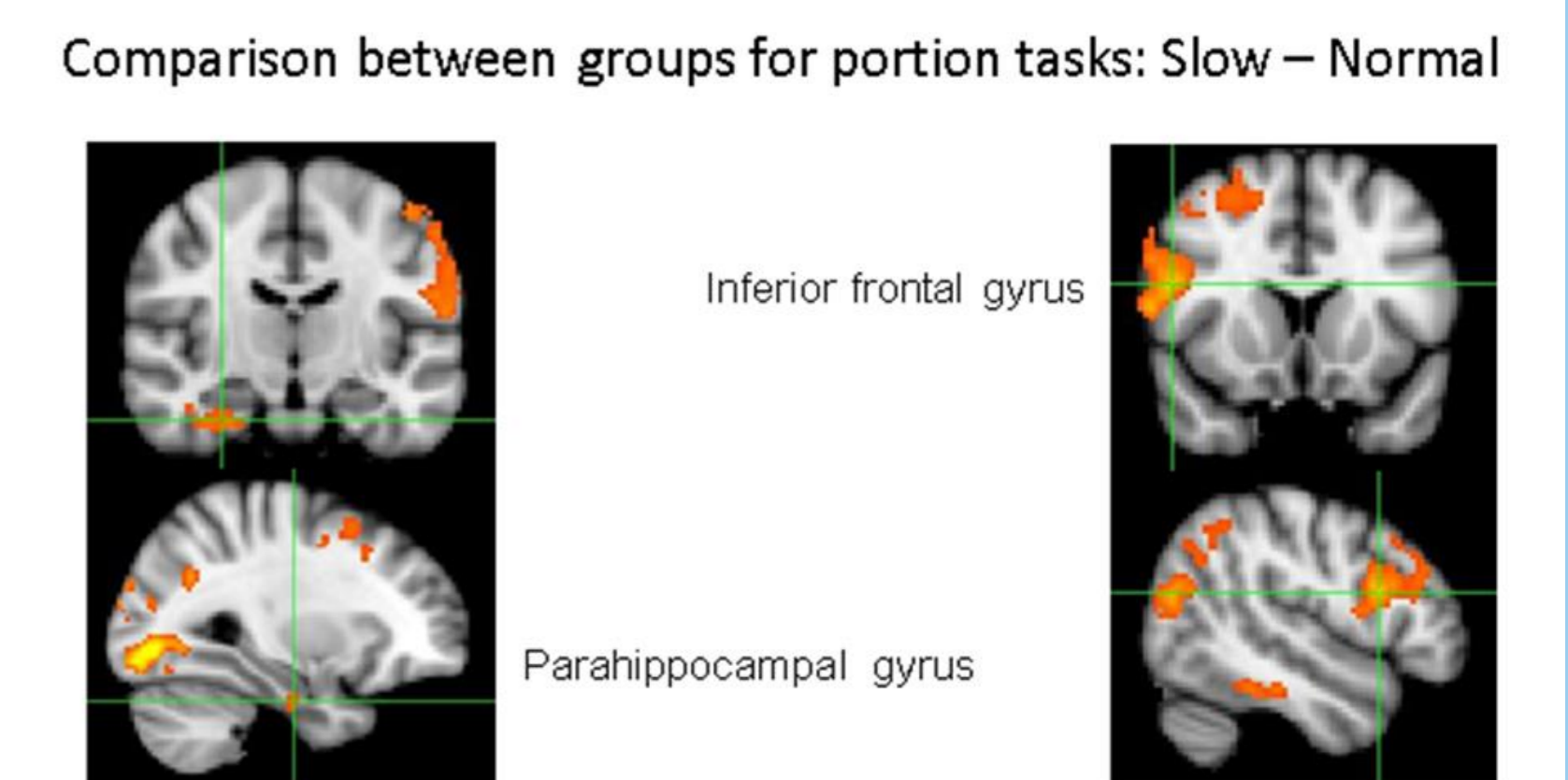


- Ghrelin suppression was greater in the slow group than the normal group at 30 and 120 mins post-meal.
- Ghrelin at 180 mins correlated with ad-libitum intake ($r=0.59$, $p=0.013$).
- PYY levels at 30 mins correlated with enjoyment of meal ($r=0.451$, $p=0.046$) and memory task activation in precuneus, striatum and insula.



fMRI: Each trial type contrasted with mean of the other two trial types (e.g. Portion – mean(interval/room) to reveal unique areas of activation.

Areas with greater response to portion task in slow compared to normal group, parahippocampus involved in memory and a frontal area which may be involved in satiety.



Conclusions

- Experimentally slowing eating rate lead to:
 - Greater signal change in satiety-responsive brain areas ✓
 - Increased ghrelin suppression and increased PYY secretion ✓
 - Reduced enjoyment and satisfaction ✓
 - Greater feeling of fullness post meal ✓
 - Improved memory of the meal ✓
 - Reduced subsequent food intake ✓
- fMRI provides information about potential underlying processes
- Encouraging results for design of interventions: slow group ate 25% less

References

- Kwok, S. C. and Macaluso, E. Immediate memory for "when, where and what": Short-delay retrieval using dynamic naturalistic material. 2015. *Hum. Brain Mapp.*, 36: 2495–2513.
- Robinson E et al. A systematic review and meta-analysis examining the effect of eating rate on energy intake and hunger. *Am J Clin Nutr.* 2014; 100(1):123-51.
- No conflicts of interest