

# The effect of exposure to food odours on attention to and recall of low and high calorie food images.

J. M. Thomas<sup>1</sup>, M., Khan<sup>1</sup> & R. Nash<sup>1</sup>

<sup>1</sup> Department of Psychology, Aston University, Birmingham, UK, B4 7ET. [thomasj8@aston.ac.uk](mailto:thomasj8@aston.ac.uk)

## Introduction

Exposure to food odours can enhance appetite for, and nudge choice towards, the associated food<sup>1,2</sup>.

However, despite the interest in cognitive processes that underpin eating behaviour, few studies have examined the relationship between food odour, attention towards and memory for food<sup>3</sup>.

In the present study we examined whether exposure to odours signalling a fruit (orange), an energy-dense food (chocolate) or a non-food item (neutral odour), affected attention to and the recall of low and high calorie food images.

## Methods

### Participants

93 women undergraduate students from Aston University were recruited to take part in this study in exchange for course credits.

### Independent Variables

Between-subjects, Odour: Orange, Chocolate or Non-food Neutral. Within-subjects, Food Image: Low Calorie, High Calorie and Non-food (latter not presented here for brevity).

### Dependent Variables

- (1) Reaction times to images.
- (2) Number of items correctly recalled.

### Food Categorisation Task

- 120 images: 60 food (30 low calorie and 30 high calorie) and 60 non-food items (see **Figure 1**).
- When the image appeared participants were required to indicate whether the item was a food or non-food item (via mouse click).



**Figure 1:** Example of a low calorie food (left), high calorie food (centre) and non-food image (right).

### Food Recall Task

- Asked to recall as many items as possible from the food categorisation task (food and non-food items).
- Responses typed on a computer.
- Six minutes to complete this task.

### Procedure

- Information sheet & consent form.
- Lifestyle Questionnaire (age, gender, etc.).
- Visual Analogue Scales for Mood and Appetite (mood and appetite items, e.g. hunger).
- Odour manipulation: participants were asked to wash their hands with a hand wash (corresponding to their odour condition). They were told that they would be questioned on their handwashing at the end (test).**
- Food Categorisation Task.
- Food Recall Task.
- Three Factor Eating Questionnaire (TFEQ-R21).
- Demand Check & Manipulation Check.
- Debrief.

### Bias Scores

(1) Reaction times to low calorie items were subtracted from reaction times to high calorie items to produce a high calorie reaction time bias (correct trials only, reaction times +/- 3 SD from the mean were excluded).

(2) The number of low calorie items recalled were subtracted from the number of high calorie items recalled to produce a high calorie recall bias.

## Participant Characteristics & Scores

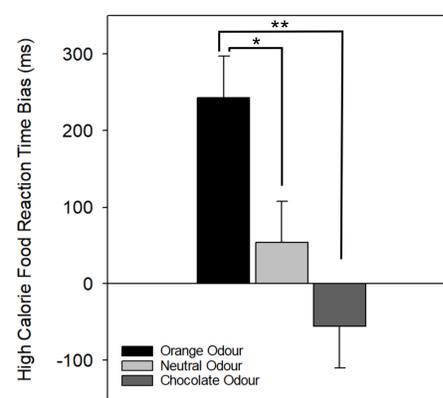
**Table 1** Mean (SD) participant characteristics and questionnaire scores split by condition

Measure	Orange Odour	Chocolate Odour	Neutral Odour	<i>p</i> value
Age	20.0 (2.2)	19.5 (1.2)	19.5 (1.1)	0.4
Body Mass Index (BMI)	23.7 (4.0)	22.4 (4.2)	21.8 (3.8)	0.2
VAS Hunger	53.1 (29.2)	52.6 (30.2)	47.2 (33.9)	0.7
TFEQ Uncontrolled Eating	2.4 (0.7)	2.1 (0.6)	2.1 (0.5)	0.1
TFEQ Cognitive Restraint	2.4 (0.7)	2.3 (0.7)	2.0 (0.7)	0.2
TFEQ Emotional Eating	2.5 (0.6)	2.6 (0.6)	2.4 (0.5)	0.4

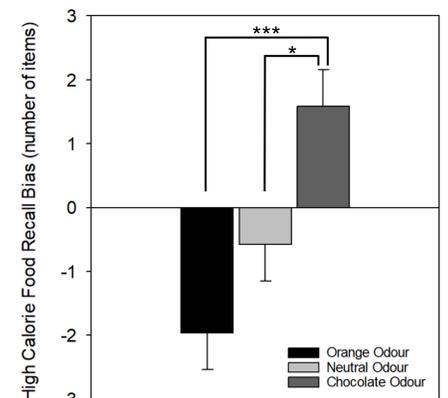
There was no main effect of odour for any of these measures (all *ps* > 0.05).

## Main Results

ANOVA confirmed a main effect of odour for reaction time bias ( $p < 0.01$ ) and recall bias ( $p < 0.001$ ). Bonferroni corrected t-tests were used to examine these further:



**Figure 2** Participants exposed to the orange odour were significantly slower to respond to high calorie (vs. low calorie) food items, compared to those exposed to the neutral or chocolate odour. \*  $p < 0.05$  \*\*\*  $p < 0.001$

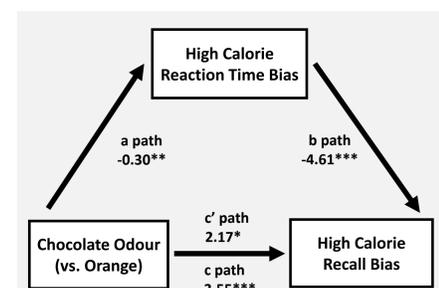


**Figure 3** Participants exposed to the chocolate odour recalled significantly more high calorie (vs. low calorie) food items, compared to those exposed to the neutral or orange odour. \*  $p < 0.05$  \*\*\*  $p < 0.001$

Participants exposed to the orange odour were slower to respond to high (vs. low) calorie foods, compared to the neutral or chocolate odour. They also recalled more high (vs. low) calorie foods when exposed to the chocolate odour, than the neutral or orange odour.

## Post-hoc Mediation Analysis

Chocolate odour (vs. orange) predicted reaction time bias ( $p < 0.01$ ) and reaction time bias predicted recall bias ( $p < 0.001$ ). The direct effect of chocolate odour on recall bias was significant ( $p < 0.05$ ) as was the total effect ( $F(1,60) = 15.942$ ,  $p < 0.001$ ,  $R^2 = 0.21$ ). The indirect effect of chocolate odour on recall bias through the mediator was significant ( $a*b = 1.38$ , CI [0.39,2.43]) and the mediator accounted for 39% of the total effect.



**Figure 4** Mediation direct and indirect paths \*  $p < 0.05$  \*\*  $p < 0.01$  \*\*\*  $p < 0.001$

## Conclusion

- These results suggest that exposure to food odours is sufficient to bias our attention towards similar foods, and subsequently, to bias our recall towards those foods also.
- This may help to explain how the 'obesogenic environment' encourages poor eating choices, by modulating cognitive processes to nudge people towards certain foods.
- The effect of the orange odour to blunt both the reaction time and recall bias to high calorie foods, might point towards the solution to these environmental stimuli; recalibrating the environment to actively promote healthy food odours.
- It should be noted that the present study did not examine food intake. This will be examined in a future study to determine whether these attentional and memory biases predict subsequent choice and intake.

## Acknowledgements & References

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