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The effect of mindful eating on subsequent intake of a high calorie snack

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ABSTRACT

This study examined the effects of applying a mindful eating strategy during lunch on subsequent intake of a palatable snack. It also looked at whether this effect occurred due to improved memory for lunch and whether effects varied with participant gender, level of interoceptive awareness or sensitivity to reward. Participants ($n = 51$) completed a heartbeat perception task to assess interoceptive awareness. They were then provided with a lunch of 825 calories. Participants in the experimental group ate lunch while listening to an audio clip encouraging them to focus on the sensory properties of the food (e.g. its smell, look, texture). Those in the control group ate lunch in silence. Two hours later participants were offered a snack. They then completed a questionnaire assessing sensitivity to reward as well as other measures assessing various aspects of their memory for lunch. The results showed no significant difference in lunch intake between the two groups but participants in the experimental group consumed significantly less snack than those in the control group; mean = 112.30 calories ($SD = 70.24$) versus mean = 203.20 calories ($SD = 88.05$) respectively, Cohen's $d = 1.14$. This effect occurred regardless of participant gender or level of interoceptive awareness. There was also no significant moderation by sensitivity to reward although one aspect, reward interest, showed a trend towards significance. There was no evidence to indicate that the mindful eating strategy enhanced participants' memory for their lunch. Further research is needed to assess the long-term effects of this strategy, as well as establish the underlying mechanisms. Future work on the relationship between sensitivity to reward and the effects of mindful eating may also benefit from larger sample sizes.

1. Introduction

Mindful eating can be described as a "non-judgmental awareness of physical and emotional sensations associated with eating" (Framson et al., 2009). Elements of mindful eating are increasingly being incorporated into interventions designed to facilitate weight loss and manage obesity-related eating behaviours (Olsen & Emery, 2015). Although such interventions are often associated with improvements in eating behaviours and weight management, the extent to which these effects are driven by mindful eating is unclear (Olsen & Emery, 2015; O'Reilly, Cook, Spruijt-Metz, & Black, 2014; Tapper, 2017).

The current study takes just one aspect of mindful eating, attending to the sensory properties of food, and examines its effects on eating in a more controlled laboratory setting. Previous research using this type of strategy has failed to find any immediate effect on food intake i.e. while the strategy is being applied (Bellisle & Dalix, 2001; Cavanagh, Vartanian, Herman, & Polivy, 2014; Long, Meyer, Leung, & Wallis, 2011). Other studies, however, have found that focusing on the sensory properties of food is associated with reduced food intake at a later point (Arch et al., 2016; Cavanagh et al., 2014; Higgs & Donohoe, 2011). For example, Higgs and Donohoe (2011) examined the effect of focusing on the sensory properties of lunch on cookie consumption 2–3 h later among female participants. Results showed that those who were asked to focus on the sensory properties of their lunch consumed fewer cookies (a difference of 27 g) in comparison to those who ate lunch while reading an article about food or those who ate lunch without any manipulation. Similar results were also attained by Robinson, Kersbergen, and Higgs (2014), whereby overweight and obese female participants who focused on the sensory properties of their food during lunch showed a 30% reduction in consumption of an

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afternoon snack (equivalent to 106 calories).

To explain the above findings, Higgs and Donohoe (2011) suggested that attending to the sensory properties of food enhanced participants' memory for it, which subsequently helped them appropriately interpret physiological signals in the afternoon and adjust their cookie consumption accordingly. This interpretation was supported by the fact that, compared to those in the control condition, participants in the experimental condition rated their memory of the lunch they had consumed as more vivid. However, Robinson et al. (2014) failed to replicate this effect on memory, possibly because of ceiling effects in their measurement of memory vividness. They also explored another aspect of memory, memory of quantity of food consumed, but again failed to find evidence that it mediated the relationship between the focused attention manipulation and reduced intake. As such they suggested that interoceptive memory (i.e. memory of level of hunger and fullness after lunch) may be more important.

The current study extends this research in a number of ways. First it examines whether the effects of focusing on the sensory properties of food extends to males as well as females. Both studies conducted by Higgs and Donohoe (2011) and Robinson et al. (2014) were restricted to females. However, given gender differences in eating behaviour and food-related concerns (Missagia, Oliveira, & Rezende, 2013; Nowak & Speare, 1996) it would be unwise to assume we would necessarily obtain similar results with males. Second, the study explores in more detail the role of memory as a mechanism to explain the effects of mindful eating on subsequent food intake. It does so by examining four different types of memory: interoceptive memory, memory vividness, memory for quantity of food consumed, and memory for type of food consumed. And third, the study explores whether the effects of the mindful eating strategy are moderated by individual differences in interoceptive awareness and sensitivity to reward.

Interoceptive awareness is the ability to detect inner bodily states or signals like heartbeat and feelings of satiety (Herbert, Blechert, Hautzinger, Matthias, & Herbert, 2013). Previous research has shown that a positive relationship exists between levels of interoceptive awareness and ones ability to recognise, and respond to, signals of hunger and fullness (Herbert et al., 2013). Whilst interoceptive awareness may not be amenable to change via mindfulness practice (Melloni et al., 2013; Parkin et al., 2014) it is possible that it may moderate its effects. For example, the mindful eating manipulation may work by increasing individuals' attention toward feelings of satiety which may in turn enhance interoceptive memory. As such we would expect it to be less effective amongst those with lower levels of interoceptive awareness, since they would be less able to detect such feelings in the first place.

Research has also shown that individuals with a higher sensitivity to reward tend to be more responsive to appetizing foods and food cues (Tapper, Pothos, & Lawrence, 2010), show an increased tendency to overeat (Davis et al., 2007) and consume more fat in their diet (Tapper, Baker, Jiga-Boy, Haddock, & Maio, 2015). As such, participants high in sensitivity to reward may be inclined to eat appetizing foods irrespective of their level of satiety. Thus again we may find that the mindful eating strategy is less effective at reducing intake of a highly palatable snack amongst those with higher sensitivity to reward. For this study a relatively new measure of reward sensitivity was employed; The Reinforcement Sensitivity Theory Personality Questionnaire (RST-PQ; Corr & Cooper, 2016). This measure was selected as it addresses some of the problems with previous measures and better aligns with recent revisions to Reward Sensitivity Theory (Corr & Cooper, 2016; Corr, 2016). The RST-PQ includes four subscales relating to reward sensitivity: (1) reward interest; openness to trying new experiences that are potentially rewarding, (2) goal drive persistence; maintenance of motivation especially when reward is not available immediately, (3) impulsivity; tendency to display behaviour that may lack consideration of consequences, and (4) reward reactivity; feelings of pleasure and emotional 'highs' associated with the experience of reward. Because previous studies have found effects with different reward sensitivity subscales (Davis et al., 2007; Tapper et al., 2010, 2015) and because the subscales in the RST-PQ do not map directly onto those used in previous studies, the effects of each subscale were examined in an exploratory fashion.

2. Methods

2.1. Participants

Originally, 60 male and female participants were recruited. However, two failed to attend the second part of the study leaving a total of 58. These participants had an average age of 24.22 years (*SD* 7.81). Participants were recruited using an advert placed on an online platform affiliated with the university, as well as via flyers and posters placed on billboards around the university buildings. In order to avoid participants guessing that their food consumption was being measured, the study was described as exploring the effect of mood on heart rate perception and taste preferences. Participants who completed the study received course credits or 5 pounds sterling. Inclusion criteria were fluency in English and exclusion criterion were food allergies to any of the foods being offered and being on any medication that could affect appetite. Ethical approval was granted by the City, University of London Psychology Department Research Ethics Committee.

2.2. Experimental design

A between-subjects design was used with two conditions: (1) control group where participants ate lunch with no audio recording, (2) experimental group where participants received instructions via an audio recording that asked them to focus on the sensory properties of their lunch whilst eating.

2.3. Test foods

2.3.1. Lunch

In order to avoid ceiling effects on measures of memory for lunch items consumed, a range of different foods were given to participants for their lunch. These consisted of: one cheese and tomato sandwich (158 g, 405 kcal), 5 cherry tomatoes (55 g, 11 kcal), 5 Ritz crackers (19 g, 95 kcal), 5 red grapes (30 g, 20 kcal), 5 green grapes (33 g, 20 kcal), 4 mini lemon cakes (33 g, 135 kcal) and 4 mini chocolate cakes (32 g, 139 kcal). The sandwiches comprised two pieces of wholegrain bread cut into 2 triangles. This was presented alongside the cherry tomatoes, crackers, and grapes on a plate. The cakes were presented in a separate bowl. The meal contained approximately 825 calories in total. The amount of food consumed by each participant was calculated by counting the number of foods eaten as well as weighing the foods individually before and after the participant ate their meal. In addition to the food provided, two participants requested a cup of water, which they were given.

2.3.2. Afternoon snack

This consisted of three separate 60 g portions of original (295 kcal), milk chocolate (296 kcal), and dark chocolate (299 kcal) digestive biscuits, each served on a separate plate. The biscuits were broken into smaller pieces to reduce the possibility that participants would keep count of the number they had eaten. The amount of biscuits consumed by each participant was calculated by