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Reactivity to television food commercials in overweight and lean adults: Physiological, cognitive and behavioural responses

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ABSTRACT

Recent evidence indicates that acute exposure to food advertising increases food intake. However, little research to date has explored the potential mechanisms underpinning this, such as the extent to which food commercials elicit conditioned physiological responses (e.g. increased salivation). The aim of the current study was to examine salivary, cognitive and consumptive responses to televised food commercials in overweight (N = 26) and lean (N = 29) adult females. Participants attended two laboratory sessions in a counterbalanced order; in one session they viewed a television show with embedded commercials for unhealthy foods, and in the other session they viewed the same show with non-food commercials. In both conditions, following viewing participants were exposed to an in vivo food cue (freshly cooked pizza) which they were then invited to eat ad libitum. Salivation was measured at baseline, during commercial exposure, and during in vivo exposure. Participants also self-reported components of appetite on visual analogue scales and completed a word stem task. Results indicated little evidence of increased salivary reactivity to the food commercials. In both conditions, lean participants showed reliable salivary responses to the in vivo food cue. In contrast, overweight participants only showed increased salivation to the in vivo cue in the food commercials condition. Food commercial exposure did not increase the number of food-related cognitions or amount of food consumed, but did drive a greater increase in desire to eat prior to pizza consumption than exposure to the control commercials. Exposure to food advertising primes eating-related motivations, and while it may not be associated with increased intake or salivation per se, non-food commercials may attenuate subsequent physiological responses to actual food cues in overweight individuals.

1. Introduction

The obesogenic food environment has been strongly implicated as a causal factor contributing to the global obesity epidemic [1]. Globally 2.1 billion adults are overweight or obese [2], and this excess weight is contributing to increased incidence of non-communicable disease [3]. Poor diet is a greater risk factor for disease incidence than tobacco, alcohol and inactivity combined [4]. The persuasive and excessive marketing of energy-dense foods is a key component of the obesogenic environment, and in several countries restrictions have been placed on the marketing of such foods to children, either through Government intervention or industry self-regulation [5,6]. This policy action reflects the large body of evidence demonstrating that food marketing influences children's eating behaviours including attitudes and preferences [7–9].

Far fewer studies have explored this phenomenon in adults. One systematic review explored the effects of food and non-alcoholic beverage advertising on food-related behaviour, attitudes and beliefs in adult populations, but the findings were inconclusive [10]. A subsequent review of reviews also noted the evident variability in findings across studies, but concluded that the majority reported a significant positive association between food advertising and food choice in adults [11]. A recent systematic review and meta-analysis of the impact of acute experimental exposure to food advertising (via television or the Internet) on food intake reported on just seven studies with adult participants [12]. Of these, three reported a significant main effect of food advertising condition on consumption. In Harris et al., [13] participants consumed an average of 6.5 g more snack food following food commercials compared to after non-food commercials and Koordeman et al., [14] found that food advertising exposure significantly increased adults' soda intake. Furthermore, Wonderlich-Tierney et al., [15] found an interaction between food advertising condition and 'transportability' (defined as "a mechanism by which narratives influence individuals' beliefs and behaviours through their

Abbreviations: BMI, Body Mass Index; CR, conditioned response

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thoughts, emotional responses, and imagery of the events during the story", p58). In that study, those participants deemed 'high' in transportability ate more after exposure to food advertising than they did after neutral commercials or no commercials at all. However, in the overall meta-analysis there was no evidence of an effect of acute food advertising exposure on short-term food consumption in adults, which contrasts with the significant moderate sized effect observed across studies with children [12]. One possible explanation for this disparity is that adults are capable of resisting food advertising or altering their behaviour such that it overrides the influence of food advertising on food intake. This may be because of more advanced cognitive abilities that enable them to be critical viewers of advertising and potentially to deploy cognitive defence mechanisms [16]. Another possibility is that research aims were insufficiently disguised in these studies, and thus the data were vulnerable to demand characteristics (participants believing themselves aware of the aims of the study and behaving in accordance with those beliefs). It may also be that adult participants were aware that their food intake was being monitored. Importantly this awareness has previously been associated with a weakening of the (usually robust) effect of portion size manipulations on intake in adults [17].

A small number of studies, in which outcome measures other than food intake were used, do suggest that food advertising exposure has an effect on eating-related behaviours in adults. For example, food commercials have been shown to prime food-related cognitions which are associated with self-reported desire to eat. Specifically, Kemps et al. showed that exposure to food commercials increased the number of food- and eating-related words that were produced in a word-stem completion task relative to a non-food commercial control condition. Food commercial exposure also increased self-reported desire to eat but only for overweight and obese participants [18].

This finding is consistent with the wider literature on learned associations and cue reactivity. Through a process of classical conditioning, external cues (e.g., the sight and smell of food) become conditioned stimuli for the rewarding consequences of eating. These conditioned cues acquire the ability to elicit conditioned responses (CRs) that influence eating initiation and meal size [19]. Accordingly, exposure to food cues has been shown to reliably elicit CRs such as changes in subjective state (increased hunger, desire to eat and craving), physiological readiness to eat (increased salivation and heart rate) and cognitive changes, such as food-related attentional bias [20–25]. Food cue exposure also increases the amount of food that is subsequently consumed, relative to no-cue exposure control conditions [21,26,27].

The extent to which television food commercials might function as conditioned cues for eating has received little empirical attention. Notably, a recent meta-analysis indicated that visual food cues (e.g., pictures and videos of food) are as powerful as real food exposure in terms of influencing subsequent eating behaviour [26]. Another recent study found that televised commercials for energy-dense foods elicited greater skin conductivity than commercials for less energy dense foods [28]. These findings are important because when viewing food commercials the cued food is often not immediately available for consumption. Relatedly, it has been found that salivary responses to a real food cue were not influenced by perceived availability; that is, participants showed increased salivation to the food regardless of whether they perceived it as available or unavailable for consumption [29]. However, to the authors' knowledge, no studies have examined whether exposure to food cues via television commercials is sufficient to invoke an increased salivary response.

There is also evidence that differences in weight status and eating traits should be taken into account when exploring the impact of food commercials on eating behaviour in adults. Schacter's externality theory purports that obese individuals are particularly sensitive to external cues to consume [30]. With respect to food advertising exposure, this theory is supported by a previous study with child participants in which normal weight children increased their intake by 89% following food commercials relative to non-food (toy) commercials, but overweight and obese children increased their intake by 101% and 150% respectively [31]. In adults, exposure to real food cues elicited a greater salivary response and desire to eat in overweight, compared to normal weight, individuals [22], and food commercial exposure increased self-reported desire to eat but, again, only for overweight and obese participants [18]. Relatedly, trait external eating refers to the general tendency to eat in response to external food-related cues. Previous research suggests that individuals who score highly on a trait measure of external eating may be particularly susceptible to the effects of food commercials on behaviour. Specifically, van Strien, Herman and Anschutz found that high external eaters consumed more food in response to food commercials compared to neutral commercials, whereas as low external eaters did not show this effect [32]. However, to our knowledge, no studies have explored the potential moderating role of trait external eating on physiological and cognitive responses to food commercials.

Based on the limited literature to date exploring the impact of food advertising exposure on consumptive responses in adults, and in order to address the paucity of research integrating physiological and cognitive responding, weight status and eating traits within this field, the following primary research questions were formulated: (i) does television food advertising exposure elicit increased salivation in adults relative to control (non-food) commercials?; (ii) does television food advertising exposure prime desire to eat and food-related cognitions?; (iii) is cognitive and salivary reactivity associated with the level of food intake after television advertising exposure?; and (iv) are weight status (lean versus overweight and obese) and eating trait (low versus high external eating) differences apparent in salivary, cognitive and consumptive responses to television food advertising exposure?

2. Methods

This study was approved by the University of Liverpool's Institute of Psychology, Health and Society's Research Ethics committee on June 12th 2015 and data were collected between late June and August 2015.

2.1. Participants

Fifty-five female participants [mean age 32.4 (range 20–62) years] were recruited from the staff and student population at the University of Liverpool, UK, and from the general population of the surrounding area of Merseyside. Only female participants were included in order to ensure large sex-related differences in intake did not obscure the anticipated more subtle effects of the experimental manipulation. Participants were screened to ensure they had no chronic illness, no known food allergies or intolerances, were not currently dieting, and were not taking any medication that might influence taste, salivation or appetite (excluding the contraceptive pill). Twenty-nine participants were lean (i.e. body mass index [BMI; kg/m^2] < 25) and 26 were overweight or obese (i.e. BMI > 25; hereafter 'overweight'). Upon completion of the study, participants were reimbursed for their time and inconvenience with a £10 high street shopping voucher.

2.2. Advertising stimuli

Participants were exposed to 10 food commercials and 10 non-food commercials (embedded within two episodes of the same comedy programme, 'The IT Crowd') on two different occasions. Counterbalancing of condition order and programme episode (e.g. episode 1 with food commercials at first visit, episode 2 with non-food commercials at second visit) was conducted for each weight status group (lean and overweight) using www.randomizer.org. All commercials were obtained from contemporary UK television recordings held by the research group. The food commercials all promoted high calorie