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Research report

The role of attentional bias in the effect of food advertising on actual food intake among children ☆

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ABSTRACT

This study examined the potential moderating role of attentional bias (i.e., gaze duration, number of fixations, latency of initial fixation) in the effect of advergames promoting energy-dense snacks on children's snack intake. A randomized between-subject design was conducted with 92 children who played an advergame that promoted either energy-dense snacks or nonfood products. Eye movements and reaction times to food and nonfood cues were recorded to assess attentional bias during playtime using eye-tracking methods. Children could eat freely after playing the game. The results showed that playing an advergame containing food cues increased total intake. Furthermore, children with a higher gaze duration for the food cues ate more of the advertised snacks. In addition, children with a faster latency of initial fixation to the food cues ate more in total and ate more of the advertised snacks. The number of fixations on the food cues did not increase actual snack intake. Food advertisements are designed to grab attention, and this study shows that the extent to which a child's attention is directed to a food cue increases the effect of the advertisement.

Introduction

A large body of research shows that young children are susceptible to food advertisements (Boyland, Harrold, Kirkham, & Halford, 2012; Folkvord, Anschütz, Buijzen, & Valkenburg, 2013; Folkvord, Anschütz, Nederkoorn, Westerik, & Buijzen, 2014; Halford, Gillespie, Brown, Pontin, & Dovey, 2004). Most of the food products promoted in advertisements are energy-dense, high in fat, sugar and/or salt (WHO, 2009). In particular, online digital games that are used to advertise a product or a brand, so called 'advergames', seem to influence food intake among children strongly (Folkvord et al., 2013, 2014; Harris, Speers, Schwartz, & Brownell, 2011; Nairn & Hang, 2012). These online games provide a more highly involving, interactive, and entertaining brand experience than conventional media (Nairn & Hang, 2012). As yet, very little is known about the determinants of individual susceptibility of children to persuasive food messages in the media on consumption behaviour.

Individual susceptibility to food advertisements among children can possibly be explained by the amount of attention that is paid to food-related cues during exposure to these advertisements. It is via cognitions (e.g., thinking or learning processes), emotional aspects, or external sensory cues (e.g., the sight or smell of food) that the environment influences our eating behaviour, influencing the so-called non-homeostatic system of food intake (Berthoud, 2006; Cornier, 2011). The incentive sensitization theory suggests that through classical conditioning substance-related stimuli elicit the expectancy of substance availability, which in turn causes both attentional bias for substance-related stimuli and subjective craving (Field & Cox, 2008). During the past two decades, a considerable body of evidence has accumulated to suggest that substance use and abuse are characterized by biases in the attentional processing of substance-related stimuli. Via classical conditioning, a cue that is substance related acquires incentive-motivational properties and, subsequently, "grabs attention, becomes attractive and 'wanted,' and thus guides behaviour to the incentive" (Robinson & Berridge, 1993, p. 261). Classical conditioning occurs at a very young age. Therefore, it is important to examine the role of attentional bias for food cues in eating behaviour among children. The automatic and cue-driven nature of this classical conditioning is well supported by literature on craving and substance use (Goldstein & Volkow, 2002; Mogg, Field, & Bradley, 2005; Palfai & Ostafin, 2003; Tiffany & Carter, 1998) and has recently been applied to eating behaviour. For example, a study by Veenstra and de Jong (2010) demonstrated that restrained eaters showed increased automatic

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approach tendencies towards food. Havermans, Giesen, Houben, and Jansen (2011) found that obese men had a pronounced approach tendency towards high caloric food, providing additional support for altered motivational functioning.

In a similar vein, Castellanos et al. (2009) found that obese individuals in a satiated state had longer gaze durations and preferred orientation towards food images, compared to normal weight individuals. The longer duration gazes and preferred attention towards food images is generally labelled as 'attentional bias' (Field & Cox, 2008). Attentional bias theory (Field & Cox, 2008) proposes that when people have an increased motivation to receive or avoid a rewarding substance (e.g., food or alcohol), they show increased attention towards environmental cues related to that specific substance.

In this study a randomized between-subject design is used with an advergame promoting either energy-dense snacks or nonfood products, to examine the moderating role of attentional bias in the effect of food advertising on actual food intake among children. Based upon earlier findings, we have multiple reasons to expect this moderating effect. First, studies have shown that some children are more susceptible to food advertisements than others, for example impulsive (Folkvord et al., 2014) and overweight children (Forman, Halford, Summe, MacDougall, & Keller, 2009; Halford et al., 2004). Second, studies have found that attention to food cues generate greater activation in brain areas among children that are associated with food reward processing (Yokum, Ng, & Stice, 2012), food motivation and general appetitive cues (Holsen et al., 2005), and with future weight gain and weight maintenance (Murdaugh, Cox, Cook, & Weller, 2012). Third, according to the incentive sensitization theory (Robinson & Berridge, 1993), salient sensory attributes are transformed into incentives by repeated exposure, causing craving and subsequent actual eating behaviour of energy-dense food. This would imply that an attentional bias for food cues during a food advertisement could lead to more craving and, subsequently, to higher caloric intake. Until now, no study has examined whether an attentional bias for food cues during a food advertisement explains subsequent eating behaviour. The aim of this study is to examine the moderating role of attentional bias in the effect of food advertising on actual food intake among children.

By analogy of other studies (Castellanos et al., 2009; Nijs, Muris, Euser, & Franken, 2010), we use an eye-tracker to measure attentional bias by assessing gaze duration, number of fixations, and latency of the initial fixation, on commercial food or nonfood cues. In general, we expect that children who play the advergame promoting energy-dense snacks will eat more afterwards than children who play an advergame promoting nonfood products (H1). More specifically, we expect that children with a longer gaze duration (H2a), a higher number of fixations (H2b), and a faster latency of the initial fixation (H2c) to the food cues will eat more of the energy-dense snacks after playing the advergame.

Procedure

The committee for ethical concerns of the Faculty of Social Sciences at the Radboud University Nijmegen approved the current study. After obtaining written consent from the schools to participate, we sent the parents of the children a letter with detailed information regarding the study, and we asked them to inform us if they did not want their child to participate in the experiment or if their child was allergic to one of the test foods. Children who were allergic to the test food did not participate in the experiment. Around 90% of the children were allowed to participate. We emphasized to the parents and the children beforehand that all of the data that we collected would remain confidential and that children could cease participation at any moment.

We tested the children individually at their schools during regular school hours. The experimenter collected one child at a time from the classroom; the teacher assigned the children (in alphabetical order) to the experimenter. The experimenter brought each child to a separate classroom or office containing a computer. The children started with an online questionnaire for approximately 3 minutes to assess sex, age, class, and pre-experimental hunger. We masked the question about hunger with questions about their perceived levels of energy, fatigue, and arousal. Subsequently, the child was placed behind a separate computer to play a version of the advergame and participant's eyes were calibrated and validated. After calibration was successfully conducted, the experimenter assigned one of the advergames to the child. Then the experimenter read the instructions from the screen, which stated that the child would be playing a memory game for 5 minutes and should attempt to finish as many games as possible, the number of games being unlimited. Children played on average seven memory games during these 5 minutes. The experimenter left the room until the child finished playtime. When the playtime was finished, the child signalled the experimenter. The child was placed at a different table and the experimenter placed the bowls with food and a glass of water at the table. The experimenter explained to the child that (s)he was having a break for 5 minutes and could eat and drink something during the break, *ad libitum*. These methods have been used in previous studies (Folkvord et al., 2013, 2014).

After the break, the experimenter and the child filled out the second part of the online questionnaire. The second part of the questionnaire assessed liking of the test food, brand and product recognition, attitude to the advergame, frequency of playing similar advergames at home, and attitude to the candy brand. At the end of the session, we asked the children to indicate the goal of the research, but no child gave the correct answer. The experimenter read the questions and answers aloud, and the children gave their answers to the experimenter who wrote the answers in the questionnaire on the computer. When the questionnaire was finished, the experimenter measured the height and weight of the children to assess body mass index. The children were then accompanied back to their classrooms, and the experimenter invited the next child to participate. The experimenter requested that all children refrained from discussing the experiment with their classmates. After each session, the experimenter weighed the bowls to calculate caloric intake. The experimenter refilled and weighed the bowls before the next child entered the room to make sure that the children did not notice whether and how much the previous child had eaten.

Material and methods

Experimental design and stimulus materials

We used a factorial between-subjects design: 2 (type of advergame: energy-dense snacks vs. nonfood products) × 2 (attentional bias: high vs. low), with caloric intake as the dependent variable. To manipulate type of advergame we randomly assigned children to one of two conditions, playing either (1) the energy-dense snacks advergame (i.e., promoting a popular candy brand and different gummy and jelly sweets from this popular candy brand; see Fig. 1); or (2) the nonfood advergame (i.e., promoting a popular Dutch toy brand and individual toys from this brand; see Fig. 2). Thus, children played either the advergame promoting energy-dense snacks or the advergame promoting nonfood products.

Attentional bias was operationalized as eye movements while playing one of the advergames, recorded with a corneal reflection eye tracker (Tobii T120 Eye Tracker, Tobii Technology, Danderyd, Sweden). The Tobii eye-tracking system was integrated to a 17″ TFT flat screen monitor on which the stimuli were presented. The apparatus recorded gaze data of both eyes at 60 Hz with an average accuracy of 0.5° visual angle. The gaze of each child was cali-