

# An associative account of how the obesogenic environment biases adolescents' food choices



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## ABSTRACT

Adolescents and children are the targets of much food advertising, the majority of which is for unhealthy snacks. Although the effects of advertising on food preferences and consummatory behavior are well documented, our understanding of the underlying mechanisms is still limited. The present study investigates an associative (ideomotor) mechanism by which exposure to rewarding (snack) outcomes may activate behavior that previously resulted in these rewards. Specifically, we used a computerized task to investigate whether exposing adolescents to food pictures directly, or to Pavlovian cues predictive of those food pictures, would bias their subsequent responses towards the presented/signaled food. Furthermore, we assessed whether this effect was particularly pronounced with palatable, high-calorie snacks (crisps and chocolate) relative to low-calorie snacks (tomatoes and cucumber). In two experiments, adolescents learnt that certain key presses would yield particular food pictures – some high calorie and others low calorie – before learning Pavlovian associations between cues (cartoon monsters) and these same food pictures. Subsequently, in a response-priming test, we examined the extent to which the food pictures and Pavlovian cues spontaneously primed the previously associated response. The results show that we replicated, in adolescents, previous demonstrations of ideomotor response priming in adults: food pictures biased responding towards the response that previously yielded them, and this effect transferred to the Pavlovian cues. Furthermore, the priming effect was significantly stronger for high-calorie rewards than for low-calorie. These findings indicate that the ideomotor mechanism plays an important role in the detrimental effect of our obesogenic environment, with its plethora of unhealthy food reminders, on adolescents' food-related choices.

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## 1. General introduction

Obesity is on the rise amongst children and adolescents with one in five children under 15 being overweight or obese across member states of the Organisation for Economic Co-operation and Development (OECD, 2014). The food choices made by children and adolescents are thought to be biased by the obesogenic environment that constantly exposes them to palatable, unhealthy food and targeted advertisements (Cairns, Angus, Hastings, & Caraher, 2013; Livingstone, 2005; Lobstein & Dobb, 2005). Indeed, the

majority of advertisements aimed at children and adolescents are for unhealthy foods high in sugar and/or fat (Boyland, Harrold, Kirkham, & Halford, 2011; Powell, Szczypka, Chaloupka, & Braunschweig, 2007). Although the detrimental effect of advertising on food-related behavior of children and adolescents is well documented (see e.g. Harris, Pomeranz, Lobstein, & Brownell, 2009 for review), little is known about the mechanisms of food-marketing effects (Harris, Bargh, & Brownell, 2009; Harris, Pomeranz, et al., 2009). In the current study we investigated a possible mechanism that may underlie the effect of advertising and food exposure on adolescents' food-related choices.

A number of studies have investigated the effect that external food cues have on children's food preferences and food consumption (Folkvord, Anschutz, Wiers, & Buijzen, 2015; Halford,

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Gillespie, Brown, Pontin, & Dovey, 2004; Harris, Bargh et al., 2009; Robinson, Borzekowski, Matheson, & Kraemer, 2007). Pavlovian conditioning (learning the predictive associations between cues and outcomes) plays an important role in building brand awareness and preference at a young age. In two studies, children preferred food wrapped in fast food restaurant wrappers or affixed with a well-known cartoon character (Roberto, Baik, Harris, & Brownell, 2010; Robinson et al., 2007). It has also been demonstrated that viewing unhealthy food advertisements either during TV commercials or in computer games led children to consume more unhealthy food relative to a control group (Halford et al., 2004; Harris, Bargh, et al., 2009; Harris, Pomeranz, et al., 2009; Folkvord et al., 2015). A possible mechanism for these detrimental effects is provided by ideomotor theory as well as certain associative theories (Asratyan, 1974; Gormezano & Tait, 1976; Hommel, 2009; Hommel, Müsseler, Aschersleben, & Prinz, 2001; James, 1890; Lotze, 1852; Pavlov, 1927; see for review de Wit & Dickinson, 2009).

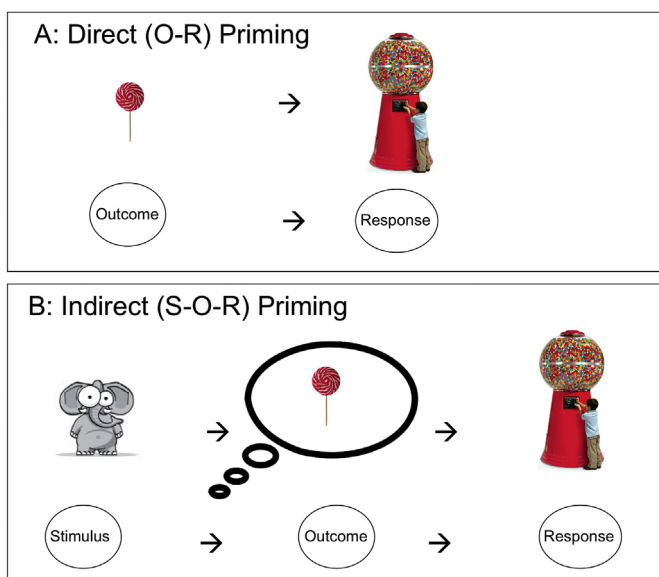
Ideomotor theory proposes that exposure to a certain outcome can activate the behavior that previously yielded this outcome. For example, seeing someone enjoying candy may initiate a trip to the nearest candy dispenser. Bi-directional associations between responses (R) and outcomes (O) are argued to underlie this O–R priming effect (as shown in Fig. 1). Researchers in the field of human psychology have shown that images of chocolate will lead participants to preferentially respond on keys previously associated with chocolate (Hogarth, 2012; Hogarth & Chase, 2011). However, as advertisers are well aware, stimuli (S) in our environment can also indirectly influence behavior, argued by these associative theories to be via a S–O–R associative pathway. Consider how candy brands use popular cartoon characters to market their products. Following exposure to advertisements in which cartoon characters are associated with candy, one can be reminded of candy merely by seeing the cartoon character (S–O), which in turn can activate the associated response (O–R; to head to the nearest candy dispenser; see Fig. 1). The latter indirect S–O–R priming effect has been studied using food rewards in several experimental ‘Pavlovian-to-

instrumental transfer’ (PIT) studies (in adults) in recent years (Bray, Rangel, Shimojo, Balleine, & O’Doherty, 2008; Prévost, Liljeholm, Tyszka, & O’Doherty, 2012; Watson, Wiers, Hommel, & de Wit, 2014).

To study indirect S–O–R priming Watson et al. (2014) first instructed participants during an instrumental training phase that one key would yield popcorn and the other chocolate Smarties. Subsequently, in a Pavlovian training stage, the participants learnt the relationships between two black and white patterns and popcorn and Smarties. Finally, in the critical test, participants were able to press on either of the keys to gain popcorn and chocolate Smarties for later consumption. Occasionally the Pavlovian cues were presented. In line with the predictions of ideomotor theory, participants pressed more for chocolate Smarties when the pattern associated with Smarties was on screen and pressed more for popcorn during the popcorn pattern. Crucially the cues had never been trained with an instrumental response – participants were indirectly primed to perform the instrumental response that was associated with the signaled food reward.

In the present study, we investigated direct O–R and indirect S–O–R priming with food rewards in adolescents, and we addressed for the first time the question whether these effects are more potent with palatable, high-calorie food outcomes than with bland, low-calorie outcomes. Adolescents were trained to respond for both high and low-calorie food outcomes (instrumental training phase) and then in a Pavlovian training phase they learnt the relationships between Pavlovian stimuli (cartoon monsters) and these same food outcomes. Subsequently, in a (nominal extinction) test, we examined the extent to which the food-outcome pictures spontaneously primed the response that had previously yielded that food picture during instrumental training (direct O–R priming). We also measured the extent to which the Pavlovian stimuli would spontaneously prime the instrumental response for the outcome that they predicted (indirect S–O–R priming). We expected that the palatable, high-calorie food pictures would be more motivating for the adolescents than the bland, low-calorie food pictures, and that this motivational difference would lead to relatively strong response-priming rates for the high-calorie outcomes.

We also examined whether adolescent boys and girls would show differential rates of learning and/or response priming as a function of calorie content. A number of studies in adults report that men and women differ in their behavioral and neuronal responses towards food images (Cornier, Salzberg, Endly, Bessesen, & Tregellas, 2010; Houben & Jansen, 2011; Wang et al., 2009) although the evidence for these gender differences in children and adolescents is less clear (Folkvord et al., 2015; Nederkoorn, Coelho, Guerrieri, Houben, & Jansen, 2012; Snoek, van Strien, Janssens, & Engels, 2006). Finally we included measures of impulsivity in our study to assess whether impulsivity would be related to the priming effects. Individuals with higher levels of trait impulsivity are argued to be more sensitive to cues that predict rewards (Carver & White, 1994; Stanford et al., 2009). One previous study investigating O–R priming with financial rewards reports a stronger priming effect in individuals scoring higher on a measure of reward sensitivity (Muhle-Karbe & Krebs, 2012). In addition, children and adolescents who are overweight score higher on various measures of impulsivity – both self-report measures (Van den Berg et al., 2011) and response inhibition tasks (Batterink, Yokum, & Stice, 2010; Nederkoorn, Braet, Van Eijs, Tanghe, & Jansen, 2006) suggesting a link between conditioned food-seeking behaviors and impulsivity. Therefore, we hypothesized that those adolescents scoring higher on impulsivity would show stronger priming effects for high-calorie food outcomes.



**Fig. 1.** A) Direct response priming – the sight of candy triggers a trip to the candy dispenser. B) Indirect response priming – following advertising associating a cartoon character with candy, seeing the cartoon character reminds one of candy and triggers a trip to the candy dispenser.

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