



# Food advertising and eating behavior in children

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Systematic research reviews have repeatedly shown that food advertising affects children's eating behavior. Given that most food advertising promotes unhealthy, palatable, and rewarding food products, it is considered to be a significant contributor to the current obesity epidemic. This review describes recent studies that have tested the effect of contemporary food advertisements on children's eating behavior, including newly emerging data showing marketing effects on subconscious cognitive processes and studies illuminating the mechanistic underpinnings of these effects. In addition, this review presents an integration of empirical findings in a new theoretical framework that increases the understanding of the effects of food advertising on eating behavior and might be used for future research in this area.

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## Introduction

Food companies spend copious amounts of resources on marketing to increase sales and market share [1], with advertising as one of the most important marketing instruments. Food brands are advertised in such a way as to: build positive brand associations by using engaging themes and linking with appealing nonbrand content; and seek to induce craving for the advertised foods by persuasive messages. Children have many years of consumer behavior ahead of them, and bombarding them with attention-grabbing and persuasive food advertisements early on might guarantee brand loyalty for a lifetime [2].

In the USA, a stunning 98% of advertised food products are considered unhealthy by nutritionists [3], typically being energy-dense and high in added sugar, salt, and fat. These foods are intrinsically rewarding [4,5], potentially driving children to eat much more than they actually need [4,5,6\*,7,8\*,9]. Despite the introduction of governmental regulations and industry codes of practice for responsible advertising, recent content analyses have shown that the food advertising that children are exposed to still predominantly promotes unhealthy food products [6\*,10–16].

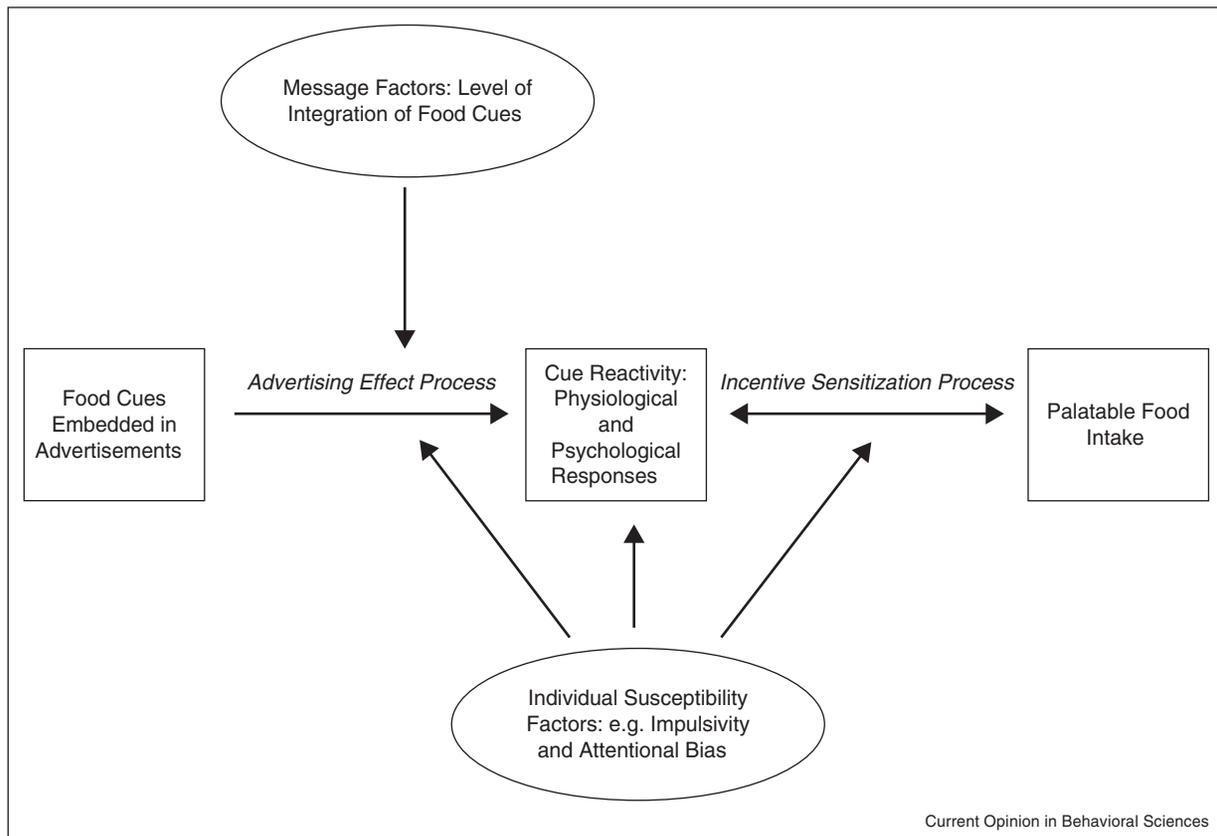
The ubiquitous advertising for these unhealthy foods stimulates the intake of energy-dense foods and undermines international and national recommendations for healthy eating behaviors and guidelines for disease prevention. This review article describes recent findings on the effects of food advertising on children's eating behavior and aims to integrate empirical findings in a new theoretical framework that might be used for future research in this area.

## Food advertising to children

Food advertising refers to any form of communication that is designed to increase the recognition, appeal, and/or consumption of particular food products, brands, and services [6\*]. Although television remains the most important platform for food advertising, it is gradually being complemented by an increasingly multifaceted mix of marketing communications — including websites, advergames, and product placements [6\*,17]. Systematic research reviews conclude that advertising has an effect on unhealthy eating behaviors in children [5,6\*,17].

Both observational [18,19] and experimental data [20,21\*,22,23\*,24\*\*,25\*\*,26] consistently show that exposure to food cues in advertising is related to increased choice and actual intake of foods among children, particularly for snack foods. More specifically, modification of behavior as a result of food advertising that occurs at the food *category* level rather than at the specific brand level, is an important determinant of problematic eating behavior [17]. For example, when children encounter an advertisement that promotes candy-brand X, they will not necessarily consume that specific candy brand as a consequence. Rather, available candy from any brand within the same food category (i.e., candy) will suffice to fulfill their advertising-induced craving. Understanding the impact of children's exposure to food advertising on the obesity epidemic relies on exploring the influence of industry-developed *food cues* on eating behavior [4].

Figure 1



Reactivity to Embedded Food Cues in Advertising Model (REFCAM).

Such food cues are the visual, mental, or auditory signals in advertising that may prompt affective and behavioral responses towards eating.

In a society characterized by the continuous presence of food cues, people are frequently triggered to consume food [27]. Cue reactivity theory [28] states that food cues in advertisements can trigger a series of physiological (e.g., increased heart rate, gastric activity and salivation) [29–31] and psychological responses (e.g., increased thoughts about food) [28,30,32], that subsequently induce eating behavior. This has been identified as the *advertising effect process* (Figure 1). Food cues become reinforcing through classical conditioning. Specifically, such conditioned stimuli (the advertisements) become associated with the unconditioned stimuli in the form of palatable foods, which are in turn natural reinforcers due to their rewarding effect [33,34]. Thus, conditioned stimuli activate a central appetitive state, resulting in eating behavior responses [27,35], and, in the long run, weight gain for certain individuals [36–39,40\*]. Reactivity to food cues becomes a stronger predictor of subsequent food intake, and an increased food intake in turn reinforces the reactivity to food cues, resulting in a reciprocal relation

between food cue reactivity and food intake, identified as the *incentive-sensitization process* [33,41].

### Processing of food cues in advertising

Currently, there is no theoretical model specifically explaining how food cues in advertising influence children's eating behavior. In this section two communication processing models will be discussed that may help to explain how food cues affect eating behavior, and that can provide a foundation for an integrated food cue reactivity model. First, the Processing of Commercialized Media Content (PCMC) model [42] states that the level at which children process persuasive messages influences the extent to which food advertising impacts on their eating behavior. The model predicts that when children use less cognitive elaboration to process the food cues embedded in the advertisement, it will have a stronger effect than when children use more cognitive elaboration. Most new forms of advertising, such as Internet 'advergimes' (branded games), integrate the commercial food cues within media entertainment content. Children automatically process these cues, with a minimal level of cognitive elaboration [42,43,44\*], making it more difficult to initiate consumer defenses such as persuasion knowledge and

skepticism [45]. In these cases, children are unaware that they are targeted by food advertisements.

Second, the Differential Susceptibility to Media Effects Model [44<sup>\*</sup>] predicts that not all children process and react to food cues in advertising to the same extent. Individual differences in impulsivity and attentional bias may modify the direction and strength of advertising's effect on eating behavior [24<sup>\*\*</sup>,25<sup>\*\*</sup>]. Folkvord *et al.* [24<sup>\*\*</sup>] showed that impulsive children were more susceptible to an advergame promoting energy-dense snacks, and that attentional bias for food cues in an advergame led to an increased intake of energy-dense snacks [25<sup>\*\*</sup>]. Yokum *et al.* [39] have shown that neurological responses to food advertisements predicted future weight gain, thereby supporting the notion of individual differences in neural susceptibility to food advertisements. In addition, studies have found that overweight children showed higher immediate responsiveness to food advertising than children with normal weight [26]. Individual dispositional factors underpin variability in the processing of food cues in advertisements, and therefore are integral components of the new theoretical model being proposed in this paper.

### An integrated model for processing food cues in advertising

Organizing, integrating, and extending theoretical and empirical insights will improve understanding of food advertising effects on eating behavior and may serve as a guiding framework for future research. To come to an integrated model, this section provides a synthesis of state-of-the-art media and advertising processing models and empirical evidence assessing children's responses to food marketing. The model is visualized in [Figure 1](#) and is termed the Reactivity to Embedded Food Cues in Advertising Model (REFCAM).

The REFCAM is based on three foundational assumptions, based on the literature described above. First, it assumes a two-step process, where (1) food cues induce physiological and psychological reactivity to food (*advertising effect process*), which (2) leads to a reciprocal relationship with eating behavior (*incentive-sensitization process*). Second, message factors, such as the level of integration of food cues, influence their effect, because the message and its media context influence the level of elaboration. Third, individual dispositional factors determine susceptibility to food cues in advertisements.

Although no studies have systematically compared the effects of advertising across different media, research findings indicate that television food advertisements, which involve relatively high awareness and elaboration, have a smaller effect on food intake [17,20] than advergames where food cues are more integrated [23<sup>\*</sup>,24<sup>\*\*</sup>,25<sup>\*\*</sup>,45]. The PCMC-model [42] suggests that in low elaboration scenarios there is not enough cognitive

capacity available to activate skepticism regarding the intention of the commercial message. This is particularly relevant for children who are more susceptible to food cues, such as impulsive [24<sup>\*\*</sup>] and overweight children [26,40<sup>\*</sup>], or children with increased attention for the food or snack [25<sup>\*\*</sup>,32]. According to the incentive-sensitization theory [33,40<sup>\*</sup>], in the long run, eating these energy-dense foods may thus result in neurological adaptations and sensitization of these foods.

Some evidence for this reciprocal relation between cue reactivity and food intake (i.e., incentive-sensitization process) was found by Bruce *et al.* [46] and Yokum *et al.* [39]. Bruce *et al.* [46] showed that food brand logos hyper-activated neural regions related to self-regulation areas (i.e., bilateral middle/inferior prefrontal cortex) among obese children, but not in lean children. Yokum *et al.* [39] showed that increased activation in the striatum in response to food commercials was positively associated with BMI one year later. These findings support the assumption raised by scholars that some children have a greater tendency than others to consume unhealthy and rewarding snacks after exposure to food advertisements. The intake of these foods in turn leads to neuroadaptations that reinforce the value of energy-dense snacks over repeated presentations [47]. This makes children even more susceptible to cues that are related to the intake of these foods. Importantly, not all children process and react to these cues to the same extent, as has been suggested by the Differential Susceptibility to Media Effects Model [44<sup>\*</sup>].

REFCAM is not only relevant for researchers, but also for parents, teachers, health professionals, and policy makers, for whom the model can identify at-risk children and inform food advertising policy. In addition, it seems essential to gain more insight into the 'how' and 'when' of underlying individual susceptibility factors (e.g., impulsivity and attentional bias) moderating the effect of food cues on food intake. Such insights may make it possible to develop effective intervention strategies that can reach these at-risk groups and be nuanced to address the determinants of these individual susceptibility factors. In addition to addressing the general question of how integrated food cues in advertisements affect eating behavior in more fine-grained detail, future research should seek to test the model proposed here.

### Guideline for future research

The REFCAM can serve as a guiding framework for future research questions. First, it appears that newer forms of food marketing typically embed commercial messages within the media content more extensively than traditional advertisements [42]. Research should investigate whether these immersive forms of food advertising have a stronger effect on children's eating behavior than more traditional food advertisements. Such a study may include an examination of the exact role of

cognitive processing levels of the food cues in advertisements on the basis of cue-reactivity and subsequent food intake [48], as suggested by the PCMC-model [42].

Second, until now the exact mechanisms underlying the effects of food cues in advertisements on eating behavior have not been addressed adequately and need future study. It may be interesting, for example, to investigate if food advertisements influence craving by studying physiological responses that prepare children for future intake, such as saliva or hormonal responses (e.g., insulin, ghrelin), when they are exposed to food advertisements [33]. Moreover, research has shown that obese adults have increased salivary responses and craving after exposure to food cues, compared to normal weight adults [49]. This has not been examined among children, nor with food advertisements as stimulus material. In addition, it would be interesting to examine if brain areas related to the reward system are activated when children are exposed to food advertisements [31], and if this also increases subsequent food intake among children. For example, Gearhardt *et al.* [40<sup>\*</sup>] have shown that adolescents exhibited greater activation in regions implicated in reward areas during food commercials, but this has not yet been tested among children, nor have studies tested the effects on snack intake.<sup>7</sup>

Third, future research should examine whether and how the accumulation of food advertisements influences the classical and operant conditioning of food cues and subsequent intake of palatable food among children. For example, although most studies have focused on primary school children, attentional bias to food cues might develop at an earlier age.

Fourth, the REFCAM suggests that intervention studies may target a number of different mechanisms that are responsible for the effects of food cues on palatable food intake. For example, future research should investigate if increased advertising literacy for children, possibly via training or education, could increase the level of cognitive processing of the food cues. This could foster children's skepticism towards the advertisements and thereby possibly decrease the cue-reactivity to such food cues. What is more, the extinction of a classical conditioning relationship between food cues and subsequent intake seems to be successful among adults following training [50], but this has not been studied in children. In summary, intervention studies are needed to investigate the effectiveness of training or educational programs in reducing susceptibility to food cues, disrupt progression of the incentive-sensitization process, and ultimately protect children from overeating.

## Conclusions

Evidence shows that food advertising affects eating behavior among children, but more research is needed to examine

individual susceptibility factors and the exact underlying mechanisms. The proposed REFCAM provides a framework for, first, explaining the relationship between exposure to advertised food cues and food behaviors and second, guiding future research questions and intervention opportunities. Although companies assert their right to freedom of commercial speech, restrictions of marketing efforts should be seriously considered — especially those directed at children, because this marketing contributes to childhood obesity [4,5]. In times of increasing childhood obesity rates and related rises in health service utilization and costs, there is a need for public debate on advertising techniques attempting to persuade children subconsciously. Reversing the trend of increased childhood obesity will require both bold action by policymakers to restrict children's exposure to unhealthy food marketing and evidence-based interventions to help children defend themselves against commercial messages promoting unhealthy food intake.

## Conflict of interest statement

Frans Folkvord, Doeschka J Anschutz, Emma Boyland, Bridget Kelly, and Moniek Buijzen declare that they have no possible conflicts of interest. Emma Boyland receives no funding for food advertising research but receives funding from Weight Watchers for weight management work and from Bristol-Myers Squibb for pharmacotherapy research.

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