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REGULAR ARTICLE

Online food advertisements and the role of emotions in adolescents' food choices

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Abstract

Adolescence is a critical period for future health outcomes. Food habits and cognitive development are underway, and it is a period of heightened sensitivity to external influences and emotional shifts. We experimentally test the individual and combined influence of food advertisements and emotional primes (i.e., positive, negative, neutral) on adolescent food choices. Participants completed a food choice task selecting five snacks out of twenty healthy and unhealthy options in an online experiment. Prior to the food choice, we randomized whether adolescents were exposed to unhealthy food or non-food online advertisements. To induce experimental variation in adolescents' emotions, they were assigned to watch two, two-minute film clips validated to elicit the targeted emotion. The online food advertisement did not significantly impact food choices, except that Black and Hispanic groups selected a higher share of calories from unhealthy foods. Participants in a negative emotional state selected more unhealthy sweet snacks. Finally, we find only weak evidence that a positive emotional state amplified the impact of food advertisements on the nutritional quality of food selection. Together, results suggest that while a negative emotional state drives food choices, this pattern occurs independently from food advertisement exposure.

KEYWORDS
adolescents, emotions, food choices, online advertisement, online experiment

JEL CLASSIFICATION
C99, I12, M37, Q13

Résumé

L'adolescence est une période critique pour les futurs résultats en matière de santé. Les habitudes alimentaires et le développement cognitif sont en cours, et c'est une période de sensibilité accrue aux influences extérieures et aux

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changements émotionnels. Nous testons expérimentalement l'influence individuelle et combinée des publicités alimentaires et des amorces émotionnelles (c'est-à-dire positives, négatives, neutres) sur les choix alimentaires des adolescents. Les participants ont effectué une tâche de choix alimentaire en sélectionnant cinq collations parmi vingt options saines et malsaines dans le cadre d'une expérience en ligne. Avant le choix alimentaire, nous avons randomisé si les adolescents étaient exposés à des aliments malsains ou à des publicités en ligne non alimentaires. Pour induire une variation expérimentale des émotions des adolescents, il leur a été demandé de regarder deux extraits de films de deux minutes, validés pour susciter l'émotion ciblée. La publicité alimentaire en ligne n'a pas eu d'impact significatif sur les choix alimentaires, sauf que les groupes noirs et hispaniques ont sélectionné une part plus élevée de calories provenant d'aliments malsains. Les participants dans un état émotionnel négatif ont choisi des collations sucrées plus malsaines. Enfin, nous ne trouvons que de faibles évidences démontrant qu'un état émotionnel positif amplifie l'impact des publicités alimentaires sur la qualité nutritionnelle de la sélection alimentaire. Ensemble, les résultats suggèrent que même si un état émotionnel négatif détermine les choix alimentaires, ce modèle se produit indépendamment de l'exposition à la publicité alimentaire.

1 | INTRODUCTION

Adolescence is a transitional stage of physical and psychosocial development where patterns of adult health are established (Sawyer et al., 2012). Behaviors and food habits are underway (Alberga et al., 2012; Blakemore et al., 2006) and track into adulthood (Bayer et al., 2011; Daniels et al., 2005; Nicklaus et al., 2004, 2005). Moreover, adolescence is a period at high risk of developing excess body weight, when autonomy over food choices increases (Neumark-Sztainer et al., 1999; Whitney & Rolfes, 2002). In 2016, 124 million children and adolescents aged 5–19 years worldwide were obese, with an increased risk of chronic disorders such as type 2 diabetes, adverse psychosocial consequences, and lower educational attainment (Abarca-Gómez et al., 2017).

The primary cause of obesity is the maintenance of a positive energy balance above and beyond what is needed for expenditure (J. Y. Huang & Qi, 2015; Reedy & Krebs-Smith, 2010; Sahoo et al., 2015). The abundant availability of palatable energy-dense food ("unhealthy" food) in the obesogenic food environment (Harris et al., 2009; Morris et al., 2015) facilitates overconsumption. Unhealthy food marketing contributes to creating an obesogenic environment, with 65 to 80% of foods marketed to youth considered "unhealthy" based on a high quantity of added sugar, salt, and saturated fat (Boyland et al., 2016; Clark et al., 2020; Dahr et al., 2011; Powell et al., 2011; Sadeghirad et al., 2016; Smith et al., 2019; Sonntag et al., 2015). Over the past several decades, and especially during the COVID-19 pandemic due to stay-at-home mandates and school closures, the use of digital media (e.g., mobile devices, social media) has dramatically increased (Ozturk & Ayaz-Alkaya, 2021). Adolescents in the US reportedly spent an average of 4–6 h per day on digital media in 2016 (Twenge et al., 2019), with around 45% reporting that they used the internet "almost constantly" in 2018 (Anderson & Jiang, 2018). As a result, adolescents are exposed to pervasive food and beverage advertising and promotions (Kelly, Vandevijvere et al., 2015; WHO, 2019). About 65%−80% of food advertising online is for high-energy and low-nutrients unhealthy products or brands associated with these foods (Potvin et al., 2019; Qutteina et al., 2019). Kidd et al. (2021) monitored the exposure of 34 adolescents to advertisements on Facebook and found that 98% of the food advertising was for unhealthy food products. Analyzing the impact of food advertising on food choices could be critical in determining adolescents' eating behaviors and risk for developing chronic conditions like obesity.

Prior research has provided strong evidence that the marketing and advertising of unhealthy foods contribute to overweight and obesity (Boyland & Tatlow-Golden, 2017; Boyland et al., 2016; WHO, 2016). Unhealthy food items attract more interest and attention than other healthy and non-food ads (Doolan et al., 2014; Murphy et al., 2020; Werthmann et al., 2013). The food advertising hierarchy of effects framework by Kelly et al. (2015) stipulates that brand recognition not only

influences brand attitudes but also eating behaviors. There is also evidence for beyond-brand effects of food advertisements on eating behavior in youth and adults (e.g., Boyland et al., 2016; Halford et al., 2008; Hastings et al., 2003). That is, advertisements promoting a particular brand also increase motivation to choose other foods within the same category (e.g., fast food, high-caloric foods). Hence, exposure to television food advertisements that target youth can affect choices, purchasing behaviors, and intake of energy-dense foods (Boyland et al., 2016; Dahr et al., 2011; Sadeghirad et al., 2016; Smith et al., 2019; Sonntag et al., 2015). This has led to several regulatory measures to decrease food advertising targeted at youth through the medium of television (Galbraith-Emami & Lobstein, 2013). As a result, food companies are increasingly allocating their advertising budgets toward online and social media formats (e.g., YouTube, Instagram) (Cairns et al., 2013; Tatlow-Golden et al., 2016). The UK government recently restricted the advertisements of foods high in fat, salt, and sugar to be broadcasted on TV and online platforms from 9 pm to 5 am, to protect youth from being overly influenced by those ads (UK Government, 2021). In this study, we assess the impact of online food advertising on adolescents' food choices in an incentivized task, and the mechanisms moderating this relationship. In particular, we are interested in whether positive or negative emotions exacerbate the susceptibility to food advertising in adolescents. This analysis provides timely insight to policymakers in many countries who consider limiting online food advertising.

Emotions are defined as a complex set of biological and subjective processes that are elicited by an external or internal stimulus or event, are experienced as valenced arousal (e.g., pleasure/displeasure), and may drive goal-directed behavior (e.g., Ekkekakis, 2013). Emotions have been shown to influence both eating behavior and sensitivity to advertising and could be an important factor in determining adolescents' susceptibility to the effects of food advertising. Negative emotions are associated with overeating and comfort eating, especially in restrained eaters (Evers et al., 2018; Macht, 2008; Stice, 2001; Stice et al., 2005); alternatively, positive moods are associated with a higher capacity to delay gratification and select healthier food items (Fedorikhin & Patrick, 2010; Garg et al., 2007; Garner et al., 2014). Moreover, emotions can influence the content and the process of cognition, with a positive mood leading to higher susceptibility to advertising due to more reliance on heuristics (Bagozzi et al., 1999; Bronner et al., 2007; Goldberg & Gorn, 1987; Owolabi, 2009). For these reasons, it is theoretically reasonable to test whether emotional states could moderate the impact of online food advertising among adolescents.

During adolescence, cognitive development is underway and cognitive control abilities have not fully matured, and susceptibility to external/social influences is high (Kelly, King MPsy et al., 2015; Moses & Baldwin, 2005; Somerville et al., 2010; van Dam & van Reijmersdal, 2019). Since adolescents may lack the ability to defend against the persuasive intent of advertising (Garde et al., 2018; Pechmann et al., 2005; Rozendaal et al., 2011) and are highly sensitive to rewards (Van Leijenhorst et al., 2010), we expect this group to be susceptible to unhealthy food advertising online. This is of particular importance since adolescence is a period of peak difficulties with impulse control, and large emotional state fluctuations (e.g., Spear, 2011). Further, emotion regulation, or the ability to modulate the experience and expression of emotions, shows protracted development across adolescence (Gross, 1998; Zeman et al., 2006; Zimmermann & Iwanski, 2014). Hence, determining the effects of online food advertising and emotions on the eating habits of adolescents is an urgent public health concern that could be critical in determining their eating behaviors and risk for developing chronic conditions like obesity (Qutteina et al., 2019; Tatlow-Golden et al., 2016; Zenith, 2020).

To study the impact of online advertisements on food choices, and the moderating impact of emotions on susceptibility to food advertisements, we conducted two online experiments with a total of 940 adolescents (13-17 years old). In Study 1, we first identified the most effective way (i.e., film clips) to induce positive, neutral, and negative emotions in adolescents using an online study with 240 adolescents.[1] Specifically, we asked adolescents to watch two randomly assigned two-minute film clips from a collection of twelve film clips (four negative, four neutral, and four positive). We then collected participants' current emotional state before and after the clip using a standardized questionnaire, that is, the Positive and Negative Affect Schedule (PANAS) developed by Thompson (2007). Based on responses, we identified the film clips that induced the greatest changes in positive, negative, and neutral emotions.

In Study 2, we carried out an online study with 750 adolescents to assess the impact of online food advertising on food choices, and the extent to which emotional priming moderated the impact of the food advertisements on food choice. A 3 × 2 between-subjects design was used where participants were randomly assigned to one of three emotional primes (negative, neutral, and positive) and one of two advertising conditions (i.e., food vs. non-food). Adolescents were asked to carefully watch two, two-minute film clips validated to elicit the targeted emotion (negative, neutral, and positive). They were randomly assigned to watch three 30-second advertisements either on unhealthy food items (Hershey Kisses, Lay's

[1] We selected the term "emotion" as the target construct since, in comparison to "moods," emotions are considered to be tied to an identifiable stimulus or event, are more likely to be induced by brief interventions (i.e., a few minutes), and are more likely to drive motivated behavior (e.g., Ekkekakis, 2013).

potato chips, and Oreos) or on non-food items (Nintendo switch, Shoes by 2GO, Spotify), one before, and two in between the two film clips, and the two film clips are validated to elicit the same emotions. We collected participants' current emotional state using the PANAS before and after the film clips and advertisements, and their hunger levels after the videos. Participants then began a food selection task. Twenty food items of similar prices per unit were displayed on the screen in random order, to avoid order effects. We presented participants with both healthy and unhealthy options: among the twenty food items, 10 are considered healthy (five sweet and five salty) and ten are considered unhealthy (five sweet and five salty). Given prior work on beyond-brand advertising effects (Boyland et al., 2016; Halford et al., 2008; Hastings et al., 2003), we selected food choice options that reflected similar categories of foods as presented in the advertisements (e.g., savory and sweet unhealthy options). Participants were asked to select the five items they would like to eat. They were also informed that one of every seven respondents would be randomly drawn to receive their selected food items via mail. The food choice was incentivized to motivate participants to make choices that reflected their desired consumption. Participants also self-reported relevant demographic characteristics, eating and internet use habits.

Results in Study 2 showed that online food advertisements did not significantly impact adolescents' food choices. In the negative emotion condition, adolescents selected more sweet food items classified as "unhealthy" and their basket of chosen foods was lower in fiber and higher in added sugars compared to adolescents in the neutral or positive emotion conditions. We found small evidence that emotions moderate the impact of food advertisements. While participants in the positive or neutral emotion conditions selected food with less added sugar and more fiber than participants in the negative emotion condition, the food-advertisement offsets this effect. The food choice of participants in the positive or neutral emotion condition who watched food advertisements was less healthy than that of participants watching the non-food advertisement.

Extensive research has consistently demonstrated that the impact of emotions and food advertising on individuals varies based on their BMI. While some studies suggest obese individuals tend to engage in emotional eating more than their normal-weight counterparts (Canetti et al., 2002; Favieri et al., 2021; Ganley, 1989), opposing theories, such as Schachter's (Schachter et al., 1968), posits that normal-weight individuals may modify their eating in response to stress, while obese individuals may not exhibit the same response. Cardi et al.'s meta-analysis (2015) revealed that although negative emotions tend to have a significant effect on increased eating, this effect is minimal on obese individuals. Furthermore, studies in populations prone to overeat, such as individuals with obesity, have reported inconsistent findings on the association with negative mood (Goldschmidt et al., 2013; Yeomans & Coughlan, 2009). Similarly, the influence of food advertising on dietary choices is not uniform across BMI categories. A review by Russell et al. (2019) found that children with overweight or obesity are more susceptible to food advertising, consuming significantly more food after exposure compared to children with healthy weight. Additionally, Gearhardt et al. (2014) identified differences in neural activation patterns between individuals with obesity compared to healthy weight in response to food commercials. To compare with these prior studies, we used similar cut-offs for BMI to compare responses to advertising among adolescents of varying weight status classifications. We found that BMI classification significantly impacted the effects of food advertisements and emotions on food choice. For adolescents with a healthy weight, negative emotions increased unhealthy food choices, especially sweets, while positive emotional states increased susceptibility to food advertising, thereby increasing unhealthy choices. Our treatments did not significantly impact food choices of adolescents classified as overweight, except for a small increase in the sodium content of the foods selected. Our treatments did not significantly impact the food choices of adolescents classified as overweight, except for a small increase in the sodium content of the foods selected.

A recent review by Backholer et al. (2021) shows that racial/ethnic minority groups from low social-economic status have greater exposure to unhealthy food advertising, and research shows that food companies target advertising of unhealthy foods to Hispanic and Black youth (Grier et al., 2008, 2010; Harris et al., 2019). Moreover, pediatric obesity disproportionately affects ethnic minorities, with obesity rates of 16.6% among White, 26.2% among Hispanics, and 24.8% among Black youth (Stierman et al., 2021). In our study, we oversampled minority groups and investigate the heterogeneous effect of our treatment on Black or African American ("Black") and Hispanic or Latino populations ("Hispanic"). We found that Black and Hispanic adolescents were impacted by food advertisements, which led to fewer healthy snack choices. Other ethnicities (including White) were instead impacted by emotions: negative emotions increased unhealthy, and particularly unhealthy sweet food choices.

This paper contributes to economics literature in three ways. First, our study contributes to the growing economics literature on how to tackle the obesity epidemic (Cawley, 2015). An important area of study in health economics is to analyze the determinants of health and investigate how public health promotion activities affect people's health (Culyer & Joseph, 2000). Various economic policies have been proposed to curb the rising trend in obesity and improve health, including sin taxes (e.g., soda tax, sugar tax), healthy food subsidies (e.g., fruits and vegetables), updated nutrition facts labels, and mandated minimum nutrition standards for school meals. Recent policies that ban unhealthy food

advertisements delivered online in the UK have received much attention (UK Government, 2021). Our study contributes to this literature on economic policies to encourage healthy eating and has direct implications on the development of policies directed at banning online food advertisements directed at youth.

Second, the current study contributes to the literature on advertising and food demand. Existing studies have mixed results on the link between advertising and food demand. For example, Duffy (2005) found little evidence to support the hypothesis that advertising has the power to affect marked changes in the inter-product pattern of consumer food demand in the UK. On the other hand, Richards and Padilla (2009) demonstrated that promotions increase fast food demand and have a smaller effect on business stealing among restaurants. More recently, Dubois et al. (2018) simulated the impact of a TV advertising ban of potato chips in the UK and demonstrated that the potential health benefits are partially mitigated by firms reducing prices and by consumers buying other poor nutritional quality food. Advertising might also affect the mental procedures that consumers use when deciding what to buy; for example, leading to a switch from using the deliberative systems to the affective systems that react more to emotional cues (Bernheim & Rangel, 2004, 2005; McClure et al., 2004). Our study builds on this literature and analyzes the impact of advertisements on food demand in an online context. Further, we examine the role of emotions as a moderating factor in changing peoples' responses to advertisements.

Third, our study expands the existing work on emotions in food marketing. Emotions are critical in determining consumers' behaviors (Bagozzi et al., 1998; M. H. Huang, 2001). Bagozzi et al. (1998) specify that emotions affect consumers' information processing, moderate reactions to persuasive appeals, mediate the effects of marketing stimuli, change goal setting, influence goal-directed behaviors, and act as ends and measures of consumer welfare. Therefore, understanding the role of emotions can assist marketers in gaining customer insights (Gaur et al., 2014). Bagozzi et al. (1998) also suggested that marketers still understand too little about the role of emotions in marketing behavior. A recent systematic review conducted by Gaur et al. (2014) showed that despite the importance of emotions, the study of its role in marketing is still in its infancy. We build on this emerging literature to document how emotions interact with advertising in influencing food demand.

The rest of the paper is organized as follows. Section 2 presents the sample and recruitment, and the experiment design. Section 3 describes the empirical analysis and the study hypotheses. Section 4 presents our results and Section 5 concludes.

2 | EXPERIMENTAL DESIGN

2.1 | Sample and recruitment

We conducted two online survey experiments with respectively 240 and 750 adolescents aged 13–17 from the US. In Study 2 we oversampled minority groups to allow us to examine heterogeneous effects implicated in prior research (e.g., Backholer et al., 2021).[2]

The recruitment and data collection were conducted with the help of the survey provider Qualtrics. Both studies were approved by the Institutional Review Board at The Pennsylvania State University. In both studies, we obtained parental consent first and asked the parent to pass survey to the child. The study on Emotion Induction was conducted from January 18 to 21, 2022, and participants spent on average 13 min taking the survey (with a minimum of 6 and a maximum of 86 min). The study on the impact of Online Advertisements and Emotions was conducted from May 10 to June 27, 2022, and participants spent on average 30 min taking the survey.[3] In both studies, we included cheap talks emphasizing the importance of revealing truthful answers. Also, we include several attention checks about the content of the treatments (advertisements and film clips) to make sure participants were giving valid answers and were paying attention to the experimental treatments.

2.2 | Study 1 - Emotion induction

In a study with 240 adolescents, we identified the most effective film clips to elicit targeted emotions in an online setting. While the impact of experimental emotion elicitation in adults has been examined in the literature (Gilman et al., 2017;

[2] Our quotas are as follows: White 50%; Black or African American 20%; Hispanic or Latino 25%; Other Race 5%.
[3] The study is preregistered in the AEA RCT registry under the following trial: AEARCTR-0009134.

Gross & Levenson, 1995; Westerman et al., 1996), there are limited data showing whether similar methods of emotion induction are effective with adolescents, particularly in an online rather than in a laboratory setting.

2.2.1 | Experimental treatments

We selected twelve film clips (four negative, four neutral, and four positive) from publicly available films, documentaries, or internet videos, both new and from repositories of 2-minute excerpts that have been shown to elicit discrete emotional responses in prior studies with adults (Gilman et al., 2017; Maffei & Angrilli, 2019). Table A.1.1 in Appendix A.1. reports a list and description of the film clips used in this study. We asked adolescents to watch two randomly assigned two-minute film clips from the collection of twelve film clips and assessed participants' emotions before and after each clip, using the short form PANAS developed by Thompson (2007). We asked participants where the film clips were set as attention checks and removed participants who failed the attention checks in our data analysis.

2.2.2 | Outcome measures

The PANAS is a 10-item scale that measures positive affect (PA) and negative affect (NA). It consists of 5 items on the PA scale (joyful, cheerful, happy, lively, proud) and 5 on the NA scale (miserable, mad, afraid, scared, sad). Items were self-rated on a 5-point Likert scale from 1 (very slightly or not at all) to 5 (extremely). Scores for PA and NA were summed, PA and NA overall scores may range between 5 and 25, with a high score indicating a more positive emotional state for PA and a more negative emotional state for NA. Since we measured PA and NA at baseline and post-film, we also computed the difference between post-film clip and at baseline for both PA and NA (ΔPA and ΔNA).[4]

2.2.3 | Film clips selection

Table A.1.2 in Appendix A.1. reports the average PANA after the film clips in columns 1 and 3, and the difference between post-film clip and baseline PA and NA in columns 2 and 4. We can reject the null hypothesis that PA and NA are equal across videos, based on the results of the ANOVA analysis. We selected the two clips with the lowest average PA and highest average NA for the negative emotion condition (Pursuit of Happiness—Homelessness, and My girl—Funeral). For neutral emotions, we selected the two film clips with the smallest difference to baseline in PA and NA, and a moderate average PA and NA (BBC Planet Earth Desert, and BBC Planet Earth Seasonal Forests). For positive emotions, we selected the two film clips with the highest average PA and lowest average NA (Mr. Bean—Photo, and D2: The Mighty Ducks—Speech).

2.3 | Study 2 - Food advertisement and emotions

We conducted an online survey experiment with 750 adolescents to study the impact of online food advertising on food choices, and the interaction with emotions induced through the film clips identified in Study 1 "Emotion induction."

2.3.1 | Experimental treatments

In a between-subjects design, participants in the study were randomly assigned to one of six experimental conditions, resulting from the interaction of two treatments (Table 1). The first treatment varied in whether participants were exposed to unhealthy food advertisements or non-food advertisements, and the second treatment varied in the emotion elicited. For example, in = *NF* adolescents watched in sequence one non-food advertisement, one film clip to elicit neutral emotions, two non-food advertisements, and a second film clip to elicit neutral emotions. Participants then performed the food choice task in one of these six conditions.

[4] We do not take into account whether the post-film clip PA and NA referred to the first or the second film clip watched, since PA and NA are not significantly different depending on the order of the clip, based on t-tests comparing the mean affect scores if the clip was watched as first or second.

TABLE 1 Experimental treatments.

	Positive	Neutral	Negative
Unhealthy food advertisement	$+F$	$=F$	$-F$
Non-food advertisement	$+NF$	$=NF$	$-NF$

We selected six 30-s advertisements commonly available on the internet, all with an uplifting/positive mood. For unhealthy food advertisements, we selected three advertisements that show prominently the food promoted, two sweet and one savory: Hershey Kisses, Oreos, and Lay's potato chips. For non-food advertisements, we selected three advertisements about products that could be relevant for adolescents: Nintendo switch, Shoes by 2GO, and Spotify. To elicit the targeted emotions, we showed participants the two film clips selected in Study 1.

2.3.2 | Outcome measures

We asked participants to select five food items they would like to eat from a list of 20, and they could choose more than one of each item. We informed participants that we would select one out of every seven participants to be mailed the five food items chosen in the survey. Since selected participants would receive the food items of their choice, it was in their best interest to reveal their true preferences and choose the items they actually wanted to receive. Voslinsky (2021) shows that paying for a part of the participants can incentivize real choices and much prior work has used the same method to elicit truthful responses (e.g., Spiteri et al., 2019; Vitt et al., 2021). We showed participants pictures of ten healthy and ten unhealthy food items in a randomized order. Within each category, five of the foods were savory and five were sweet. We selected food items with longer shelf life and a similar price per unit (around $3). We did not use the same brand in the advertisements to assess the beyond brand impact of online advertisements on eating behavior (Halford et al., 2008). In Appendix A.2, Table A.2.1 shows a list of the 20 food items with their cost and cost per serving, and Table A.2.2 the average nutrients per 100 gr of product.[5]

2.3.3 | Procedure

A timeline of the survey experiment is shown in Table 2.[6] At the beginning of the study, we asked the parent or the legal guardian for their email informing them that one of every seven adolescent participants would be selected to receive a free basket of food delivered at home. After receiving confirmation that the survey has been passed to the child, we asked adolescents whether they were willing to commit to carefully reading and truthfully answering each question. We also asked them about their favorite subject in school, their favorite TV show, and their favorite band or musician to discourage parental completion of the survey.

First, we collected the baseline emotion using the PANAS (Thompson, 2007). Participants were then randomly assigned to watch two, two-minute film clips eliciting the targeted emotion, and three 30-s food versus non-food advertisements, in six combinations depending on the treatment assignment (Table 1). After the videos, we asked three attention questions about the setting of the two film clips and the advertisements they watched. We then collected again participants' emotions using the PANAS

Participants then began the food selection task and chose the five food items they wanted to receive. The five foods selected were delivered to 107 participants (about 14% of the total participants) after their completion of the study using the online website of one big supermarket chain in the US. After selecting their desired foods, we collected participants' level of hunger on a scale from 1 to 10, and the perceived healthfulness and tastiness of the 20 food items used in the food selection task on a scale from 1 to 10 to confirm that the food we classified as unhealthy were perceived as such.

We then assessed dietary restrained eating from the Three-Factor Eating Questionnaire (TFEQ-R18) (Fleurbaix et al., 2004). The TFEQ-R18 is an 18-item survey consisting of three subscales. In this study, we used the six questions measuring restrained eating (e.g., "I deliberately take small helpings as a means of controlling my weight"). Scores for restrained eating range from 6 to 24. To collect information on what youth were eating in their daily life, we also administered thirteen

[5] The screen participants face for the food choice task can be found at the link qualtrics_screen.
[6] he full experimental instructions given to participants can be found in the Supplementary Information S1.

TABLE 2 Timeline of the experiment.

1)	Parental consent	(1-2 min)
	Age and race screening of the child	
	Email address	
2)	Pass the survey to the adolescent participant	
3)	Consent and instructions	(1-2 min)
	Soft commitment to give best and truthful answers	
4)	Age, race, state, school grade screening questions	(1 min)
	Favourite subject in school, TV show, and musical band	
5)	Baseline emotions (PANAS)	(1 min)
6)	Experimental treatments:	
	a. 1st food/non-food advertisement	(30 sec)
	b. 1st positive/neutral/negative film clip	(2 min)
	c. 2nd food/non-food advertisement	(30 sec)
	d. 3rd food/non-food advertisement	(30 sec)
	e. 2nd positive/neutral/negative film clip	(2 min)
7)	Attention checks	(1 min)
8)	Post-film emotions (PANAS)	(1 min)
9)	Food selection task	(3-5 min)
10)	First questionnaire	
	a. Hunger level	
	b. The tastiness of food products in the choice task	
	c. The healthfulness of food products in the choice task	
	d. Emotion regulation questionnaire	
	e. Restrained eating assessment questionnaire	
	f. Food consumption questionnaire	
11)	Demographic questionnaire	
	a. Gender	
	b. Urban/suburban/rural area	
	c. Height and weight	
	d. Internet use	
	e. Trust food delivery	

Note: Except for the experimental treatments, where time was fixed, times for each stage are estimated.

questions from the 2019 Youth Risk Behavior Survey to measure the consumption of items of relevance for this study (sweet and savory snacks, fast-food consumption). Finally, we collected several demographic characteristics, including height and weight, and information about their internet use.

3 | EMPIRICAL ANALYSIS

3.1 | Empirical strategy

The empirical strategy and the results in Section 4 refer to Study 2 "Food advertisement and emotions." We first test the effectiveness of the film clips to induce the desired emotions in Study 2 by comparing the reported emotional state in the sad, neutral and positive emotion treatments with parametric tests (t-test and ANOVA).

To test the impact of emotions and advertisements on food choices, we conducted linear regression models on the outcomes: (i) share of calories from unhealthy food (calories from unhealthy items out of all the calories selected, per package), proportion of unhealthy food (number of unhealthy items divided by five), proportion of unhealthy sweet food (number of unhealthy sweet items divided by five), proportion of unhealthy savory food (number of unhealthy savory

items participants chosen divided by five); and (ii) calories (in kcal per 100 g of the products selected), sodium (in mg per 100 g of product), saturated fat, added sugar, and dietary fiber (all in grams per 100 g of product) of the selected food items as secondary outcomes. We use the following linear regression model to analyze the impact of emotions on the susceptibility to advertisements,

$$Y_i = \gamma_0 + \gamma_1 A_i + \gamma_2 N_i + \gamma_3 A_i N_i + \varepsilon_i \quad (1)$$

where Y_i are the dependent variables as specified above. As independent variables we use: a dummy variable taking the value of 1 if the advertisement watched is a food advertisement (A_i) to capture the impact of watching the unhealthy food advertisement on food choices; a dummy variable taking the value of 1 if the film clip watched is intended to induce negative emotions (N_i) to capture the impact of negative emotions on food choices (base group neutral and positive emotions); interactions between the "food advertisement dummy" (A_i) and the "emotion dummy" (A_i) to capture any interaction between the food advertisement and negative emotions.[7]

Given the randomization of the treatments, we expect to achieve balance in observable covariates across the treatments. Nevertheless, we can estimate the equation above without and with other control variables such as demographic factors. We also study the impact of the treatments on specific populations, by conducting heterogeneous effect analysis. We investigate heterogeneous effects of food advertisements and emotions depending on participants' BMI by conducting separate analyses in the subgroup of healthy weight and underweight individuals, versus overweight and obese. Finally, we investigate whether food advertisements have a larger impact on racial/ethnic minorities by conducting separate analyses on the Black and Hispanic minorities, versus the rest of the sample.

3.1.1 | Hypotheses

Based on prior literature reporting the effect of food advertising on food choices, we expect that unhealthy food advertising online will also impact the food choices of the adolescents in our study (Boyland et al., 2016; Dahr et al., 2011; Sadeghirad et al., 2016; Smith et al., 2019; Sonntag et al., 2015).

Hypothesis 1. Online unhealthy food advertising leads to more unhealthy food choices.

Moreover, emotions have been found to impact food choices. In line with the literature, we expect adolescents in the negative affect condition to have unhealthier food choices (Evers et al., 2018; Macht, 2008; Stice, 2001; Stice et al., 2005). Adolescents' difficulties regulating emotions and controlling impulses might increase the extent to which they compensate with food (Rose et al., 2018; Somerville et al., 2010; Spear, 2011).

We also draw from theoretical perspectives regarding the impact of emotional states on behavior. The hedonic contingency hypothesis (Wegener & Petty, 1994) posits that individuals tend to engage in behaviors that induce or increase pleasurable states. Similarly, according to the process model of emotion regulation (e.g., Gross, 2015), one way that individuals manage emotions is via response modulation or changing their behavior following emotion onset. In line with this perspective, food choices in emotional situations may reflect attempts to distract oneself from negative emotions, enhance positive emotions, or mask emotions altogether (e.g., Evers et al., 2010).

Hypothesis 2. Emotions will influence food choices such that adolescents will make more unhealthy food choices if they have a negative induced affective state.

Folkvord et al. (2016) proposed that the impact of advertisements on food choices is influenced by differences in the environment and individual susceptibility factors. In this model, individual dispositional factors are crucial in determining

[7] As discussed in our pre-analysis plan, we intended to estimate a model of the following form:
$Y_i = \gamma_0 + \gamma_1 A_i + \gamma_2 N_i + \gamma_3 A_i N_i + \gamma_4 P_i + \gamma_5 A_i P_i + \varepsilon_i$
where P_i is a dummy variable taking the value of 1 if the film clip watched is intended to induce positive emotions to capture the impact of positive emotions on food choices; and $A_i P_i$ is an interaction term to measure the impact of the food advertisement when watched in a positive emotional state. Since we find that PA and NA are not significantly different in the neutral and positive emotional state, we estimate a model of the form described in Equation (1). All the results presented are robust to the estimation of the model including the positive treatment dummy variable.

susceptibility to the cues in advertising. Not all individuals process and react to food cues in advertising alike, depending on long-term (e.g., impulsivity) and temporary (e.g., emotions) individual differences. We propose that emotions be individual dispositional factors that can intervene in determining susceptibility to food cues in advertisements, ultimately increasing unhealthy food choices. Griskevicius et al. (2010), for example, find that a positive affective state increases heuristic decision making and susceptibility to advertising.

Prior research (e.g., Evers et al., 2018) suggests that both positive and negative affect may increase food consumption in general. Negative affect may disrupt impulse control and lead to more unhealthy food choices, whereas positive affect has been shown to be associated with greater ability to delay gratification as well as healthier food choices (e.g., Fedorikhin & Patrick, 2010; Garg et al., 2007; Garner et al., 2014). However, research on advertising effects has demonstrated that positive affect may increase susceptibility to advertising (Bagozzi et al., 1999; Bronner et al., 2007; Goldberg & Gorn, 1987; Owolabi, 2009). Taken together, the literature suggests that affective state and exposure to advertising may interact to predict food choices, but mixed findings leave the directionality of such patterns unclear.

Hypothesis 3. Emotions will moderate the impact of online food advertising on food choice.

We will test the exploratory hypothesis that adolescents will make more unhealthy food choices if they have a positive induced affective state compared to having a negative induced affective state when exposed to food advertisements since a positive affective state increases susceptibility to advertising.

4 | RESULTS

4.1 | Descriptive statistics

The demographic characteristics of our sample for the main study with 750 participants can be found in Table 3. The only statistically significant differences between the six conditions are the height and weight of the adolescents. The average age of our sample is 14–15 years old, around 50% identify as female and 1% as non-binary. Since we defined quotas on ethnicity, our sample consists of around 50% White, not Hispanic or Latino, 20% Black or African American, 25% Hispanic or Latino, and 5% participants of another ethnicity. We compute adolescents' BMI based on the self-reported height and weight. We excluded individuals who reported unrealistic values for BMI (BMI < 12, 7 observations). F-test, where the null hypothesis is the equality of means across six groups, shows balanced samples are obtained in treatments.

Descriptive statistics of the emotions and dietary measures we collected in our survey are in Table 4. On average, the PA of participants is around 17, and the NA around 7 (on a scale from 5 to 25).

We observe a significantly different hunger level between the six conditions, with lower hunger in the negative emotion conditions. We find an average level of restrained eating of 12 (on a scale from 6 to 24). We collect participants' perceptions about the healthfulness and tastiness of the 20 snacks offered in the study. We find that healthy items are perceived as significantly healthier (7.72 vs. 3.61 average ratings) and significantly less tasty than unhealthy items (5.69 vs. 7.83 average ratings). We also found that participants in the neutral emotion conditions report more fast food intake than participants in other emotional states (2.2 vs. 1.8 average number of times fast food was consumed over the past 7 days in the neutral vs. in the positive and negative emotion conditions).[8]

4.2 | Effectiveness of emotion inducement

We test the effectiveness of our emotion inducement manipulation. Table 5 shows the PA and NA after the treatment and the change in affect state from before to after watching the film clips. In the negative condition, the PA decreases and the NA increases significantly after the treatment. In the Positive condition, the PA increases, and the NA decreases significantly after the treatment. The change in PA and NA after the treatment in the Neutral condition are not significantly different from the Positive condition (columns 1 vs. 2), so we will consolidate the two conditions in the analysis. Our emotion inducement procedure was successful at inducing positive, neutral, and negative emotions in Study 1 (Table A.1.2, Appendix A.1). We suggest that the distinction between positive and neutral emotions likely disappeared in Study 2

[8] All the results in the paper are robust to the inclusion of height, weight, hunger, and fast-food consumption.

TABLE 3 Demographic characteristics.

	(1) All	(2) +NF	(3) +F	(4) =NF	(5) =F	(6) −NF	(7) −F	F-test *p*-Value
Age	14.83	14.85	14.97	14.64	14.84	15.01	14.70	.24
	(1.39)	(1.47)	(1.32)	(1.35)	(1.49)	(1.35)	(1.35)	
Gender identity:								
Male	0.48	0.52	0.47	0.50	0.44	0.50	0.48	.84
Female	0.50	0.45	0.52	0.50	0.55	0.48	0.49	.65
non-binary	0.01	0.03	0.01	0.01	0.00	0.02	0.02	.30
prefer not to say	0.00	0.00	0.00	0.00	0.01	0.00	0.01	.58
Race:								
White, not Hispanic or Latino	0.49	0.50	0.47	0.45	0.49	0.48	0.53	.87
Hispanic or Latino	0.19	0.14	0.19	0.24	0.20	0.14	0.19	.28
Black or African American	0.19	0.21	0.19	0.19	0.19	0.22	0.16	.88
Asian/Pacific islanders	0.03	0.05	0.03	0.01	0.03	0.04	0.04	.63
White and Asian/Pacific islanders	0.01	0.00	0.01	0.01	0.00	0.00	0.01	.44
Hispanic or Latino and Black or African American	0.04	0.02	0.04	0.04	0.03	0.07	0.03	.60
other	0.01	0.01	0.01	0.01	0.01	0.03	0.01	.69
Weight (lbs)	141.07	134.82	142.07	137.81	143.97	150.46	138.95	.03
	(38.16)	(36.61)	(38.05)	(37.35)	(39.61)	(40.44)	(35.87)	
Height (in)	65.61	65.36	66.15	64.83	65.96	66.31	65.11	.03
	(4.35)	(4.45)	(4.48)	(4.06)	(4.41)	(4.25)	(4.25)	
BMI	23.10	22.20	22.95	23.10	23.26	23.93	23.34	.28
	(5.49)	(5.61)	(5.10)	(5.46)	(5.26)	(5.80)	(5.79)	
Living area:								
urban	0.37	0.36	0.37	0.41	0.35	0.32	0.38	.80
suburban	0.43	0.44	0.42	0.44	0.48	0.43	0.38	0.73
rural	0.20	0.21	0.21	0.16	0.17	0.25	0.24	.35
Trust food delivery	6.70	6.59	6.70	6.78	6.82	6.78	6.55	.97
	(2.99)	(3.07)	(2.88)	(3.00)	(3.04)	(2.96)	(3.04)	
N	789	135	139	135	150	104	126	789

Note: *p*-Values based on the F-Test of equality across the six treatment conditions. Age, weight, height, and BMI are reported as average and standard deviations are in parentheses. The other variables are reported as proportions. Trust food delivery is the average belief that the five food snacks selected will be delivered to the home addresses of the selected participants on a scale from 1 to 10.

TABLE 4 Descriptive statistics.

	(1) All	(2) +NF	(3) +F	(4) =NF	(5) =F	(6) −NF	(7) −F	(8) Min	(9) Max	F-test *p*-Value
PA before	16.79	16.37	16.93	17.12	17.06	16.08	17.03	5	25	.47
	(4.95)	(4.55)	(4.74)	(5.45)	(5.05)	(4.81)	(5.02)			
NA before	6.99	6.76	6.99	7.32	6.89	7.09	6.94	5	25	.81
	(3.27)	(2.89)	(3.39)	(3.96)	(2.82)	(3.46)	(3.09)			
Hunger	5.82	5.31	6.24	6.27	6.14	5.59	5.25	1	10	.00
	(2.72)	(2.73)	(2.64)	(2.50)	(2.61)	(2.84)	(2.88)			
Restrained Eating	12.15	12.08	12.22	12.20	12.59	11.11	12.43	6	24	.12
	(4.17)	(4.09)	(3.99)	(4.43)	(4.08)	(3.79)	(4.47)			
Healthfulness of unhealthy foods	3.61	3.57	3.73	3.83	3.62	3.43	3.40	1	10	.71
	(2.47)	(2.37)	(2.45)	(2.72)	(2.48)	(2.36)	(2.40)			
Healthfulness of healthy foods	7.72	7.62	7.64	7.77	7.80	7.70	7.76	2	10	.90
	(1.54)	(1.45)	(1.62)	(1.55)	(1.66)	(1.46)	(1.48)			
Tastiness of unhealthy foods	7.83	7.66	7.88	7.86	7.97	7.78	7.78	2	10	.60
	(1.47)	(1.43)	(1.39)	(1.47)	(1.51)	(1.44)	(1.55)			
Tastiness of healthy foods	5.69	5.73	5.66	5.83	5.73	5.66	5.54	1	10	.91
	(2.06)	(2.02)	(1.98)	(2.23)	(2.16)	(1.79)	(2.13)			
Diet:										
Savory snacks	3.57	3.48	3.59	3.63	3.56	3.36	3.75	0	6	.63
	(1.72)	(1.73)	(1.64)	(1.61)	(1.83)	(1.81)	(1.73)			
Sweet snacks	3.52	3.43	3.40	3.56	3.51	3.75	3.54	0	6	.67
	(1.68)	(1.69)	(1.66)	(1.45)	(1.80)	(1.79)	(1.70)			
Fast food	1.96	1.71	1.88	2.16	2.29	1.91	1.75	0	6	.01
	(1.53)	(1.40)	(1.44)	(1.52)	(1.71)	(1.59)	(1.42)			
Soft drinks	3.70	3.87	3.57	3.62	3.79	3.73	3.61	0	6	.80
	(1.98)	(1.80)	(2.01)	(1.95)	(2.06)	(2.02)	(2.05)			
Fruits & vegetables	6.57	6.63	6.56	7.21	6.53	5.89	6.44	0	24	.38
	(4.47)	(4.03)	(4.40)	(4.99)	(4.99)	(4.17)	(3.91)			
Breakfast	5.01	5.10	4.86	4.96	4.95	5.01	5.17	0	7	.90
	(2.25)	(2.19)	(2.29)	(2.21)	(2.23)	(2.40)	(2.26)			
N	789	135	139	135	150	104	126	789	789	789

Note: *p*-Values based on the F-Test of equality across the six treatment conditions. PA and NA before are the average positive and negative affect scores measured with PANAS at the beginning of the study on a scale from 5 to 25. Hunger is the average self-reported hunger prior to the food choices on a scale from 1 to 10. Restrained eating is the average dietary restrained eating measured with the TFEQ-R18 on a scale from 6 to 24. Healthfulness and Tastiness of foods are the average self-reported perceived healthfulness and tastiness of the food items offered in the food choice. Diet reports how often the described food categories were consumed in the past seven days on average on a scale from 1 (none) to 7 (more than 5 times).

TABLE 5 Positive and negative affect state.

	(1) Positive	(2) Neutral	(3) Negative	(1) vs. (2) *p*-Values	(1) vs. (3) *p*-Value	(2) vs. (3) *p*-Value
Post-film PA	16.92	17.10	13.07	.70	.00	.00
	(5.06)	(5.69)	(6.23)			
ΔPA	0.27	0.01	−3.53	.33	.00	.00
	(3.16)	(2.99)	(4.87)			
Post-film NA	5.99	6.14	8.44	.47	.00	.00
	(2.46)	(2.38)	(4.09)			
ΔNA	−0.88	−0.95	1.43	.73	.00	.00
	(2.55)	(2.60)	(3.47)			
Post-film PA—Post-film NA	10.93	10.96	4.62	.95	.00	.00
	(5.66)	(6.35)	(8.43)			
ΔPA—ΔNA	1.15	0.97	−4.97	.61	.00	.00
	(4.03)	(4.30)	(7.20)			
N	274	285	230	559	504	515

Note: *p*-Values based on the t-test comparing the means of two emotion conditions. ΔPA is the change in PA before and after the treatment. ΔNA is the change in NA before and after the treatment.

TABLE 6 OLS models of the impact of food advertisement on food choices.

	(1) Share of calories from unhealthy food	(2) Proportion unhealthy	(3) Proportion unhealthy sweet	(4) Proportion unhealthy savory
Food ads	0.021	0.022	−0.005	0.027
	(0.018)	(0.018)	(0.017)	(0.017)
	[0.390]	[0.394]	[0.744]	[0.269]
Constant	0.780***	0.743***	0.382***	0.361***
	(0.014)	(0.014)	(0.012)	(0.012)
Observations	789	789	789	789

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. *p*-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Share of calories from unhealthy food is the calories per package of unhealthy food items selected, divided by the total calories per package of the food items selected. Proportion unhealthy (sweet and savory) is the number of unhealthy (unhealthy sweet and unhealthy savory) food items selected divided by five. Food ads takes value of 1 for participants watching the food advertisements, 0 for participants watching the non-food advertisements.

because participants were also asked to watch three advertisements, which had a positive ambiance. This likely turned the neutral emotional state induced by the neutral film clips selected based on Study 1 (which has been documented as hard to induce in previous studies) into a positive one.

4.3 | Impact of food advertisement

In the following, we examine the impact of food advertisements by comparing the food choices made during the experiment by participants assigned to watch the food versus the non-food advertisements (Table 6). The outcome variables were described in section 3.1 empirical strategy. We do not find evidence in support of *Hypothesis 1* that online unhealthy food advertising leads to more unhealthy food choices. Participants watching the non-food advertisement selected around 3.71 unhealthy snacks out of the five snacks selected (74%), of which 1.9 were unhealthy sweet and 1.8 were unhealthy savory. Participants watching the food advertisements selected 3.82 unhealthy snacks (76%), of which 1.88 unhealthy sweet and 1.93 unhealthy savory. The difference between groups is not statistically significant.

All the results we present do not include control variables but are robust to their inclusion; and similar results are obtained by estimating OLS and Poisson models of the number of unhealthy choices, unhealthy sweets, and unhealthy savory.

TABLE 7 OLS models of the impact of emotions on food choices.

	(1) Share of calories from unhealthy food	(2) Proportion unhealthy	(3) Proportion unhealthy sweet	(4) Proportion unhealthy savory
Negative emotions	0.026	0.025	0.047**	−0.021
	(0.019)	(0.019)	(0.019)	(0.018)
	[0.329]	[0.315]	[0.039]	[0.229]
Constant	0.783***	0.747***	0.365***	0.381***
	(0.011)	(0.011)	(0.010)	(0.010)
Observations	789	789	789	789

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. p-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Share of calories from unhealthy food is the calories per package of unhealthy food items selected, divided by the total calories of the food items selected. Proportion unhealthy (sweet and savory) is the number of unhealthy (sweet and savory) food items selected divided by five. Negative emotions takes the value of 1 for participants watching the film clips eliciting negative emotions, 0 for participants watching the film clips eliciting neutral and positive emotions.

TABLE 8 OLS models of the impact of advertisement and emotions on snack choices.

	(1) Share of calories from unhealthy food	(2) Proportion unhealthy	(3) Proportion unhealthy sweet	(4) Proportion unhealthy savory
Food ads	0.039*	0.034	0.009	0.026
	(0.022)	(0.022)	(0.019)	(0.020)
	[0.376]	[0.442]	[0.873]	[0.547]
Negative emotions	0.059**	0.050*	0.076***	−0.026
	(0.028)	(0.029)	(0.028)	(0.027)
	[0.214]	[0.374]	[0.046]	[0.622]
Food ads * Negative	−0.062	−0.047	−0.053	0.007
	(0.038)	(0.039)	(0.038)	(0.036)
	[0.426]	[0.589]	[0.545]	[0.849]
Constant	0.763***	0.729***	0.361***	0.368***
	(0.017)	(0.016)	(0.014)	(0.015)
Observations	789	789	789	789

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. p-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Share of calories from unhealthy food is the calories per package of unhealthy food items selected, divided by the total calories of the food items selected. Proportion unhealthy (sweet and savory) is the number of unhealthy (sweet and savory) food items selected divided by five. Food ads takes value of 1 for participant watching the food advertisements, 0 for participants watching the non-food advertisements. Negative emotions takes the value of 1 for participants watching the film clips eliciting negative emotions, 0 for participants watching the film clips eliciting neutral and positive emotions. Food ads * Negative is the interaction between the Food ads and Negative emotions variables.

4.4 | Role of emotions

Table 7 shows the OLS results for the impact of the negative emotion. We find weak evidence in support of *Hypothesis 2* that negative emotions increase unhealthy food choices. Looking at sweet and savory choices separately, we find that participants in the negative emotions condition choose significantly more unhealthy sweet snacks: 1.8 unhealthy sweet snacks in the neutral and positive conditions (36%) versus 2 in the negative condition (40%).

4.5 | Interaction between food advertisement and emotions

Table 8 confirms that negative emotions significantly increase the number of unhealthy sweet choices relative to the groups watching neutral or positive film clips, supporting *Hypothesis 2*. When including the interaction between food

advertisement and negative emotions, both the food advertisement and negative emotions slightly increase the share of calories from unhealthy food. We find weak evidence in support of *Hypothesis 3* that positive emotions increase susceptibility to online food advertising or increasing unhealthy food choice. For adolescents in positive emotions, food advertisements only lead to slightly higher share of calories from unhealthy food, while for adolescents in negative emotions, food advertisements do not lead to more unhealthy food choices. However, we do not find the moderating effect of positive emotions in all other outcome variables including proportion of unhealthy foods selected, proportion of unhealthy sweet and proportion of unhealthy savory products chosen. Appendix A.2, Table A.2.3 reports the results including the control variables, and the results are similar.

In Appendix A.3., Tables A.3.1, A.3.2, A.3.4, we report the results for the secondary outcomes. We find that negative emotions were associated with a greater selection of products that were higher in added sugars (added sugar per 100 g of food) and lower in fiber, confirming the results for the primary outcomes. Participants watching the food advertisement in a positive or neutral emotional state selected food with fewer fibers than participants watching the non-food advertisement, as suggested in *Hypothesis 3*. However, we do not find the moderating impact of positive emotions in all other outcome variables such as added sugar, saturated fat, and calories per 100 g.

4.6 | Heterogeneous effects

Food advertisement and emotions may affect different subpopulations and their dietary choices in different ways. We examine whether different minorities (Table 9 and Appendix A.4), and people with different BMI (Table 10 and Appendix A.5) have a distinct susceptibility to food advertisements and emotions.

4.6.1 | Heterogeneous effects by ethnicity

Stierman et al. (2021) report that youth obesity disproportionately affects ethnic minorities. Hispanic (26.2%) and Black (24.8%) children and adolescents aged 2–19 years have the highest prevalence of obesity, followed by White (16.6%) and Asian (9.0%). Even though we are not aware of any study examining different exposure to unhealthy food advertising online, research has shown that food companies target advertising of unhealthy foods to Hispanic and Black youth (Grier et al., 2008, 2010; Harris et al., 2019). A recent review by Backholer et al. (2021) shows that youth from ethnic minorities, especially Blacks and Hispanics, and low social economic positions have a higher potential exposure to or impact of unhealthy food advertising.

We divide our sample into two ethnicity groups depending on race selection: 1- Black or African American ("Black") and Hispanic or Latino ("Hispanic"); 2- White, not Hispanic or Latino, Asian/Pacific islanders, Other, and belonging to more than one race ("White and others").[9] We find Black and Hispanic subgroups select more unhealthy and sweet snacks than the other ethnical group across all treatments, with lower fibers, more added sugar but fewer calories (Tables A.4.1 and A.4.2 in Appendix A.4). In the subgroup of White and others, negative emotions increase significantly unhealthy food choices, in particular unhealthy sweet ones (Table 9). Black and Hispanic subgroup is instead mostly impacted by the food advertisement, which increases unhealthy choices and the share of calories from unhealthy food. We also find that the food advertisements significantly decrease the fiber content when they make choices (Tables A.4.3 in Appendix A.4). This supports the finding in the literature that these communities are more targeted and more impacted by unhealthy food advertising.

4.6.2 | Heterogeneous effects by BMI

A substantial body of literature has highlighted that the impact of emotions and food advertising on individuals varies significantly depending on their BMI (see the reviews by Russell et al., 2019, and Favieri et al., 2021). We divide the sample into underweight and normal weight adolescents ("healthy weight"), and overweight or obese ("overweight"). We define

[9] The significance and pattern of results remain similar when defining group 2 as White, not Latino or Hispanic, and group 1 as the rest of the participants. We also investigate heterogeneous effects including a dummy variable for being Black or Hispanic, and three-way interaction terms between the variables indicating ethnic minorities, food advertisements, and emotions. The pattern of results remains similar to the separate analysis in the two subgroups.

TABLE 9 OLS models of the impact of advertisement and emotions on food choices by ethnicity.

	(1) Share of calories from unhealthy food	(2) Proportion unhealthy	(3) Proportion unhealthy sweet	(4) Proportion unhealthy savory
White and other ethnicities				
Food ads	0.006	0.014	−0.023	0.037
	(0.032)	(0.031)	(0.027)	(0.029)
	[0.863]	[0.729]	[0.865]	[0.642]
Negative emotions	0.093***	0.087**	0.110***	−0.023
	(0.036)	(0.037)	(0.038)	(0.037)
	[0.052]	[0.111]	[0.021]	[0.816]
Food ads * Negative	−0.093*	−0.081	−0.039	−0.042
	(0.052)	(0.053)	(0.051)	(0.050)
	[0.349]	[0.468]	[0.836]	[0.844]
Constant	0.754***	0.720***	0.349***	0.370***
	(0.023)	(0.023)	(0.020)	(0.022)
Observations	425	425	425	425
Black and Hispanic				
Food ads	0.075**	0.057*	0.044	0.012
	(0.030)	(0.030)	(0.027)	(0.026)
	[0.092]	[0.364]	[0.483]	[0.949]
Negative emotions	0.020	0.006	0.035	−0.029
	(0.045)	(0.044)	(0.042)	(0.039)
	[0.909]	[0.988]	[0.871]	[0.895]
Food ads * Negative	−0.014	0.003	−0.068	0.071
	(0.055)	(0.056)	(0.054)	(0.052)
	[0.981]	[0.964]	[0.665]	[0.602]
Constant	0.774***	0.739***	0.373***	0.366***
	(0.025)	(0.024)	(0.020)	(0.020)
Observations	364	364	364	364

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. p-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Share of calories from unhealthy food is the calories per package of unhealthy food items selected, divided by the total calories of the food items selected. Proportion unhealthy (sweet and savory) is the number of unhealthy (sweet and savory) food items selected divided by five. Food ads takes value of 1 for participants watching the food advertisements, 0 for participants watching the non-food advertisements. Negative emotions takes value of 1 for participants watching the film clips eliciting negative emotions, 0 for participants watching the film clips eliciting neutral and positive emotions. Food ads * Negative is the interaction between the Food ads and Negative emotions variables.

overweight as having a BMI larger than 22 to 25, depending on the age.[10] Several studies on the accuracy of self-reported height and weight in adolescents have pointed out that, while generally accurate and dependable, these measures tend to exhibit reduced accuracy with higher BMIs (Allison et al., 2020; Brener et al., 2003; Gokler et al., 2018). We hence acknowledge the potential for underestimation of overweight and obesity in our measurements. Unhealthy food choices and nutrient selections are not different across subjects with healthy weight versus overweight subjects (Tables A.5.1 and A.5.2 in Appendix A.5). We then look at the impact of our treatments in the two subgroups.[11] In adolescents with a healthy weight, negative emotions increase unhealthy choices, calories from unhealthy food, and the proportion of unhealthy sweet food items. For healthy weight adolescents, watching the food advertisement in a positive emotional state increases susceptibility to advertising: adolescents decrease the fiber content of the food selected (Table 10 and Table A.5.3

[10] An adolescent who is above the 85th percentile is considered overweight or obese. Using the body mass index-for-age percentiles by CDC, we set a threshold of BMI larger than 22 for 13 years old, 22.5 for 14 years old, 23 for 15 years old, 24 for 16 years old, and 25 for 17 years old.

[11] We also investigate heterogeneous effects including a dummy variable for overweight or obese, and three-way interaction terms between the variables indicating overweight or obese, food advertisements, and emotions. The pattern of results remains similar to the separate analysis in the two subgroups.

TABLE 10 OLS models of the impact of advertisement and emotions on food choices by BMI.

	(1) Share of calories from unhealthy food	(2) Proportion unhealthy	(3) Proportion unhealthy sweet	(4) Proportion unhealthy savory
Underweight and Healthy weight				
Food ads	0.035	0.037	0.038	−0.000
	(0.029)	(0.028)	(0.024)	(0.025)
	[0.553]	[0.509]	[0.394]	[0.988]
Negative emotions	0.098***	0.092***	0.110***	−0.017
	(0.032)	(0.034)	(0.035)	(0.035)
	[0.006]	[0.029]	[0.019]	[0.918]
Food ads * Negative	−0.114**	−0.096*	−0.108**	0.012
	(0.048)	(0.049)	(0.049)	(0.047)
	[0.093]	[0.206]	[0.127]	[0.958]
Constant	0.756***	0.718***	0.340***	0.377***
	(0.022)	(0.021)	(0.016)	(0.019)
Observations	463	463	463	463
Overweight and Obese				
Food ads	0.041	0.027	−0.036	0.063**
	(0.035)	(0.034)	(0.032)	(0.032)
	[0.739]	[0.894]	[0.793]	[0.303]
Negative emotions	0.004	−0.011	0.024	−0.035
	(0.050)	(0.049)	(0.047)	(0.041)
	[0.994]	[0.998]	[0.970]	[0.904]
Food ads * Negative	0.007	0.022	0.025	−0.003
	(0.063)	(0.062)	(0.060)	(0.056)
	[0.999]	[0.987]	[0.980]	[0.958]
Constant	0.774***	0.747***	0.394***	0.353***
	(0.026)	(0.026)	(0.026)	(0.024)
Observations	326	326	326	326

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. p-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Share of calories from unhealthy food is the calories per package of unhealthy food items selected, divided by the total calories of the food items selected. Proportion unhealthy (sweet and savory) is the number of unhealthy (sweet and savory) food items selected divided by five. Food ads takes value of 1 for participant watching the food advertisements, 0 for participants watching the non-food advertisements. Negative emotions takes value of 1 for participants watching the film clips eliciting negative emotions, 0 for participants watching the film clips eliciting neutral and positive emotions. Food ads * Negative is the interaction between the Food ads and Negative emotions variables.

in Appendix A.5). In overweight adolescents, emotions and food advertisement do not have a significant impact on dietary choices, except an increase in savory items and sodium selection after watching food advertisements. We speculate this group has a less spontaneous relationship with food and therefore is less susceptible to our treatments.

5 | CONCLUSION

In this study, we examine the effect of online food advertisements on adolescents' food choices, and the importance of emotions in moderating this effect. We conducted two online experiments with a total of 940 adolescents (aged 13–17 years old). In the first study with 240 adolescents, we identified six two-minute film excerpts that better elicited positive, neutral, and negative emotions in an online setting from a collection of twelve film clips. In the second study, 750 adolescents completed a food decision task selecting five out of 20 healthy and unhealthy snacks (of which five savory and five sweet) with approximately the same price. To increase the representativeness of the food choices in the study, one out of seven

participants received their chosen food snacks delivered to their homes. We experimentally varied the environment in which participants chose the snacks, by assigning participants to watch different videos (film clips and advertisements) for around 6 min. We varied the emotional state by assigning adolescents to watch two two-minute film clips validated to elicit either positive, neutral, or negative emotions. With a second experimental treatment, we varied whether adolescents watched three 30-s advertisements about unhealthy food or non-food products. We measured participants' emotions before and after the videos with the PANAS (Thompson, 2007) to assess the effectiveness of our emotion inducement procedure. We use the number of unhealthy snacks selected and the nutritional content of the food selected to determine the impact of emotions and online food advertising on food choices.

We found that participants in the negative emotion condition selected more unhealthy sweet snacks, resulting in a food basket with higher added sugars and lower dietary fiber density. This first finding suggests that consistent with prior work (Evers et al., 2018; Macht, 2008; Stice, 2001; Stice et al., 2005), a negative emotional state increases the propensity to make unhealthy food choices, perhaps by reducing decision-making or inhibitory control resources (e.g., Macchi et al., 2017).

We did not find evidence of an overall impact of food advertisements on snack selection. We also found weak evidence that participants in the positive or neutral emotion condition watching the food advertisements selected food items with a higher density of added sugars and lower density of dietary fibers. This suggests that positive emotionality may make youth more attuned to being agreeable with the food advertisement or find the ads more appealing, consistently with prior work (Bagozzi et al., 1999; Bronner et al., 2007; Goldberg & Gorn, 1987; Owolabi, 2009). However, this effect was marginal, suggesting the magnitude of the influence of positive emotion on food advertising susceptibility may be small.

One possible explanation for the lack of impact of food advertising on food choices is that adolescents are less responsive to "traditional" advertising. Adolescents are exposed to pervasive food marketing, both more traditional advertising by the food company as used in this study, and advertising embedded in social media like user-generated or celebrity-generated content featuring food products. Studies suggest that young people may have more difficulty recognizing digital marketing as advertising (Blades et al., 2013; Bragg et al., 2021). As a result, they might be more susceptible to non-traditional advertising, explaining the scarce effect of traditional advertising found in this study. Additionally, our focus on the beyond-brand effects of advertisements, where participants were asked to select among foods akin to but different from those featured in the videos (e.g., Pringles instead of Lays potato chips, as presented in the ads), may have limited our ability to capture the full scope of how ads directly influence the choice of advertised foods. Future research should investigate non-traditional types of advertising, the impact of peer versus celebrity emulation, and targeted brand effects of advertising in this context.

Heterogeneous effect analysis highlights that our treatments impacted only the sample of normal weight or underweight adolescents. In this sample, negative emotions increase unhealthy sweet choices, and watching food advertisements in a positive emotional state increases susceptibility to food advertisements (increasing unhealthy and unhealthy sweet food choices). Overweight or obese adolescents may be less susceptible to our treatments because they have a less spontaneous relationship with food.

Consistent with prior work (e.g., Backholer et al., 2021) suggesting that youth from racial and/or ethnic minority groups may have a higher potential exposure or impact from unhealthy food advertising, we finally find that food advertisement significantly impacts the healthfulness of food choices of the Black or African American and Hispanic or Latino subpopulations. Thus, policies that aim to limit online unhealthy food advertising exposure and efforts to improve nutritional literacy could be prioritized among Black and Hispanic groups to understand the persuasive intent of advertising and the health implications of poor food choices. Education on emotional intelligence and regulation among this group could also be promising in improving self-control, achieving delayed gratification, and reducing the impact of negative emotions on the nutritional quality of food choices. Future research is needed to conduct a thorough cost-benefit analysis for the specific policies targeted at the Black and Hispanic groups.

Our research also has important implications on food marketing and demand. This study suggests that while food advertising may be effective in increasing demand for targeted food products, the beyond brand effects of advertisements are only significant for Black or African American and Hispanic or Latino subpopulations. Thus, the spillover effects of food advertisements on other brands of similar products may be big for this subpopulation and could potentially enlarge the racial inequality in diet quality. In comparison, White adolescents are more influenced by negative emotions in terms of choosing more unhealthy foods to improve their moods. Better emotion intelligence education including teaching adolescents healthier ways to mitigate stress and negative emotions, other than comfort foods eating, particularly for the White population may be helpful.

Several limitations should be considered when interpreting the results of this study. First, our measure of BMI is constructed from self-reported measures, which are generally accurate and dependable but tend to exhibit reduced accuracy with higher BMIs (Allison et al., 2020; Brener et al., 2003; Gokler et al., 2018). This potential measurement error may have

affected our analysis, especially when examining the impact of emotions and advertising on different BMI groups. Second, in our study, the consumption of food is delayed, and so we cannot guarantee that adolescents will have actual access to the selected snacks or that they will want the snacks when they do gain access. While we ask participants to "select 5 food items that you would like to eat right now," we cannot exclude the possibility that the snack choices made represent "cold-state" decisions, reflecting what individuals consume routinely rather than what they might choose in real-time or different circumstances, potentially underestimating the impact of our treatments.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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APPENDIX

A. Additional results

A.1 Emotion Inducement

TABLE A.1.1 List of film clips.

Emotion	Clip	Description	Length (min)	Source
	Positive			
Positive 1	Key and Peele—Spoilers	Friends try to avoid spoilers	2:14	New
Positive 2	The Office—Fire Drill	Coworker causes chaos	2:03	Gilman et al., 2017
Positive 3	Mr. Bean—Photo	Man asked to take a photo runs with the camera	2:10	New
Positive 4	D2: The Mighty Ducks—Speech	Coach gives inspirational speech to the youth hockey team	2:21	Gilman et al. 2017
	Neutral			
Neutral 1	People walking in a city	First-person view of walking in the street in London	1:58	New
Neutral 2	BBC Planet Earth Mountains	Scenery of mountains with modified wind sounds	2:00	Maffei & Angrilli, 2019
Neutral 3	BBC Planet Earth Desert	Scenery of desert	2:11	Maffei & Angrilli 2019
Neutral 4	BBC Planet Earth Seasonal Forests	Scenery of forests	2:03	Maffei & Angrilli 2019
	Negative			
Negative 1	My girl—Funeral	Funeral of a child, grief of friend	2:05	Maffei & Angrilli 2019
Negative 2	Pursuit of Happiness—Homelessness	Homeless father and son spend a night in a subway restroom	2:05	Maffei & Angrilli 2019
Negative 3	Lost—Drowning	Death by drowning of a couple	2:07	Maffei & Angrilli 2019
Negative 4	Vacancy—Run	Two people run from a threat	2:00	Maffei & Angrilli 2019

TABLE A.1.2 Film clips positive and negative affect scores.

		Positive affect score		Negative affect score		
		(1)	(2)	(3)	(4)	(5)
		Average	Difference to baseline	Average	Difference to baseline	N
Positive 1	Key and Peele—Spoilers	14.68	−1.78	7.00	−0.73	37
Positive 2	The Office—Fire Drill	15.80	−0.93	8.75	0.80	44
Positive 3	**Mr. Bean—Photo**	17.84	0.30	6.62	−1.22	37
Positive 4	**D2: The Mighty Ducks- Speech**	18.63	1.70	6.37	−1.84	43
Neutral 1	People walking in a city	15.55	−2.42	7.08	−0.58	38
Neutral 2	BBC Planet Earth Mountains	15.86	−1.347	6.78	−1.46	35
Neutral 3	**BBC Planet Earth Desert**	14.866	−1.23	7.44	−1.02	43
Neutral 4	**BBC Planet Earth Seasonal Forests**	16.40	−1.00	6.98	−0.98	40
Negative 1	**My girl—Funeral**	10.30	−6.22	10.78	3.50	46
Negative 2	**Pursuit of Happiness—Homeless**	9.92	−6.50	12.31	3.83	36
Negative 3	Lost—Drowning	9.80	−6.06	10.71	2.78	35
Negative 4	Vacancy—Run	11.79	−5.61	9.71	3.08	38

Note: N is the number of subjects watching the film clip.

A.2 Food selection

TABLE A.2.1 List of foods.

Category	Food	Cost	Servings in package	Cost per serving
Unhealthy and savory	Utz cheese curls	$2.68	9	$0.30
Unhealthy and savory	Doritos nacho cheese chips	$1.98	3	$0.66
Unhealthy and savory	Pringles chips	$1.78	5	$0.36
Unhealthy and savory	Cheez-It crackers	$3.14	12	$0.26
Unhealthy and savory	Funyuns onion flavored rings	$1.98	3	$0.66
Unhealthy and sweet	Fruit by the foot snack	$2.48	6	$0.41
Unhealthy and sweet	Kit Kat wafer bar	$1.96	4	$0.49
Unhealthy and sweet	Milano chocolate cookies	$3.28	5	$0.66
Unhealthy and sweet	Little Debbie strawberry shortcake rolls	$2.58	6	$0.43
Unhealthy and sweet	Skittles candy	$1.64	4	$0.41
Healthy and savory	Blue diamond almonds	$3.22	6	$0.54
Healthy and savory	Harvest Snap green pea snacks	$2.98	6	$0.50
Healthy and savory	Hippeas chickpea puffs	$2.98	4	$0.75
Healthy and savory	Triscuit crackers	$2.98	9	$0.33
Healthy and savory	Great Value walnuts	$2.36	4	$0.59
Healthy and sweet	Del Monte mandarin oranges fruit cup	$2.18	4	$0.55
Healthy and sweet	Bear Naked fruit and granola	$3.38	6	$0.56
Healthy and sweet	Great Value dried apricots	$2.87	4.5	$0.64
Healthy and sweet	Kind grain bar chocolate	$2.78	5	$0.56
Healthy and sweet	Del Monte diced peaches fruit cup	$2.18	4	$0.55

TABLE A.2.2 Nutrients per 100 g.

Food	Calories (Kcal)	Total fat (g)	Saturated fat (g)	Sodium (mg)	Total sugars (g)	Added sugars (g)	Fiber (g)
Unhealthy savory	521.43	28.19	6.00	824.76	1.43	–	1.76
Unhealthy sweet	433.20	14.71	7.70	142.28	50.96	48.81	0.60
Unhealthy	477.32	21.45	6.85	483.52	26.19	24.41	1.18
Healthy savory	550.00	33.57	1.79	267.86	3.57	–	10.71
Healthy sweet	245.15	8.67	1.67	85.94	15.36	3.67	7.35
Healthy	397.57	21.12	1.73	176.90	9.47	1.83	9.03
Unhealthy-healthy	79.74	0.33	5.13	306.62	16.73	22.57	(7.85)

TABLE A.2.3 OLS models of the impact of advertisement and emotions on snack choices with covariates.

	(1) Share of calories from unhealthy food	(2) Proportion unhealthy	(3) Proportion unhealthy sweet	(4) Proportion unhealthy savory
Food ads	0.033	0.030	0.010	0.020
	(0.022)	(0.022)	(0.020)	(0.020)
	[0.488]	[0.553]	[0.835]	[0.636]
Negative emotions	0.057**	0.048*	0.082***	−0.034
	(0.028)	(0.028)	(0.029)	(0.027)
	[0.259]	[0.426]	[0.035]	[0.596]
Food ads * Negative	−0.055	−0.042	−0.059	0.017
	(0.039)	(0.039)	(0.038)	(0.037)
	[0.539]	[0.688]	[0.512]	[0.635]
Weight (lbs)	0.000	−0.000	−0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Height (in)	0.004	0.003	−0.002	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)
Hunger	−0.001	−0.001	0.001	−0.002
	(0.003)	(0.003)	(0.003)	(0.003)
Fast food	0.009	0.012**	0.002	0.009
	(0.006)	(0.006)	(0.006)	(0.006)
Constant	0.521***	0.503***	0.461***	0.042
	(0.153)	(0.149)	(0.133)	(0.129)
Observations	766	766	766	766

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. p-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Share of calories from unhealthy food is the calories per package of unhealthy food items selected, divided by the total calories of the food items selected. Proportion unhealthy (sweet and savory) is the number of unhealthy (sweet and savory) food items selected divided by five. Standard deviations are reported in parenthesis. Food ads takes value of 1 for participant watching the food advertisements, 0 for participants watching the non-food advertisements. Negative emotions takes value of 1 for participants watching the film clips eliciting negative emotions, 0 for participants watching the film clips eliciting neutral and positive emotions. Food ads * Negative is the interaction between the Food ads and Negative emotions variables. Weight, Hunger, and Fast food are control variables.

A.3 Nutrients selection

Table A.3.1, Table A.3.2, Table A.3.3, Table A.3.4

TABLE A.3.1 OLS models of the impact of food advertisement on nutrients selection per 100 g of product.

	(1) Calories (kcal)	(2) Sodium (mg)	(3) Saturated fat (g)	(4) Added sugar (g)	(5) Fiber (g)
Food ads	19.506	79.047	0.167	−3.755	−1.463
	(22.886)	(57.279)	(0.729)	(4.149)	(0.942)
	[0.606]	[0.476]	[0.823]	[0.708]	[0.401]
Constant	2235.587***	1893.309***	28.013***	97.869***	17.362***
	(16.210)	(42.104)	(0.530)	(3.101)	(0.718)
Observations	789	789	789	789	789

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. p-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Calories (Sodium, Saturated fat, Added sugar, Fiber) is the total calories (sodium, saturated fat, added sugar, fiber) per 100 gr of each of the five food items selected. Food ads takes value of 1 for participants watching the food advertisements, 0 for participants watching the non-food advertisements.

TABLE A.3.2 OLS models of the impact of emotions on nutrients selection per 100 g of product.

	(1) Calories (kcal)	(2) Sodium (mg)	(3) Saturated fat (g)	(4) Added sugar (g)	(5) Fiber (g)
Negative emotions	−19.258	−70.514	0.091	9.903**	−1.995**
	(26.091)	(62.415)	(0.813)	(4.652)	(0.966)
	[0.664]	[0.521]	[0.906]	[0.138]	[0.120]
Constant	2251.461***	1955.442***	28.075***	93.007***	17.174***
	(13.269)	(34.111)	(0.427)	(2.400)	(0.577)
Observations	789	789	789	789	789

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. p-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Calories (Sodium, Saturated fat, Added sugar, Fiber) is the total calories (sodium, saturated fat, added sugar, fiber) per 100 gr of each of the five food items selected. Negative emotions takes value of 1 for participants watching the film clips eliciting negative emotions, 0 for participants watching the film clips eliciting neutral and positive emotions.

TABLE A.3.3 OLS models of the impact of advertisement and emotions on nutrients selection per 100 g of product.

	(1) Calories (kcal)	(2) Sodium (mg)	(3) Saturated fat (g)	(4) Added sugar (g)	(5) Fiber (g)
Food ads	2.732	66.119	−0.323	1.547	−2.418**
	(26.582)	(68.441)	(0.858)	(4.810)	(1.157)
	[0.919]	[0.867]	[0.969]	[0.937]	[0.317]
Negative emotions	−52.006	−100.511	−0.822	20.360***	−3.820**
	(36.100)	(90.287)	(1.154)	(7.275)	(1.487)
	[0.705]	[0.841]	[0.961]	[0.044]	[0.115]
Food ads * Negative	59.624	51.036	1.684	−19.175**	3.467*
	(51.750)	(124.659)	(1.620)	(9.387)	(1.948)
	[0.815]	[0.986]	[0.865]	[0.335]	[0.510]
Constant	2250.049***	1921.259***	28.242***	92.208***	18.424***
	(19.057)	(50.713)	(0.634)	(3.463)	(0.873)
Observations	789	789	789	789	789

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. p-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Calories (Sodium, Saturated fat, Added sugar, Fiber) is the total calories (sodium, saturated fat, added sugar, fiber) per 100 gr of each of the five food items selected. Food ads takes value of 1 for participants watching the food advertisements, 0 for participants watching the non-food advertisements. Negative emotions takes value of 1 for participants watching the film clips eliciting negative emotions, 0 for participants watching the film clips eliciting neutral and positive emotions. Food ads * Negative is the interaction between the Food ads and Negative emotions variables.

TABLE A.3.4 OLS models of the impact of advertisement and emotions on nutrients selection per 100 g of product with covariates.

	(1) Calories (kcal)	(2) Sodium (mg)	(3) Saturated fat (g)	(4) Added sugar (g)	(5) Fiber (g)
Food ads	2.479	58.095	−0.297	1.381	−2.332**
	(26.592)	(69.011)	(0.856)	(4.869)	(1.146)
	[0.974]	[0.967]	[0.930]	[0.933]	[0.381]
Negative emotions	−51.581	−117.273	−0.664	21.237***	−3.776**
	(36.353)	(92.447)	(1.154)	(7.334)	(1.478)
	[0.657]	[0.668]	[0.968]	[0.038]	[0.102]
Food ads * Negative	59.983	73.079	1.579	−19.092**	3.265*
	(51.610)	(125.797)	(1.623)	(9.485)	(1.937)
	[0.853]	[0.968]	[0.856]	[0.372]	[0.590]
Weight (lbs)	−0.013	1.124	−0.010	−0.050	−0.003
	(0.309)	(0.765)	(0.010)	(0.053)	(0.012)
Hunger	1.258	−6.471	0.100	0.610	0.128
	(4.510)	(10.931)	(0.141)	(0.808)	(0.169)
Fast food	−1.002	19.650	−0.007	1.722	−0.783***
	(8.013)	(19.844)	(0.238)	(1.467)	(0.293)
Constant	2246.527***	1767.504***	28.994***	92.183***	19.539***
	(56.618)	(129.775)	(1.798)	(8.914)	(2.239)
Observations	789	789	789	789	789

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. p-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Calories (Sodium, Saturated fat, Added sugar, Fiber) is the total calories (sodium, saturated fat, added sugar, fiber) per 100 gr of each of the five food items selected. Food ads takes value of 1 for participants watching the food advertisements, 0 for participants watching the non-food advertisements. Negative emotions takes value of 1 for participants watching the film clips eliciting negative emotions, 0 for participants watching the film clips eliciting neutral and positive emotions. Food ads * Negative is the interaction between the Food ads and Negative emotions variables. Weight, Hunger, and Fast food are control variables.

A 4 Heterogeneity analysis results—by ethnicity

A.4.1

TABLE A.4.1 OLS models on food choices by ethnicity.

	(1) Share of calories from unhealthy food	(2) Proportion unhealthy	(3) Proportion unhealthy sweet	(4) Proportion unhealthy savory
Black or Hispanic	0.047***	0.030*	0.032*	−0.002
	(0.018)	(0.018)	(0.016)	(0.016)
Constant	0.769***	0.740***	0.364***	0.376***
	(0.013)	(0.013)	(0.012)	(0.012)
Observations	789	789	789	789

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. Share of calories from unhealthy food is the calories per package of unhealthy food items selected, divided by the total calories of the food items selected. Proportion unhealthy (sweet and savory) is the number of unhealthy (sweet and savory) food items selected divided by five.

TABLE A.4.2 OLS models on nutrients selection per 100 g of product by ethnicity.

	(1) Calories (kcal)	(2) Sodium (mg)	(3) Saturated fat (g)	(4) Added sugar (g)	(5) Fiber (g)
Black or Hispanic	−70.339***	−26.547	−1.120	8.822**	−3.335***
	(22.754)	(56.947)	(0.727)	(4.122)	(0.921)
Constant	2278.298***	1947.134***	28.618***	91.824***	18.131***
	(15.924)	(40.545)	(0.504)	(2.849)	(0.676)
Observations	789	789	789	789	789

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. Calories (Sodium, Saturated fat, Added sugar, Fiber) is the total calories (sodium, saturated fat, added sugar, fiber) per 100 gr of each of the five food items selected.

TABLE A.4.3 OLS models of the impact of advertisement and emotions on nutrients selection per 100 g of product by Ethnicity.

	(1) Calories (kcal)	(2) Sodium (mg)	(3) Saturated fat (g)	(4) Added sugar (g)	(5) Fiber (g)
White and other ethnicities					
Food ads	36.769	186.138*	−0.769	−7.057	−0.323
	(37.230)	(99.835)	(1.184)	(6.644)	(1.734)
	[0.906]	[0.421]	[0.935]	[0.908]	[0.857]
Negative emotions	−50.623	−87.689	0.564	26.521***	−5.898***
	(48.711)	(120.867)	(1.558)	(10.072)	(1.879)
	[0.908]	[0.945]	[0.915]	[0.068]	[0.019]
Food ads * Negative	43.503	−125.441	1.888	−16.097	4.207
	(70.366)	(168.253)	(2.225)	(12.777)	(2.613)
	[0.886]	[0.955]	[0.940]	[0.836]	[0.634]
Constant	2266.775***	1897.022***	28.524***	90.205***	19.388***
	(26.600)	(74.191)	(0.872)	(5.045)	(1.239)
Observations	425	425	425	425	425
Black and Hispanic					
Food ads	−35.034	−67.039	0.171	11.093	−4.744***
	(37.479)	(92.257)	(1.252)	(6.864)	(1.451)
	[0.923]	[0.924]	[0.892]	[0.668]	[0.013]
Negative emotions	−55.412	−113.556	−2.532	13.096	−1.399
	(53.910)	(137.041)	(1.678)	(10.530)	(2.371)
	[0.909]	[0.918]	[0.713]	[0.818]	[0.893]
Food ads * Negative	68.084	266.938	1.183	−21.733	1.991
	(75.589)	(186.255)	(2.291)	(13.794)	(2.878)
	[0.927]	[0.727]	[0.819]	[0.690]	[0.905]
Constant	2231.494***	1948.146***	27.929***	94.429***	17.355***
	(27.353)	(68.673)	(0.928)	(4.715)	(1.225)
Observations	364	364	364	364	364

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. p-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Calories (Sodium, Saturated fat, Added sugar, Fiber) is the total calories (sodium, saturated fat, added sugar, fiber) per 100 gr of each of the five food items selected. Food ads takes value of 1 for participants watching the food advertisements, 0 for participants watching the non-food advertisements. Negative emotions takes value of 1 for participants watching the film clips eliciting negative emotions, 0 for participants watching the film clips eliciting neutral and positive emotions. Food ads * Negative is the interaction between the Food ads and Negative emotions variables.

A.5 Heterogeneity analysis results—by BMI

A.5.1

TABLE A.5.1 OLS models on food choices by BMI.

	(1) Share of calories from unhealthy food	(2) Proportion unhealthy	(3) Proportion unhealthy sweet	(4) Proportion unhealthy savory
Overweight or Obese	0.015	0.014	0.012	0.003
	(0.018)	(0.018)	(0.017)	(0.017)
Constant	0.784***	0.748***	0.374***	0.374***
	(0.012)	(0.012)	(0.011)	(0.011)
Observations	789	789	789	789

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. Share of calories from unhealthy food is the calories per package of unhealthy food items selected, divided by the total calories of the food items selected. Proportion unhealthy (sweet and savory) is the number of unhealthy (sweet and savory) food items selected divided by five.

TABLE A.5.2 OLS models on nutrients selection per 100 g of product by BMI.

	(1) Calories (kcal)	(2) Sodium (mg)	(3) Saturated fat (g)	(4) Added sugar (g)	(5) Fiber (g)
Overweight or Obese	−10.261	23.927	−0.363	1.206	−1.207
	(23.267)	(58.619)	(0.734)	(4.182)	(0.957)
Constant	2250.087***	1925.000***	28.251***	95.396***	17.091***
	(14.970)	(36.454)	(0.483)	(2.717)	(0.600)
Observations	789	789	789	789	789

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. Calories (Sodium, Saturated fat, Added sugar, Fiber) is the total calories (sodium, saturated fat, added sugar, fiber) per 100 gr of each of the five food items selected.

TABLE A.5.3 Healthy weight adolescents—OLS models of the impact of advertisement and emotions on nutrients selection per 100 g of product.

	(1) Calories (kcal)	(2) Sodium (mg)	(3) Saturated fat (g)	(4) Added sugar (g)	(5) Fiber (g)
Underweight and Healthy weight					
Food ads	6.678	−55.561	−0.644	9.758	−2.758*
	(34.848)	(87.410)	(1.137)	(6.214)	(1.471)
	[0.976]	[0.975]	[0.976]	[0.570]	[0.389]
Negative emotions	−24.046	−100.259	0.174	30.881***	−5.420***
	(46.826)	(116.243)	(1.554)	(9.435)	(1.760)
	[0.928]	[0.940]	[0.916]	[0.027]	[0.029]
Food ads * Negative	60.777	86.636	2.571	−33.363***	6.527***
	(67.725)	(158.913)	(2.146)	(12.519)	(2.429)
	[0.937]	[0.967]	[0.805]	[0.063]	[0.063]
Constant	2244.260***	1968.253***	28.141***	86.816***	19.026***
	(25.063)	(63.567)	(0.851)	(3.878)	(1.138)
Observations	463	463	463	463	463
Overweight and Obese					
Food ads	−4.351	242.901**	0.072	−11.085	−1.776
	(41.095)	(109.881)	(1.297)	(7.828)	(1.855)
	[1.000]	[0.270]	[0.961]	[0.793]	[0.967]
Negative emotions	−91.773	−87.536	−2.208	4.486	−1.466
	(56.435)	(143.569)	(1.695)	(11.521)	(2.559)
	[0.659]	[0.998]	[0.849]	[1.000]	[0.997]
Food ads * Negative	62.852	−12.777	0.683	1.511	−0.690
	(80.058)	(199.226)	(2.437)	(14.317)	(3.181)
	[0.983]	[0.997]	[1.000]	[1.000]	[1.000]
Constant	2259.583***	1843.856***	28.408***	101.087***	17.433***
	(29.180)	(83.992)	(0.932)	(6.514)	(1.354)
Observations	326	326	326	326	326

Note: Robust standard errors are shown in parentheses. Significance levels are indicated as follows: *$p < .1$, **$p < .05$, ***$p < .01$. p-Values adjusted for multiple hypothesis testing using the bootstrap approach proposed in List et al. (2019) are shown in brackets. Calories (Sodium, Saturated fat, Added sugar, Fiber) is the total calories (sodium, saturated fat, added sugar, fiber) per 100 gr of each of the five food items selected. Food ads takes value of 1 for participants watching the food advertisements, 0 for participants watching the non-food advertisements. Negative emotions takes value of 1 for participants watching the film clips eliciting negative emotions, 0 for participants watching the film clips eliciting neutral and positive emotions. Food ads * Negative is the interaction between the Food ads and Negative emotions variables.