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The impact of food branding on children's eating behavior and obesity ☆

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ABSTRACT

Branding is a technique used by the food industry to create a recognizable image to attract consumers and hopefully boost sales of the product. Children recognize food brands from a young age, but their impact on the development of eating behaviors and obesity is unclear. In addition, the notion that some branding techniques may be used to increase intake of healthful foods, like fruits and vegetables, has not been rigorously investigated. Three laboratory-based intake studies designed to test the impact of common food brands on children's eating habits are presented. In the first study, four to six year-old children (n = 43) were exposed to ad libitum test-meals where foods were presented either with or without their associated branding. In the second study, a novel food brand based Stroop task was developed and tested to assess children's cognitive response to food brands, and following this procedure, seven to nine year-old children (n = 41) ate ad libitum test-meals consisting of foods packaged with or without a logo from a popular fast food restaurant. Finally, a pilot intervention was conducted with four to five year-old children (n = 16) to demonstrate the efficacy of using licensed (spokes) characters to package and promote intake of fruits and vegetables. These studies demonstrate that branding is an important influence on what and how much children eat, but some children may be more susceptible to these influences than others. Future studies are needed to better understand the influence that child age, sex, and obesity has on response to food branding and marketing.

1. Introduction

The prevalence of childhood obesity has increased to epidemic proportions over the last three decades [1,2]. Increased obesity has been associated with a concomitant increase in incidence of chronic diseases in children, including cardiovascular disease, type II diabetes, and hypertension [3]. Curbing these trends has proven to be one of the most challenging public health problems of recent times. One of the reasons these efforts have been challenging is because the food environment is highly obesogenic and has been described as "toxic" due to the ubiquitous nature of palatable, high-energy foods and the lack of physical effort needed to acquire these foods [4]. One of the most important contributors to this toxic environment is food advertising. Children are bombarded with advertisements for foods and beverages telling them what, where, and how to eat, and they are exposed to these messages through not only television, but many other media outlets. It is estimated that children may view as many as 40,000 advertisements for food each year [5], and 98% of these are promoting foods high in fat, sodium, and sugar [6]. Several key regulating bodies in the United States and Europe have reviewed the available evidence and have concluded that food advertising plays a powerful role in shaping children's eating habits and may be causally linked to the development of obesity [5,7].

There are a variety of forms of food advertising directed at children, but the impact each of these forms may have individually is unknown. One example is food branding, a form of marketing directed commonly at children that is intended to develop strong emotional attachments with a product name or logo [8]. The importance of branding can be illustrated by examining marketing campaigns like the Pepsi® challenge. Despite the fact that in blind taste tests, the majority of Americans report a preference for Pepsi®, follow-up tests done without blinding consumers to the cola's brand showed that the majority preferred Coke® [9]. In a follow-up neuroimaging study,

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researchers demonstrated differences in how the brain responds to Coke® versus Pepsi® that reinforce the idea that branding of a product can override the product's sensory attributes [10]. Clearly, branding plays a powerful role in forming our hedonic reactions to foods, and more critically, our reactions to brands may not be under conscious control.

Children learn to recognize brands early in life [8,11], but until recently, the impact of branding on children's food preferences and eating behavior had rarely been studied under controlled laboratory conditions. Robinson et al. conducted a laboratory study with preschool children to determine the impact of placing McDonald's® packaging on foods that were not actually from McDonald's®. In addition to French fries and hamburgers, they also included healthier options, like carrots and apples. They found that children reported liking the foods more if they were presented with McDonald's® branding, compared to when the foods were presented in plain packaging [12]. In two related studies, similar aged children reported that they liked snack foods better when they were in containers that contained licensed cartoon characters on them, compared to when they were presented in plain containers [13,14]. The mechanisms behind these effects are unclear. It is possible that popular brands, like McDonald's®, decrease children's level of neophobia for an associated food, thus making it a safer and more familiar option. Another possibility is that the addition of familiar brands or cartoon characters may simply serve as a colorful, fun visual stimulus that enhances the overall eating experience. Additional research is needed to better understand how changes in food packaging can impact children's preferences and intake. This research is particularly needed at a time when children consume less than the recommended amounts of many fresh fruits and vegetables (F&V) [15]. Techniques used by the food marketing industry may ultimately provide suggestions for making healthful foods more appealing to children.

Soaring rates of childhood obesity throughout the world [16] necessitate studies that examine the impact of food marketing on obesity. Although the evidence is still controversial, work from several investigators supports the notion that obese children may be more susceptible to external food advertising cues than are their lean counterparts. In previous work from Halford et al. [17,18], children were exposed to advertisements for either foods or non-foods in school-based settings, and following, they were allowed to consume ad libitum from an assortment of snacks. In addition, a brand awareness test was administered to determine whether overweight/obese (OW) children would be able to recognize more food advertisements than non-overweight (non-OW) children. They found that all children consumed more after exposure to food advertisements, compared to after viewing non-food advertisements. However, the increase in intake was greater in the OW children than in the non-OW children. Furthermore, OW children were able to recognize more food brands in the brand awareness test than were non-OW children. The authors hypothesized that OW children were more responsive to external food cues, an idea rooted in the theory of externality proposed by Stanley Schachter [19]. In Schachter's work with adults and children, he manipulated external cues related to eating, such as meal times, and he noted that OW individuals were more likely to eat in response to changes in these external cues than were non-OW individuals. Several follow-up lines of evidence support this notion in children, including work from Jansen et al. [20], Carnell et al. [21], and others [22,23]. However, whether greater externally motivated eating is a causal factor in the development of obesity is not known, and the idea remains controversial.

Given the powerful impact that branding and packaging have on food preference, we hypothesized that it might be possible to increase children's intake of foods in a controlled laboratory setting simply by manipulating brand and packaging cues. In addition, because of the previously discussed evidence that OW children might be more susceptible to food cues, we hypothesized that they might be more responsive to food branding and packaging manipulation, compared to non-OW children. To address these questions, we conducted a series of pilot studies from 2006 to 2011 that were designed to assess the impact of manipulating food brand packaging on children's intake and eating behaviors. These studies are examined below.

2. Laboratory studies testing the role of food branding on children's eating behavior

2.1. Study one: Do familiar food brands affect test-meal intake in four to six year-old children?

The purpose of this study was to determine if the presence of familiar food brands alone would result in increased intake of a multi-item buffet meal compared to a control condition where foods were served in plain packaging (unbranded). In order to answer this question, we tested 43 healthy, four to six year-old children, mean age 5.9 ± 0.9 years, from diverse ethnic backgrounds living in New York City [24]. Seventeen ($n = 17$) of the children were boys (39.5%) and the remaining 26 were girls (60.5%). Twenty-three ($n = 23$) children were non-OW and 20 were OW, defined as BMI-for-age ≥ 85th % [25]. There were no differences in the breakdown of sex, ethnic or income group as a function of child weight status. In order to be enrolled in the study, children had to be both familiar with and like at least five out of the seven foods used in the study based on parental report during the screening procedure. Prior to their first visit, children were randomized to the order in which they received four test-meals, two "unbranded" meals and two "branded" meals. In the unbranded meals, all foods were served in plain, white plastic containers. In the branded meals, all foods were served in their original brand packaging. For the test-meals, foods that are commonly advertised to children (e.g. Lunchables®, Trix Yogurt®, Oreos®, etc.) were selected. In addition, prior to the test-meal, we administered a brand awareness test similar to the protocol employed by Halford et al. [17].

2.1.1. Results: Study one

Results showed no differences in intake at the branded vs. unbranded condition when all children were combined ($p = 0.80$). However, the difference in intake between the branded and unbranded conditions was significantly different between OW and non-OW children and this difference remained after adjusting for child age, sex, and ethnicity. OW children consumed about ~41 cal more when foods were branded, while non-OW children consumed about ~45 cal less when foods were branded ($p \leq 0.05$) compared to when they were unbranded. We also found a significant effect of sex on intake at the two conditions, with boys tending to eat more at the branded condition than girls ($p < 0.05$), however, this was likely due to two boys who were outliers. When removed from the database, the effect due to sex was no longer significant ($p = 0.4$). It was unclear why non-OW children actually consumed fewer calories when foods were branded, but we hypothesized that children may have been less willing to open packages of some of the foods (e.g. potato chips) if they were only going to have a few bites. In contrast, OW children may have been more familiar with receiving foods in their packaging, or they may have been more motivated to open this packaging to sample the contents. Despite these differences in intake, we found no differences in level of brand awareness or reported hours spent watching television in OW and non-OW children. For additional details, the reader is referred to the published report [24]. In a related study, Halford et al. did find a positive association with branded food selection and quantity of TV viewing in older children (unpublished results). One important confound that should be investigated in future studies is the food packaging itself. As noted above, the fact that children had to open packages of foods in the branded condition may have influenced the response, and future studies should adjust for this effect.

The results of this first experiment demonstrated that food brands are an important visual cue and some children may overeat in their presence. The observation that OW children appeared more responsive

to food branding exposure than non-OW children is supported by previous studies from Halford et al. with children aged nine to eleven years-old [17,18]. In both these studies, the authors exposed children to food and non-food related advertisements embedded in a cartoon, followed by ad libitum consumption of a range of sweet and savory low- and high-fat snacks. Under these conditions, all children ate more after exposure to food advertisements compared to non-food advertisements, but the effects were greater in OW compared to non-OW children. Several studies do not support these findings, however. Halford et al. did not show any differences between OW and non-OW children's response following food advertising exposure in five to seven year-old children [26]. The authors hypothesize that the weight-related response to food advertisements might be dependent on other factors such as child age, although a mechanism for this effect has not yet been investigated. Further, Dovey et al. found that level of child neophobia predicted children's responsiveness to advertisements for healthy foods [27]. In addition, this same group did not find any differences in 11–13 year-old children's food preferences after food advertising exposure, although food intake was not assessed in this study so it is not possible to compare these findings with our own [28]. Harris et al. [29] tested intake of "goldfish" snack crackers during exposure to television programming embedded with either advertisements for food or non-foods. They found that regardless of child weight status, viewing advertisements for foods increased intake of the crackers by 45% compared to the non-food conditions. It is important to note, however, that the latter study used only one test food, goldfish crackers, whereas both our study and the two by Halford [17,18] offered a variety of test foods that ranged in palatability. Offering a variety of test foods could have stimulated a greater response in OW children than that seen by Harris et al. [29]. Moreover, children were offered the "fish" crackers to consume while they were watching the advertisements as opposed to "priming" them with advertising exposure as in Halford's studies [17,18]. Because of these differences in protocols, comparing directly across studies is not possible. Undoubtedly, additional research is required to better understand these relationships.

The first experiment led to several follow-up questions. First, if some children are more susceptible to the effects of food brands, how can one measure this susceptibility in the laboratory? Second, the food brands selected in this first experiment were limited and children likely had different levels of familiarity with these brands that could have potentially impacted the results. Would similar results be observed if we selected a single, highly recognizable brand, for example a brand from a popular fast food restaurant?

2.2. Study two: The role of fast food branding in children's eating behavior

In this follow-up study, the goals were to select a recognizable fast food brand logo, similar to that used in Robinson et al. [12] and determine the impact of placing this brand on a multi-item test-meal that contained a range of healthful and age-appropriate food items. This was a cross-sectional study where children came to the lab for two dinner sessions where they were randomly assigned to receive a test-meal that was either "branded" with fast food logos or "unbranded" with no fast food logos. While the previous study by Robinson et al. [12] had only measured the impact of fast food branding on children's liking of foods, the purpose of this study was to translate these effects to food intake, a more direct link to diet and body weight regulation. A second goal of this study was to develop a modified Stroop task to test the hypothesis that OW children have an attentional bias toward food brand images. The food industry reaches out to children through an increasing number of avenues, including television, the internet, billboards, and product placement in schools [5]. Because of the ubiquitous nature of food advertising, attempts by parents or policy makers to limit exposure to these images are often unsuccessful. As a result, developing a reliable method to identify children who might be most susceptible to food branding is a worthwhile research endeavor.

2.2.1. Participants

A total of 41, seven to nine year-old children [mean = 8.4 ± 0.5 years] completed this study. Older children were selected due to the cognitive demands required of the Stroop task. Additionally, older children would have experienced a great number and diversity of marketing messages from a variety of media sources. Twenty-two (22) of the children had a BMI-for-age < 85th % (non-OW) and 19 children were OW (≥ 85th % BMI-for-age) [25]. Fifty-one (51%) of the children were boys, and ethnic background was representative of upper Manhattan, with ~65% of the children coming from African-American (33%) and Hispanic-American (32%) backgrounds.

2.2.2. The Food Brand Stroop Task

As identified in the study described above by Forman et al. [24], some children may be more susceptible to the effects of food branding than others. In addition, several previous studies have found that OW children are more susceptible to external food cues and more likely to eat in their presence compared to non-OW children [20,23,30]. Although Schachter's theory of externality [19] has not been widely accepted as a causal factor in the development of obesity, these studies make a strong case that for some children, exposure to external food cues, like advertising, may increase their likelihood of overeating. In previous studies, external eating has been measured with the use of scales, such as the Children's Eating Behavior Questionnaire [31] or the Dutch Eating Behavior Questionnaire [32]. However, a more direct approach to measuring cognitive bias toward food brands might be achieved through a variation on the Stroop task [33]. The classic color–word Stroop task is one of the most widely used tests of cognitive function where participants are asked to view color words (e.g. "red, blue") and name the color the word is printed in but ignore the actual content of the word. This task is easy when the color and word are congruent (e.g. red printed in red ink), but it is more difficult when the color and word are incongruent (e.g. red printed in blue ink). The difference in reaction time on incongruent versus congruent tasks is a reliable assessment of cognitive processing [33,34]. Several modifications have been made to the classic color Stroop, including the picture–word Stroop task, where words are printed over simple drawings or pictures. The theory behind this test is that more influential words will result in longer reaction times than less influential words [35]. In addition, an emotion-based version of the Stroop task has been used to show that patients who have eating disorders experience delayed reaction times in naming words related to food or shape (e.g. "fat," "thin," "chocolate," etc.), and this has been interpreted as a heightened cognitive processing of food-related stimuli [36]. Similar methods have been used to report biases toward food-related words among obese patients [23]. In the first part of this study, we developed and tested a modified version of the Stroop task to assess children's cognitive bias toward food brand images with the prediction that OW children would perform more poorly on incongruent versus congruent trials than non-OW children. In addition, children also completed the classic color Stroop task [33].

For the Food Brand Stroop Task, a total of 136 different food image photographs were printed in color on 8 1/2 in. × 11 in. cards. Half of the images were of foods without brand logos (e.g. broccoli, cookies) and the rest were pictures of common food brand logos. All images were matched for color intensity, luminance, length and width dimensions, and pixel size. Images were printed on a high-quality laser jet printer, placed in protective plastic folders, and presented to children in a three-ring binder. In order to create the congruent and incongruent tasks, each food image was superimposed with a word that either matched the image for the congruent tasks (see Fig. 1a and b) or did not match the image for the incongruent tasks (see Fig. 1c and d). For the incongruent tasks, there was always the presence of either a picture

Fig. 1. Example images in the Food Brand Based Stroop Task. Image (1a) is unbranded congruent, image (1b) is branded congruent, image (1c) is unbranded congruent, and image (1d) is branded congruent. Children were either asked to "read the word" or "name the picture." Time to respond to each task was recorded and averaged across congruent vs. incongruent tasks. Higher scores on incongruent tasks were interpreted as an increased cognitive bias toward food brand images.

of a food brand logo or the name of a food brand (e.g. Frosted Flakes®). This was done based on the assumption that children who had a greater cognitive interference to food brands would take longer to respond to the task in question (either naming the food pictured behind the branded word or reading the word placed in front of the branded image). In order to prevent confusion, branded images were digitally altered so that the only words present were those involved in the Food Brand Stroop Task (see Fig. 1b and d). Congruent and incongruent tasks were balanced, as were pictures of branded and unbranded foods. As in the color Stroop, images were arranged in blocks of four. Each block contained two branded images and two unbranded images, and was either congruent or incongruent.

Upon presentation of the images, children were asked to either read the word or identify the food image. Children were reminded of these instructions before each block. In the case of image identification, more than one answer was often accepted as correct (i.e. "chocolate" or "candy bar" were acceptable in lieu of "Snickers", or vice versa). Children were not penalized for incorrect responses, but were not shown the next image until a correct answer was given.

2.2.3. Scoring the Food Brand Stroop Task

All Stroop sessions were recorded using a hand-held audio recording device. A stopwatch was used to time children's performance on each block of four (congruent or incongruent). To assess performance, children's average time for both congruent and incongruent images was calculated and a score was created corresponding to the difference in time to respond to the incongruent compared to the congruent images. Higher scores on both the color and Food Brand Stroop suggested greater cognitive interference. With the Food Brand Stroop, in particular, we interpreted higher scores to mean a cognitive bias toward food brand words or logos.

2.2.4. Multi-item test-meal

After administration of the Stroop tasks, children received a multi-item test-meal that was either "branded" with the logo of a popular fast food restaurant, or "unbranded" — served in plain white packaging. The order in which children received the test-meals was randomized. Children were allowed 30 min to eat as much as they wanted. They ate individually while a research assistant read books to provide a neutral distraction. The same foods, serving equipment, and tray placement was used across both meals. The test-meal included: turkey and cheese, ham and cheese, and peanut butter and jelly sandwiches, pretzels, graham crackers, apple slices, carrot sticks, pudding, plain and chocolate milks.

2.2.5. Results: Study two

A similar pattern of response was found for both the color and Food Brand Stroop tasks, suggesting that the latter was at the very least successful at demonstrating a Stroop like effect. On the color Stroop, incongruent tasks took longer to respond to than congruent tasks ($t = -6.93$; $p < 0.001$). Children averaged 5.48 ± 1.03 s. on congruent tasks and 7.57 ± 1.33 s. on incongruent tasks for the color Stroop. On the Food Brand Stroop, children averaged 7.91 ± 2.09 s. on congruent tasks and 9.97 ± 4.33 s. on incongruent tasks ($t = -2.39$; $p < 0.05$).

Children with higher BMI z-scores tended to show greater cognitive interference on the Food Brand Stroop Task, but not on the color Stroop. After adjusting for age and reading performance, the difference between OW and non-OW children on the color Stroop was not significant ($p = 0.10$). In contrast, OW children had greater response times on the incongruent versus the congruent trials of the Food Brand Stroop Task than non-OW children ($p < 0.05$). On average, OW children took approximately 2 s longer than non-OW children to respond to the incongruent trials. We interpreted this result to suggest that OW children may have a cognitive processing bias toward some food brand images, however, the sample size was small and results need to be confirmed in larger cohorts. A limitation in any Stroop procedure is that one cannot deduce the exact reason for the delayed reaction time on incongruent trials. For example, children's prior experience with a product or their degree of liking or wanting for a food might

have also influenced reaction times, and assessing these parameters in future studies is warranted.

For the test-meal portion of the study, there was a trend for all children, regardless of weight status, to eat more at the branded compared to the unbranded meal, with mean ± standard deviation intakes of 793.0 ± 302.9 kcals and 730.0 ± 326.4 kcals, respectively ($p = 0.07$). When test-meal foods were analyzed individually, there were no significant differences in intake between conditions depending on whether the food was healthy (e.g. carrots, apples) or unhealthy (e.g. ham and cheese sandwich, and chocolate milk). Rather, children tended to increase intake by a small amount across all test foods at the branded compared to the unbranded meal. There was a trend for OW children to eat more than non-OW children regardless of brand condition, with mean (SD) intakes of 843.7 ± 314.1 kcals and 691.7 ± 265.3 kcals, respectively ($p = 0.10$). However, child weight status did not interact with brand condition ($p = 0.80$). On the other hand, children did show different responses to the branding condition as a function of sex. Regardless of whether the meals were branded or unbranded, boys ate a similar amount of food ($p = 0.66$). In contrast, girls ate about 100 cal more when the meals were branded 732 ± 199.6 (kcals) than when they were unbranded 632 ± 197.3 kcals, [$F(1,21) = 5.8$; $p < 0.05$] (Fig. 2).

The results of this study revealed two novel findings. First, the Food Brand Stroop Task demonstrated that OW children may have a cognitive bias toward some food brand images, although these findings should be interpreted with caution because of the small number of children tested and the fact that the instrument has not yet been validated. Moreover, although the Stroop task revealed a possible cognitive bias towards food brand images in OW children, we did not find that OW children consumed more when the test-meal was served in meals branded with fast food logos compared to when it was served in plain packaging. Because this finding disputes our original hypothesis, that OW children are more responsive to food cues that non-OW children, additional studies are needed to address these inconsistencies. These studies should be done in larger cohorts, after adjusting for important confounders, such as child age, sex, neophobia, and previous experience with a particular food brand or advertisement. Including the Stroop test prior to the test-meal was also a confounder in the present study because exposing children to food brands before the meal could have influenced their subsequent intake. The second finding from this research was that branding of test-meals with fast food logos was not associated with increased intake in all children. This is in contrast to reports from Robinson et al. who found that the presence of fast food branding increased preschool children's liking for foods [12]. Unexpectedly, we did find that girls appeared to be more susceptible to the hyperphagic effects of fast food branding than were boys at this age. It is possible boys were less susceptible to the influence of fast food brands because they in fact knew the foods served in the laboratory were not actually from a fast food restaurant. The notion that girls appeared to be more susceptible to branding than boys at this age should be investigated in future studies.

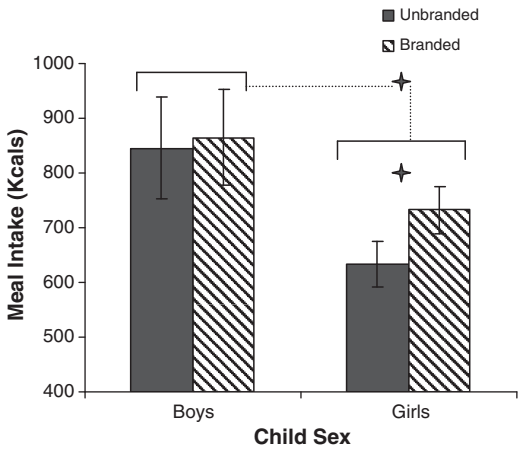

Fig. 2. Intake (kcal) at the ad libitum test-meal as a function of child sex (boys vs. girls) and brand condition (unbranded vs. branded). Overall, boys ($n = 21$) ate more than girls ($n = 20$), regardless of brand condition ($p = 0.04$). There interaction between brand condition and sex was not significant ($p = 0.20$). However, analyses run separately showed that girls ate ~100 kcals more during the branded condition than they did during the unbranded condition ($p < 0.05$), while boys ate similar amounts regardless of condition ($p = 0.86$).

2.3. Study three: Can food marketing techniques be used to increase intake of healthful foods?

Undoubtedly, food marketing elicits a powerful effect on consumer food choice. However, given that most foods that are marketed are rich in sugar and fat, the argument can be made that it is the high palatability of these foods that is responsible for their popularity, and not the influence of marketing. If this were true, food marketing techniques would not be as effective at promoting intake of healthful foods, like fruits and vegetables. In the "real-world," advertisements for fresh fruits, vegetables, and dairy products are rare [37,38]. Part of the challenge in marketing these foods is that they are commodity products that are perishable; the ability of industry to profit from the sales of these goods is limited. However, understanding the impact of utilizing marketing techniques to promote fruit and vegetable intake in children is a worthwhile research endeavor because parents and schools could use this information to improve the ways foods are presented and served to children. Recent work from Nicklas et al. demonstrated moderate effectiveness of creating commercials based on two characters, "Judy Fruity" and "Reggie Veggie" at increasing children's preferences for some vegetables [39]. Whether or not a similar strategy could be used to increase children's intake of these foods was the focus of this third study.

The ultimate goal of this study was to use a behavioral marketing approach to increase the incentives for eating F&V among young children. Through this approach, we employed a multitude of mechanisms commonly used by the food industry to market food to children, including licensed characters, fun and colorful packaging, and the use of "premiums" or prizes placed within packaging. The strength of this method is that it uses a multi-faceted approach that is more naturalistic than manipulating only one aspect of the food brand or package. Currently, highly sweetened, energy dense foods offer large incentives for consumption because they are palatable, satiating, and often marketed in colorful, fun, and age-appropriate packaging [40]. Vegetables, on the other hand, are often short-changed because they are naturally less palatable, have lower satiating potential, and are typically served without the appeal of marketing. Although changing the palatability of vegetables is a challenge, it may be possible to package and present them in a way that would offer greater incentives to children for eating them. To demonstrate the efficacy of this approach, we conducted a seven week randomized control trial with four to five year-old children from diverse ethnic backgrounds. All the children were "at risk for obesity," based on having at least one parent with a BMI ≥ 25 kg/m^2, and they had to consume fewer than two servings of F&V per day, based on parental report during a screening phone call. A total of 19 children were recruited, but due to scheduling conflicts, only 16 families finished all seven visits and the findings from these families will be described herein.

Prior to the first visit, children were randomly assigned to the intervention ($n = 7$) or control groups ($n = 9$). Baseline measures (sex, ethnic breakdown, BMI z-score, and age) were similar across the two groups. Families in both groups attended weekly, small-group sessions with the researchers where baseline measures were taken and family-based nutrition education was delivered. Although the researchers were not blinded to who was receiving the treatment, the

nutrition education lessons were run in small groups of two to three children in each, made up of children who were from both experimental groups. Thus, both groups received the same nutrition counseling. The counseling sessions were interactive and focused primarily on children, although parents were actively involved in helping children with activities. In addition to nutrition education, all families received 24, eight-ounce plastic containers filled with the following F&V: beets, broccoli, carrots, red peppers, pineapple, and blueberries. All F&V were cut into bite sized pieces on the day of the study and were packaged and served raw. In addition, a packet of light ranch dressing was included with the packages of vegetables. Parents were instructed to offer a fruit and/or vegetable of the child's choosing three times per day at meals and once additional at snack time. Parents were instructed not to cook the foods, and not to coerce or pressure children into eating anything. In addition, parents were responsible for bringing leftover F&V back to the lab the following week so they could be post-weighed.

Children who were in the control group received F&V in plain plastic containers throughout the study. Children who were in the intervention group received plain plastic containers during the two baseline weeks and the follow-up week, but during weeks three through six, they were given F&V in containers decorated with their favorite cartoon characters. In addition, a sticker was included inside each decorated container to simulate the practice of premiums used by the food industry [41,42]; children were allowed to collect these stickers on a game board to cash in for a prize the following week. An example package is shown in Fig. 3.

2.3.1. Results: Study three

Children in the intervention group consumed more servings of both fruits and vegetables across the three study time points: baseline, treatment, and control ($p<0.05$ for all). It is unclear why children in the intervention group demonstrated such high F&V consumption at baseline, as they reportedly consumed fewer than two servings per day before starting the study. However, we observed a trend for an increase in daily vegetable intake of approximately 20 g per day, approximately one serving, from baseline in the intervention group, while the control group showed no change in intake ($p<0.05$). In addition, fruit intake also increased by approximately one serving per day from baseline in the intervention compared to the control group, however, due to the small cohort size, this difference was not significant ($p=0.61$). Because children in the intervention group showed such high baseline consumption, it is likely we hit a ceiling effect with respect to fruit intake. In all, children in the intervention group increased total F&V consumption by approximately 125 g over four days (~ two servings per day), while children in the control group showed no change ($p=0.07$). At follow-up, children in the intervention group showed a 200 g increase over four days (~three servings per day) compared to baseline, and this was significantly greater than the change in F&V intake in the control group ($p<0.05$) (Fig. 4). It is interesting to note that even when packaging cues were removed at follow-up, children in the intervention group continued to show higher F&V intake, suggesting that once these behaviors are established, the incentives are no longer needed. These findings need to be replicated in a larger cohort. Once replicated, packaging F&V in age-appropriate, colorful, cartoon packaging may be a strategy families could use to increase intake of these foods in young children.

An unexpected finding from this study was the decrease in BMI z-score observed in the intervention group, while children in the control group showed an increase across the study ($p<0.05$). Although previous studies in children have demonstrated that substituting low energy foods, like F&V, for higher fat options may result in weight loss [43], our study focused on adding F&V to the diet, as opposed to substitution. In studies with adults that have looked at the impact of adding F&V to the diet, there has generally been no effect on body weight [44,45]. In addition, because the study lasted only seven weeks, we did not expect changes in weight status across this time period. It is possible that children may be more responsive to the effects of adding low energy dense foods to the diet because they are smaller and have lower calorie requirements overall. In addition, it is not known if these effects would persist over a longer time period, once children have an opportunity to adjust to changes in their diets. Regardless, these findings are intriguing and warrant follow-up.

The take-home message from this study was that it might be possible to manipulate food branding cues to promote intake of healthful foods among children. These results should be interpreted with caution because the cohort was small and the study period was short. In addition, there are several limitations to the study. Foremost, we used multiple incentives and packaging cues in the treatment group: deducing these effects to one single mechanism is not possible, but should be investigated in future studies. Finally, this was a short-term study. Food marketers establish relationships with children over long periods of time, with each exposure intended to reinforce the products' appeal [11]. It is possible that with additional exposure to the packaging created in the present study, the improvements in F&V intake might have been greater; future studies are needed to test this.

Fig. 3. Packages created for 4–5 year-old children in the intervention group of Study three. Package designs were tailored to the children's interests and contained their favorite cartoon characters. In addition, stickers were provided inside the packages to serve as an additional incentive for consumption.

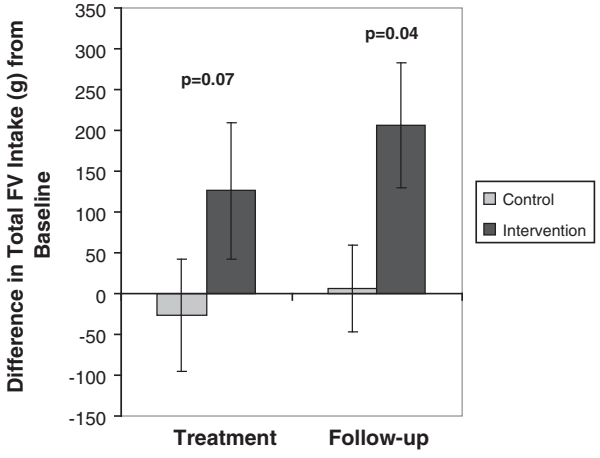

Fig. 4. Difference in fruit and vegetable intake between the treatment weeks (weeks 3–6) and baseline and the follow-up week (week 7) and baseline. During the treatment weeks, there was a trend for children in the intervention group to increase intake to a greater extent than control children ($p=0.07$). Children in the intervention group increased intake during the follow-up week a greater amount than did control children ($p<0.05$).

3. Conclusions and recommendations for future studies

The studies in this paper illustrate the power of branding to influence children's eating behaviors. The presence of branding alone was associated with increased intake of laboratory test-meals in some children, particularly overweight four to six year-old children and seven to nine year-old girls. In addition, among four to five year-old children, we demonstrated a possible role for use of licensed cartoon characters in increasing intake of healthful, traditionally unmarketed, fruits and vegetables. Although tentative, these studies demonstrate that branding cannot only change a child's affective reaction to a food [13,14], but can also impact how much of that food a child eats, at least in a short-term controlled laboratory setting. The implications that branding may have on longer term eating patterns and obesity require additional study.

Regulating the amount of exposure children get to food marketing has been a challenge, particularly in the United States (US). Although regulations on both quality and quantity of advertising directed at children were debated actively in the 1970s, no statutory limits were passed to prevent the food industry from continuing to target young children [5]. One could argue, however, that regulations directed at the food marketing industry are antithetical to the very notion of a free market economy. Even if regulations are passed, they are unlikely to happen anytime soon. Meanwhile, childhood obesity rates are continuing to increase around the globe [46], despite the fact that many other countries have longstanding (e.g. Sweden) or more recent restrictions (e.g. United Kingdom) [47] on both the amount and content of foods marketed at children. A further complicating factor is where these regulations should be directed given the multiple avenues used by the food and beverage industry to reach consumers, including the internet (e.g. advergames), product placement at schools, television, viral marketing, and numerous other strategies.

Given the challenges inherent in regulating the food industry, there is a clear need to develop alternative solutions. This is underscored by the fact that marketers are currently developing more powerful and efficient methods of reaching consumers through the use of brain imaging techniques like functional magnetic resonance imaging fMRI [48]. The studies presented within this paper reveal some possible strategies for applying marketing techniques to healthier food options. The appeal of these methods is that they can be instituted on a smaller scale basis, within individual families or at schools, and they can be enacted immediately. However, before these strategies can be promoted at the public health level, additional studies are needed. First, the impact of child age on response to food branding and advertising is unclear. It is believed that before age of seven, children are unable to understand the intention of advertising, and thus may be more vulnerable to its influence [49]. If advertising strategies are used to promote healthful foods, it is possible that a window of opportunity exists where these methods are more likely to work than others. Second, additional studies are needed to determine the characteristics that might make a child susceptible to advertising cues. For example, child weight status may be one factor that is associated with increased susceptibility to these cues [17,24]. Investigating additional characteristics, such as food cue responsiveness [20,23] and eating related disinhibition [31] might also shed light on why some children are more susceptible to food advertising than others. Third, the mechanisms by which food advertising works are still unknown. Brain imaging techniques, like fMRI, may serve as a novel approach to understanding how the brain perceives brands. The food industry has embraced these techniques, but researchers have yet to widely apply these methods to studying the effects of advertising in the laboratory.

In conclusion, these studies demonstrate that branding is an important visual cue that impacts how much children eat, although some children appear to be more susceptible to these cues than others. Future studies that can pinpoint the exact mechanisms by which branding works are necessary. Parents should be advised to continue to work toward limiting children's exposure to advertising, while at the same time developing strategies to present healthier foods to children that are attractive, appealing, and age-appropriate.

Disclosure

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