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Impact of schoolchildren's involvement in the design process on the effectiveness of healthy food promotion materials[☆]

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ABSTRACT

Marketing techniques may improve children's vegetable consumption. However, student participation in the design of marketing materials may increase the material's salience, while also improving children's commitment and attitudes towards healthy eating.

The impact of student-led design of vegetable promotional materials on choice and consumption was investigated using 1614 observations of students' vegetable choice and plate waste in four public elementary schools in Kearney, Nebraska. Data were collected on children's vegetable choice and consumption in four comparison groups: 1) control; 2) students designed materials only; 3) students were exposed to promotional materials only; and 4) students designed materials that were then posted in the lunchroom. Vegetable choice and consumption data were collected through a validated digital photography-based plate-waste method.

Multivariate linear regression was used to estimate average treatment effects of the conditions at various time periods. Dependent variables were vegetable choice and consumption, and independent variables included the condition, time period, and interaction terms, as well as controls for gender and grade.

Relative to baseline, students in group 4 doubled their vegetable consumption ($p < 0.001$) when materials were posted. Vegetable consumption remained elevated at a follow-up 2–3 months later ($p < 0.05$). Students in group 3 initially increased the quantity of vegetables selected ($p < 0.05$), but did not increase consumption. In the follow-up period, however, students in group 3 increased their vegetable consumption ($p < 0.01$). Involving elementary-aged students in the design of vegetable promotional materials that were posted in the lunchroom increased the amount of vegetables students consumed.

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1. Introduction

Over one-third of American 6–19 year-olds are overweight or obese (Ogden et al., 2014). Sustained improvement of dietary quality is a priority for reducing overweight and obesity, conditions that are known to contribute to long-term health problems (Reilly and Kelly, 2011). In particular, fruit and vegetable consumption among youth is well below recommended levels (Banfield et al., 2016). Marketing techniques, which have been used by food manufacturers to promote processed foods, are thought to have contributed to the obesity epidemic (Nestle, 2006); consequently, some oppose their use in any context (Gosliner and Madsen, 2007). Recently conducted research suggests that marketing techniques adapted to promote healthy foods can effect positive change in food choice (Wansink et al., 2012; Hanks et al., 2016), and there have been calls among health-focused groups to employ

healthy food promotional materials to increase healthy food intake. In the past few years, groups including the Institute of Medicine and the Partnership for a Healthier America—founded in conjunction with Michelle Obama's Let's Move initiative—have promoted or initiated marketing campaigns (IOM, 2013). The Partnership for a Healthier America has worked with the Produce Marketing Association and Sesame Workshop to use Sesame Street characters to promote fruits and vegetables, and has created “FNV”, an effort to “brand” fruits and vegetables, a phrase the abbreviation “FNV” is meant to evoke, complete with celebrity promotions (Partnership for a Healthy America, 2017).

While the use of marketing techniques to promote healthy diets shows promise, its effectiveness may be limited in the target audience until a threshold level of exposure to the materials has been reached (Hanks et al., 2016). Standard marketing campaigns are typically rolled out through multiple media (e.g., television, radio, and Internet) and are frequently reinforced by in-store displays. Research has found the effects of marketing efforts aimed at increasing fruit and vegetable consumption to be minor for students with the lowest level of exposure to the materials, with similar limitations observed when using branded mascots to encourage more physical activity (Hanks et al., 2016; Olesen

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et al., 2016). Until healthy food marketing campaigns are rolled out systematically, healthy food marketing interventions may not meet expectations.

Self determination theory provides a basis for the hypothesis that students' participation in the creation of promotional materials may enhance the materials' effectiveness (Ryan and Deci, 2000). Self determination theory suggests that participation can increase intrinsic motivation and commitment to decisions (Ryan and Deci, 2000). The process of designing the materials with other students may also establish group norms about attitudes and preferences towards healthy food consumption (Sharps and Robinson, 2016). Empirical studies show that students' participation in decision-making makes a difference in healthy food consumption. For instance, youth offered choices among vegetables (e.g. carrots and celery)—rather than one vegetable (carrots) only—increase vegetable consumption, even when the students all choose carrots (Just and Wansink, 2009). Children's participation in gardening has also been found to improve attitudes, willingness to try, and preferences for vegetables (Carney et al., 2012; Gatto et al., 2012; Ratcliffe et al., 2011). Children's participation in meal preparation also yields positive outcomes for preferences and consumption (Chu et al., 2013; van der Horst et al., 2014).

In this article, we investigate a simple, low-cost intervention by involving students in the creation of vegetable marketing materials. We examine the effect of student participation in the design of vegetable promotional materials on food choice and consumption in three conditions at different schools: a *participation and marketing* condition, in which students designed promotional materials, which were subsequently posted in the lunchroom; a *participation only* condition, where students designed promotional materials only (the materials were not posted); and a *marketing only* condition, in which students were exposed to materials that they had no role in designing. Food choice and consumption were also monitored in a control school.

2. Methods

University of Nebraska-Lincoln IRB approved this study. Researchers obtained written consent from parents and verbal assent from students to observe students' food choices and consumption in the school lunchroom. Researchers only gathered data from those students whose parents provided written consent for their participation and who themselves assented to participation. Researchers identified participating students by placing a number, which uniquely identified students who met informed consent/assent requirements, on the students' trays.

Students in four public elementary schools (kindergarten–5th grade) in a rural Nebraska community of approximately 30,000 people participated in the study. The four schools were selected because they were closely matched on key socio-economic and demographic variables, including the proportion of the student body qualifying for free or reduced school lunches and the racial/ethnic composition of the schools. Similar socio-economic profiles were sought to minimize baseline differences in vegetable choice and consumption. The student population in these four schools is largely white (77%); 54% of students qualify for free or reduced school lunches. Schools were assigned randomly to one of four conditions: 1) *control* (enrollment of 246 students); 2) *participation only* (enrollment of 246 students); 3) *marketing only* (enrollment of 355 students); or 4) *participation and marketing* (enrollment of 211 students). Students at both schools in a *participation* condition (conditions 2 and 4) designed promotional posters for vegetables as a voluntary, take-home school activity.

All students in every grade in the *participation and marketing* school and the *participation only* school were invited to create characters representing vegetables served on the schools' salad bars. Students were provided with a list of eligible vegetables on a poster sheet, which included room for them to complete their drawing, and were free to choose which vegetable or vegetables they wanted to focus on. Students designed and drew the characters on their own time, and

had a two-week time frame within which to create their drawings. This activity was not accompanied by nutrition education. Researchers selected drawings to ensure that posters were available for each vegetable served. Posters selected from the materials submitted by students in the *participation and marketing* school were printed and mounted on the salad bar above the vegetable represented in the poster in the *marketing only* and *participation and marketing* schools. Promotional materials were rotated so that the posters matched the vegetables available on the salad bar on a given day. Ultimately, 182 students created and submitted posters, 128 of which were submitted by students in the *participation and marketing* condition (or 61% of the student body), while students in the *participation only* condition created 54 of the posters (22% of the student body). The large difference in the number of posters submitted per school may be due to the fact that students were not blinded to the condition they were in. Researchers selected 19, or approximately 15%, of the 128 posters submitted by students at the *participation and marketing* school to print.

Posters designed by students in condition 4 (*participation and marketing*) were subsequently professionally printed and displayed in schools in condition 3 and 4 to control for the content and design of the posters. Researchers collected a total of 1614 observations on students' choices and plate-waste data, which can be used jointly to calculate consumption, on two days during each study period at each school, and additionally recorded each student's gender and grade level. The periods were: a) *pre-intervention* (October 2014); b) *design*, in which students in condition 2 and 4 designed the materials (November 2014); c) *promotional*, in which consumption data were collected shortly after the posters were displayed in lunchrooms in condition 3 and 4 (February 2015); and d) a *follow-up* period two months after the implementation of the promotional materials (April 2015). Students from all grades (kindergarten–5th grade) were eligible to participate, and researchers randomly selected students from the population of eligible students on days on which they collected data. Students at all schools saw the same selection of vegetables each day, which always featured a mixed lettuce salad and one or more additional vegetables, including carrots, garbanzo beans, celery, cucumbers, cauliflower, broccoli, green peppers, and Bibb lettuce. Table 1 presents the number of students observed in each condition and time period.

Data on food choice and consumption were collected using a digital photography-based plate waste method, which has been found to produce results that closely match data produced from weighed plate waste methods (Williamson et al., 2003). Researchers took digital photographs of students' plates at two time points: 1) after they had selected their food, but before beginning to eat, and 2) after the students had finished eating and were returning their trays. Numbered stickers were placed on students' trays to identify the same tray before and after food had been consumed. Researchers created reference plates displaying a full serving of each vegetable—one cup for lettuce and one-half of a cup for all of the other vegetables (Dietz and Stern, 2011)—that was offered. This included references for combinations of vegetables with differing serving sizes (e.g. Bibb lettuce and broccoli). Two research assistants received training on assessing the food taken and remaining as the percentage of a standard serving from photographs, and independently assessed pre- and post-meal photographs to create food choice

Table 1
Number of students observed in each condition and time period.

	Condition			
	Control	Participation	Marketing	Participation and Marketing
Pre-intervention	71	107	109	148
Design	79	136	102	153
Promotion	83	117	97	121
Follow Up	64	68	75	84

Data were collected in elementary schools in Kearney, NE in 2014–15.

and consumption data (Williamson et al., 2003). Inter-rater reliability of the research assistants was high (Cronbach's alpha = 0.988).

The dependent, or outcome, variables for the analyses were coded as the number of servings of vegetables taken and consumed by each student observed on a given day. Predictor variables in the analyses were indicator variables for condition (control, participation only, marketing only, participation and marketing) and period (pre-intervention, design, promotion, follow-up), and the interaction between condition and period. Other control variables included in the analyses were gender and grade level. The control group and the pre-intervention period are omitted in the analysis to prevent perfect multicollinearity; therefore, all estimated parameters represent the treatment effects relative to these omitted indicator variables. Missing observations (60 missing observations on gender) were dropped from the analysis, but the results do not change if Gender is instead excluded as a covariate. Parameter estimates with p -values < 0.05 are considered to be statistically significant. Data were analyzed using multivariate linear regression with R Statistical Software (R Core Team, 2016) to identify the treatment effects of the three intervention conditions (participation only, marketing only, participation and marketing) relative to the control condition in each period.

The estimated choice and consumption of vegetables (in terms of servings) are reported in Table 2. Multivariate linear regression was used to estimate the average treatment effect of each condition on changes in vegetable choice and consumption in treatment groups

Table 2
Estimated change in student vegetable consumption (in servings) for experimental conditions relative to the control condition in the baseline period by study period.^a

Condition	Vegetable servings chosen	Vegetable servings consumed
Intercept	0.834 (0.633, 1.035)	0.436 (0.249, 0.624)
1 (control)		
Pre	Omitted	Omitted
Design	−0.189 (−0.440, 0.061)	−0.121 (−0.354, 0.112)
Promotion	−0.233 (−0.481, 0.015)	−0.113 (−0.344, 0.118)
Follow up	−0.238 (−0.502, 0.026)	−0.208 (−0.454, 0.038)
2 (participation only)		
Pre	− 0.308 (−0.594, −0.022)	− 0.347 (−0.614, −0.080)
Design	0.192 (−0.167, 0.552)	0.268 (−0.067, 0.603)
Promotion	0.383 (0.022, 0.744)	0.328 (−0.009, 0.664)
Follow up	−0.008 (−0.400, 0.385)	0.172 (−0.194, 0.538)
3 (marketing only)		
Pre	− 0.281 (−0.515, −0.046)	−0.131 (−0.344, 0.087)
Design	0.158 (−0.169, 0.486)	0.067 (−0.238, 0.373)
Promotion	0.385 (0.058, 0.712)	0.128 (−0.177, 0.433)
Follow up	0.702 (0.352, 1.052)	0.485 (0.159, 0.812)
4 (participation & marketing)		
Pre	−0.217 (−0.439, 0.006)	−0.088 (−0.295, 0.119)
Design	0.375 (0.068, 0.681)	0.261 (−0.024, 0.547)
Promotion	0.954 (0.643, 1.264)	0.756 (0.466, 1.045)
Follow up	0.352 (0.015, 0.689)	0.327 (0.013, 0.641)

Boldface indicates statistical significance ($p < 0.05$).

^a Values reported are changes in servings of vegetables consumed with 95% confidence intervals in parentheses. Estimates were obtained using a multivariate linear regression model. Data were collected in elementary schools in Kearney, NE in 2014–15.

(participation only, marketing only, and participation and marketing) in each period (pre-intervention, design, promotion, and follow up) of the intervention. Additional control variables include the gender and grade level of each student observed.

To prevent perfect multicollinearity, one variable in each category must be dropped. The categorical variable for the Control condition and the categorical variable for the Pre-intervention period are omitted in the analysis to prevent perfect multicollinearity. Additionally, the omitted gender category is Male, and the omitted grade level is Kindergarten. Therefore, all estimates represent changes in vegetable choice and consumption relative to a male kindergarten student in the pre-intervention period control condition. The intercept represents the average choice and consumption of the omitted categories.

3. Results

The estimated coefficients for the Pre period represent pre-intervention choice and consumption of students in the intervention conditions relative to the control condition, controlling for gender and grade level. Students in the participation only condition selected significantly fewer (-0.31 , $p = 0.03$) and consumed significantly fewer (-0.35 , $p = 0.01$) servings of vegetables than students in the control school. The vegetable choice of students in the marketing only condition was significantly less than students in the control condition (-0.281 , $p = 0.02$), but vegetable consumption was not different. Choice and consumption in the participation and marketing condition were not significantly different than the control condition.

There was no change in vegetable consumption in the design period. In the promotion period, however, students in the participation and marketing condition increased their consumption of vegetables by over three quarters of a serving ($p < 0.001$)—an increase of over 100% relative to pre-intervention consumption. Students in the participation and marketing condition increased vegetable consumption markedly more than students in the other conditions ($p < 0.05$). Consumption in the participation condition and in the marketing condition was not significantly different from the control group.

Consumption data were additionally collected at a two-month post-intervention follow-up period to examine the sustainability of the intervention. Students in the participation and marketing condition continued to have elevated levels of vegetable consumption ($p = 0.04$), eating one-third of a serving more than pre-intervention. In the follow-up period, consumption in the marketing only condition also increased significantly ($p < 0.01$), though it was not statistically different from consumption changes in participation and marketing. Aggregating across intervention periods, students in the participation and marketing condition consumed nearly half an additional serving of vegetables relative to baseline ($p < 0.001$), and a 0.2-serving larger increase than any other condition.

Observation of students' choice of vegetables and vegetables left uneaten on the tray at the end of lunch provides additional insight into the effects of participation and promotion on vegetable choice and consumption. In the design period, students in the participation and marketing condition increased vegetable choice by over a third of a serving ($p = 0.02$). The amount of vegetables chosen did not change significantly in the marketing or participation only conditions, nor did the servings of vegetables left uneaten change in any intervention condition.

In the promotion period, students in all three intervention conditions selected significantly more vegetables. However, students in the marketing only condition also left significantly more—equal to a quarter of a serving—on their trays ($p = 0.003$), resulting in no increase in consumption. Students exposed to promotional materials in the participation and marketing condition also left more vegetables on their trays ($p = 0.02$), but had increased their choice of vegetables enough—by a full serving ($p < 0.001$)—that their consumption also increased markedly. Students in the participation only condition chose

more vegetables ($p = 0.04$), but did not throw more away ($p = 0.56$). In the *follow-up* period, students in the *marketing only* condition increased their vegetable choice ($p < 0.001$), while students in the *participation and marketing* condition continued to have elevated levels of vegetable choice relative to baseline ($p = 0.04$). Students in the *marketing* condition also left a fifth of a serving more of vegetables on their tray than they had in the *pre-intervention* period ($p = 0.02$).

4. Discussion

In recent years, researchers have begun to systematically investigate ways to promote healthier eating habits by changing the food environment or through methods that explicitly encourage healthier consumption. While promotional materials have been shown to encourage healthier food choice, involving the target population in the development of promotional materials may enhance their effectiveness by increasing the salience of the materials, and strengthening participants' inherent motivation to eat healthier foods. The process of designing promotional materials may also create an improved attitude towards vegetable consumption by establishing a perception of group norms, which have been found to influence individuals' decisions in other domains (for instance, energy consumption, see, e.g. [Asensio and Delmas, 2015](#)). Students who create and who observe their peers designing materials promoting vegetables may change their attitudes towards and consumption decisions about vegetables by establishing the perception that the vegetable consumption is socially valued.

Our novel research design aimed to separately identify the effects of participation in the design of promotional materials, exposure to promotional materials, and the combination of participation in the design of promotional materials that are subsequently posted. Student participation in designing materials to promote healthy foods—a simple, inexpensive activity integrated into the school day—that were subsequently posted in the school lunchroom magnified the promotional materials' effects on vegetable choice and consumption. Students who participated in the development of materials and then saw them posted in their school lunchroom increased their consumption of vegetables significantly more than students who participated in the development of the materials or were exposed to the promotional materials separately.

The results additionally shed light on potential shortcomings of relying on promotional materials to increase the consumption of fruits and vegetables. Evidence on the effects of marketing materials on healthy food is limited, and mostly focused on choice rather than consumption ([Wansink et al., 2012](#); [Hanks et al., 2016](#)), a limitation that this study addresses. While students responded to promotional materials by increasing the number of vegetable servings they took, they also left more on their trays. An increase in vegetable waste upon exposure to vegetable promotional materials was especially pronounced and long lasting among students who did not help develop the promotional materials ($p = 0.003$ in *promotion* and $p = 0.019$ in *follow up* periods). The results of this study also suggest a delayed response to promotional materials by students in the *marketing only* condition relative to students in the *participation and marketing* condition.

Evidence on children's consumption of fruits and vegetables shows a larger gap between recommendations and actual consumption for vegetables than fruit ([Banfield et al., 2016](#); [Kim et al., 2014](#)), arguing for methods that explicitly target an increase in vegetable consumption. While a significant literature exists on encouraging healthy food choice through “smarter lunchrooms,” few of these studies focus explicitly on vegetable consumption ([Wansink et al., 2012](#); [Hanks et al., 2013](#)). The methods studied in this paper may help close the gap between recommended and actual vegetable consumption, since our findings suggest students respond more to promotional materials when they are involved in their design. The

results argue for further investigation of healthy food interventions that enhance the salience of the materials by involving the target audience in the development of intervention materials.

There are, however, a few limitations to this study. Though the full *participation and marketing* intervention, which shows the greatest promise in increasing vegetable consumption, is simple and inexpensive to implement, it does require coordination. Given pre-existing demands on the time of school employees, individuals passionate about promoting healthy food choices may need to voluntarily implement the program. Additionally, our results could have been strengthened if we had been able to collect more detailed data. Ideally, we would have collected data for every eligible student at every time point, resulting in a panel dataset that would have allowed us to control for unobservable individual characteristics, such as tastes and preferences. An ideal study would also have included a social network analysis to differentiate the effects of materials on students whose work was displayed and their close friends versus those whose work was not displayed or who were not close to the students whose posters were selected.

Despite some limitations to the study, our results indicate that students exposed to promotional materials that they designed significantly increased their consumption of vegetables. While all three intervention groups increased vegetable consumption, the participation and marketing students had the largest gains, more than doubling consumption. Participation in the development of promotional materials also seems to reduce food waste; students who were only exposed to the marketing materials increased vegetable selection, but also threw more away than students who created the vegetable promotional materials. This finding aligns with theories suggesting that participation increases positive attitudes and commitment. Involving students in the production of healthy food promotional materials may be a way to simultaneously increase consumption of healthy foods and reduce food waste.

Conflict of interest

Gustafson, Abbey, and Heelan declare that they have no conflicts of interest.

No financial disclosures were reported by the authors of this paper.

Author contributions

Study concept and design: Gustafson, Heelan, Abbey
 Acquisition of data: Abbey, Heelan
 Analysis and interpretation of data: Gustafson
 Drafting of the manuscript: Gustafson
 Critical revision of the manuscript for important intellectual content: Gustafson, Heelan, Abbey
 Obtained funding: Gustafson, Heelan, Abbey
 Administrative, technical, and material support: Abbey
 Study supervision: Gustafson, Heelan, Abbey
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Data Access: Christopher R. Gustafson had full access to the data used in analysis and take full responsibility for the integrity and accuracy of the results.

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