The short- and long-term impact of an incentives program on healthier eating:
A quasi-experiment in school cafeterias in Brazil

Claudio Meilman Ferreira
Master of Science in Administration
EBAPE / FGV

Rio de Janeiro
2016
Claudio Meilman Ferreira
The short- and long-term impact of an incentives program on healthier eating:
A quasi-experiment in school cafeterias in Brazil

Thesis presented as a requirement for obtaining the Master’s Degree in Administration

Fundação Getulio Vargas

Supervisor: Rafael Guilherme Burstein Goldszmidt

Rio de Janeiro
2016
Ferreira, Claudio Meilman

The short-and long-term impact of an incentives program on healthier eating: a quasi-experiment in school cafeterias in Brazil / Claudio Meilman Ferreira. – 2016. 37 f.

Dissertação (mestrado) - Escola Brasileira de Administração Pública e de Empresas, Centro de Formação Acadêmica e Pesquisa.
Orientador: Rafael Guilherme Burstein Goldszmidt.
Inclui bibliografia.


CDD – 613
CLAUDIO MEILMAN FERREIRA

THE SHORT- AND LONG-TERM IMPACT OF AN INCENTIVES PROGRAM ON HEALTHIER EATING: A QUASI-EXPERIMENT IN SCHOOL CAFETERIAS IN BRAZIL.

Dissertação apresentada ao Curso de Mestrado em Administração da Escola Brasileira de Administração Pública e de Empresas para obtenção do grau de Mestre em Administração.

Data da defesa: 06/12/2016

ASSINATURA DOS MEMBROS DA BANCA EXAMINADORA

Rafael Guilherme Burstein Goldszmidt
Orientador (a)

Filipe João Bera de Azevedo Sobral

Daniel Mochon
Abstract

The impact of economic incentives on healthier eating is unclear, particularly in the long-term (i.e., after the intervention period). This research assessed the short- and long-term effectiveness of a private nutrition company’s promotion initiative in school cafeterias in Belo Horizonte, Brazil. Two hundred and eight children and adolescents from 3 schools participated in a short-lived, lottery-based incentives program contingent on the purchase of locally promoted healthy products. One hundred and forty-four children and adolescents from a fourth comparable school served as controls. A multilevel model compared the average number of promoted healthy products purchased daily per participant before (26 weekdays), during (9 weekdays), and after (28 weekdays) the intervention period. The results indicate a clear short-term effect. The incentives program significantly increased the purchase of promoted healthy products during (vs. before) the intervention period in the treated schools, specially among girls and younger children. On average, no long-term effect was observed. The purchase of the promoted healthy products returned to pre-intervention levels immediately after the removal of the incentives program. Interestingly, a detailed analysis revealed a rather heterogeneous long-term effect based on past consumption behavior. The incentive promoted a positive long-term effect on the children who had never consumed the incentivized healthier products prior to the intervention, whereas a negative long-term effect was noted for the already habitual consumers of the targeted healthier products. Past consumption behavior must be taken into consideration for a complete understanding of the long-term effects of incentives on healthier eating.

Keywords: healthy eating; long-term effect; crowd-out; habit formation; behavior change; food intake.
1. Introduction

Child obesity represents a serious public health concern worldwide. On average, children are failing to meet recommended daily servings of fruits and vegetables (Klerman, Bartlett, Wilde, & Olsho, 2014). Children are also becoming overweight and obese over the years (Malik, Willett, & Hu, 2013; Roberto et al., 2015). Although various developed countries have observed an apparent reduction in the increase in obesity prevalence since 2006, no country has reported significant decreases over the past three decades (Kleinert & Horton, 2015). In many developing countries, the situation is grim. Take Brazil as an example. Obesity among Brazilians has significantly increased in the past 40 years. Between 1974 and 1997, the prevalence of overweight children and adolescents (i.e., 6 – 18 years) more than tripled from 4.1% to 13.9% (Wang & Lobstein, 2006). The latest most comprehensive assessment of health indicators in Brazil revealed a 23.7% prevalence of overweight and 7.8% of obesity among adolescents aged 13 to 17 years. Furthermore, the prevalence of overweight and obese teenagers is significantly higher in private compared with public schools (Instituto Brasileiro de Geografia e Estatística, 2015). Not surprisingly, the short-term health problems related to childhood and adolescence obesity are increasing in Brazil (Niehues, Gonzales, Lemos, Bezerra, & Haas, 2014).

Attempts to change this reality abound, and children represent an intuitive target for health promotion efforts. Eating patterns established in childhood tend to persist throughout life (Lien, Lytle, & Klepp, 2001; Lowe, Horne, Tapper, Bowdery, & Egerton, 2004). In addition, obesity in children is a slow-paced condition and is attributed to small changes in energy balance. Thus, efforts needed to prevent obesity in children should be comparatively small (Gortmaker et al., 2015). Importantly, the school is the location where (a) children and teens spend most of their time when they are away from home (Story, Nanney, & Schwartz, 2009), (b) an educational environment and powerful social network of teachers and peers is
in place (Khambalia, Dickinson, Hardy, Gill, & Baur, 2012; Wang et al., 2013), and (c) stable and recurring contexts arise (Wood & Rünger, 2016). These characteristics position schools as rather promising environments for the implementation of interventions designed to promote healthier habits.

Indeed, a number of programs have been established to push schoolchildren towards healthier eating. Many of the programs have focused mainly on translating knowledge into behavior through intensive communication and education-based activities (Wang et al., 2013). However, many school-based programs failed to deliver the expected results (Lowe et al., 2004; Wang et al., 2013), in part due to the fact that eating behavior is dependent on more factors than knowledge dissemination about the long-term benefits of health and the costs of unhealthy eating (Dallas, Liu, & Ubel, 2015). People’s food choices are also contingent on intrinsic preferences and multiple economic, social, and contextual forces (Bere, te Velde, Småstuen, Twisk, & Klepp, 2015; Birch, 1999; Casey & Rozin, 1989; Smith & Epstein, 1991).

1.1. Short- and long-term impacts of incentives

Among the host of possible health-related interventions, economic incentives have stood out as a plausible candidate (Charness & Gneezy, 2009; Lowe et al., 2004; Volpp et al., 2008, 2009) based on their ability to align short- and long-term benefits (Haisley, 2008). Although intuitively appealing, the impact of economic incentives on healthy food intake remains unclear, particularly in the long run. Jensen et al. (2011) reviewed 28 studies that used economic incentives to promote healthier eating in schools. In the short term (i.e., during the intervention period), the interventions proved successful in general. However, the overall effect was less convincing in the long term (i.e., after the intervention period) for
essentially two reasons. First, only approximately one-third of the studies that assessed the direct effects of economic incentives on participants’ choice had follow-up analyses. Second, the few studies that did measure residual effects observed mixed outcomes, which also resonate with more recent findings.

Some studies have observed a lasting post-intervention effect. In a pre-post treatment design, Loewenstein, Price, & Volpp (2016) offered students a financial incentive of 25 cents for eating a serving of fruits or vegetables during lunch for up to a 5-week period. Compared with an average baseline rate of 39%, the incentive nearly doubled the proportion of children eating at least one serving of fruits or vegetables. The effect was still present two months after the end of the intervention, and the consumption rate at schools remained 21% to 44% above baseline (see also Horne et al., 2009, and Mochon, Schwartz, Maroba, Patel, & Ariely, 2016). Other researchers observed a clear diminishing effect over time. Bere and colleagues (Bere, Veierød, Bjelland, & Klepp, 2006; Bere, Veierød, & Klepp, 2005; Bere, Veierød, Skare, & Klepp, 2007) observed a significantly positive though progressively diminishing effect at one-, two- and three-year follow-ups of a one-year intervention that offered free fruits at Norwegian schools (see also Bere et al., 2015). Finally, a group of researchers found no evidence of any long-term effect. French et al. (1997) observed a four-fold increase in the consumption of fruits and a two-fold increase in the consumption of carrots when a 50% discount for these products was offered. However, sales returned to baseline three weeks after the price discount was removed. This was similar to what Just and Price (2013b) observed. In a randomized controlled field experiment, these authors offered material (lottery tickets for the following prizes: rip-sticks, tennis rackets, soccer balls, and swim goggles) or pecuniary (5 or 25 cents) incentives contingent on fruit and vegetable consumption during school lunch for 5 days over a 2- to 3-week period and observed persistent effects during the first 2 weeks.
after the intervention. Nonetheless, the consumption of fruits and vegetables regressed to baseline merely 4 weeks after the intervention was suspended.

To make the phenomenon even more challenging and interesting, theoretical reasons and some empirical evidence suggest that the removal of a short-term incentive may produce a negative long-term impact (i.e., to regress to a level below the baseline). According to self-determination theory (Ryan & Deci, 2000), external rewards undermine feelings of autonomy and competence. According to over-justification theory (Lepper, Greene, & Nisbett, 1973), the presence of a reward leads one to believe that a certain behavior is being performed solely for the compensation. In both cases, these psychological inferences could weaken intrinsic motivation and negatively influence the persistence of the desired behavior after the removal of the incentive. This so-called “crowd-out effect” was repeatedly demonstrated in a number of studies involving children in different settings (for a review, see Deci, Ryan, & Koestner, 1999). More recent evidence suggests that the previous attitude toward the action/product that is being incentivized is likely to moderate the effect (Charness & Gneezy, 2009; Lacetera, Macis, & Slonim, 2014). For instance, if people already consume a healthy product prior to any intervention, an incentive may replace an intrinsic motive with an extrinsic one. From this point forward, product preference becomes a function of an exogenous incentive. Once the extrinsic motive is removed, the product’s appeal is also removed (Cooke, Chambers, Añez, Croker, et al., 2011). In these cases, post-intervention consumption may actually reach lower levels than pre-intervention consumption. Another potential explanation for a crowd-out effect is satiation. For instance, if an individual who already consumes a particular healthier item is exogenously incentivized to further consume the product, s/he may “overdo” it during the intervention period. As a result, once the incentive is over, satiation may lead the individual to reduce dramatically, or stop completely, the consumption of the incentivized products.
In summary, although there seems to be a general agreement on the positive short-term impact of incentives on healthy food intake, its long-term consequences are still a matter of much debate: some find a long-lasting positive effect (e.g., Mochon et al. 2016), some find a slow diminishing effect (e.g., Bere et al., 2015), some find a quick return to baseline (e.g., Just & Price, 2013b), and some even find a negative effect (e.g., Birch, Birch, Marlin, & Kramer, 1982). Furthermore, most research in the literature (a) has focused exclusively on fruits and vegetables as the target promoted products (Belot, James, & Nolen, 2016; Bere et al., 2015; Cooke, Chambers, Añez, Croker, et al., 2011; French et al., 1997; Hendy et al., 2005; Just & Price, 2013a; Just & Price, 2013b; Loewenstein et al., 2016), (b) has been conducted in the United States or in Europe (Belot, James, & Nolen, 2016; Cooke et al., 2011; Hendy et al., 2005; Jensen et al., 2011; Just & Price, 2013a; Just & Price, 2013b; Loewenstein et al., 2016), and (c) has rarely paid attention to the moderating role of past consumption behavior (for an exception, see Cooke, Chambers, Añez, Croker, et al., 2011).

This paper addresses these gaps. Precisely, this study assesses the effectiveness of a private nutrition company’s promotion initiative targeted at multiple healthier products available in school cafeterias in Belo Horizonte, Brazil. The nature of the data collection (school cafeteria “debit cards”) allows for an unobtrusive observation of each individual purchase behavior prior, during and after the intervention. In doing so, the process directly and precisely measures the short- and long-term impact of the incentive and the moderating roles of the demographics and past eating habits. In addition, the unique nature of (a) the target healthy products (i.e., healthier snacks allocated from a pool of naturally occurring products at the school cafeteria), and (b) the population under investigation itself (i.e., upper-middle-class Brazilian children and adolescents in private school cafeterias) tests the robustness and nuances of the phenomenon.
2. Material and methods

2.1. Context and dataset

School cafeterias are virtually omnipresent in Brazilian private schools. A third party most commonly operates the cafeteria, and menus are created under the supervision of a dietitian-nutritionist with the compliance of the school directory board and the parents’ council. The cafeteria owner signs a contract with the school administrator by which the establishment agrees to operate under strict rules, otherwise bearing the risk of being dismissed. The cafeteria may have opening hours similar to those of the school, and purchases can be made at any time. However, purchases are much more frequent during the morning and afternoon recess breaks.

The payment method varies across school cafeterias. In 2014, a startup nutrition company based in Rio de Janeiro developed a system to offer a payment solution and nutritional database for private schools in Brazil. Once an agreement is made between the school and the company, all students become eligible users. Participants of the program use a pre-paid card to buy snacks selected from a touch-screen menu installed in customized totems in the school. The device prints a ticket that is exchanged for the chosen products at the cafeteria counter. Purchase data are stored at the individual level. The advantages of this system include (a) the reduction of cash transactions in the school environment and (b) the ability for the school, the company, and the parents to monitor the eating patterns of children (e.g., a parent can monitor what is being offered in the cafeteria and what is consumed by his/her child at school). The company also assesses the nutritional value of food and drinks offered at schools by following the NRF9.3 nutritional scale’s scores (Drewnowski, 2010), and the offerings are classified into three main categories: low (e.g., soft drinks, fried pies, chocolate bars and candies, and other ultra-processed items), moderate (e.g., locally prepared sandwiches, baked pies, pizza, chocolate milk), and high (e.g., fruits, natural fruit juices, low-
fat snacks made with whole-grain flour) nutritional value. By the end of 2015, the platform was operating in 11 cities in 7 Brazilian states. In total, there were 37 schools, with 6,130 frequent pre-paid card users aged 6 to 19 years old.

2.2. Participants and intervention

In an attempt to improve healthier food habits among its customers, the company designed and executed an intervention targeted at students from three schools (hereafter, treated schools) in the city of Belo Horizonte, Brazil.

The intervention lasted 9 weekdays from September 8th to 18th, 2015. Treated schools were selected from the company’s pool using subjective criteria, mainly the quality and frequency of exchange of information with the dietitian-nutritionist. The intervention consisted of the promotion of 5 target products in each school through raffle giveaways. The 5 products were a combination of food and drink items of moderate (e.g., locally made cheese and tomato pastry, chicken pastry, whole-grain cookies) and high nutritional value (e.g., fruit salad, fresh orange juice, apple). The company’s alleged goals for the design and implementation of this intervention were to increase the user base and the average value of a purchased ticket and to promote the consumption of healthy products. However, our research interest focuses exclusively on the latter, namely the extent to which the intervention increased healthier food purchase in the short term (during the intervention period) and long term (after the intervention period). We learned about the intervention only after its execution. Although we did not have any say about the intervention itself (e.g., type and duration), we decided on the design (i.e., the inclusion of a pre-post period and a control condition), the measures (i.e., how to compute the main dependent variable), and statistical analyses.
We obtained ethical approval from FGV-EBAPE research committee (#06102015-1701) as well as from the company (Technical Cooperation Term #09062015) to independently analyze the data. Students’ anonymity was preserved. To avoid any potential conflict of interest, no member of the company participated in the analyses or reporting of this, now called, quasi-experiment.

Each of the participant school cafeterias selected five products of moderate or high nutritional value regularly offered on the menu. Each time students bought any of those promoted items using the startup card system, they received a raffle ticket that could be drawn to win a board game and a credit of R$15 (approximately US$ 5) in their pre-paid card account. The raffle was advertised in the participating schools through posters that were affixed before the start of the promotion (September 2nd) such that students who were not using the system could join and participate (from September 8th onwards). Each school cafeteria exhibited a case where the raffle tickets should be filed. The winners were drawn from a ballot box on September 14th and again on September 21st, when the prizes (board games) were delivered. The R$15 in credit was later loaded into the winners’ accounts.

2.3. Measures and design

The outcome variable was the average number of promoted products purchased daily per participant. We chose to use this measure to better capture individual small changes in purchasing behavior given that we were dealing with varied menus and a rather small sample of students. However, other outcome variables, such as the proportion of promoted products chosen, the daily average of promoted items purchased, and the daily average of Brazilian Reais spent on promoted products, which were all calculated at the children level, yielded similar results and conferred robustness to our findings. When a participant did not appear in
the database on a given day (not every kid used the debit card on every observed day), the consumption on that day was considered as zero. Although we measured purchase rather than actual consumption, the former serves as a rather reliable proxy (French et al., 1997; Hannan, French, Story, & Fulkerson, 2002; Jeffery, French, Raether, & Baxter, 1994).

A pre-post design was implemented. To avoid interferences due to winter vacations (which occurred from July 11th until July 31st), the timeframe of interest was restricted to the period between August and October 2015. National holidays and weekends were not considered. The final sample included a pre-intervention period of 26 weekdays, an intervention period of 9 weekdays, and post-intervention period of 28 weekdays.

2.4. Moderators

Sex and age represented the main demographic variables of interest. Girls feel more social pressure to stay thin, are more dissatisfied with their bodies because they feel overweight (Stice, Shaw, & Marti, 2006), and may start dieting at a very early age (Abramovitz & Birch, 2000). Thus, one could expect girls to be more motivated than boys to adhere to an intervention that rewarded choosing a healthier, less energy-dense snack. Conversely, boys are more likely to take financial risks (Hillier & Morrongiello, 1998), overestimate the chances of winning (Liben & Bigler, 2014), and enjoy gambling (Hardoon & Derevensky, 2002). Thus, one could expect boys to be more attracted to a lottery-based reward than girls.

The impact of age is also possible, but the direction is likewise unclear. Although younger children might find it difficult to understand and respond to complex behavioral interventions (Baranowski, Cullen, Nicklas, Thompson, & Baranowski, 2002), older students might be less likely to change their habits since food preferences are formed early in life (Birch & Fisher, 1998; Schwartz, Scholtens, Lalanne, Weenen, & Nicklaus, 2011).
addition, longer-standing behaviors are harder to be substituted by new ones (Lustig, Konkel, & Jacoby, 2004). Moreover, adolescents might already have experienced losses in games of chance and could therefore be less optimistic about the lottery outcome than younger children (Bjorklund & Green, 1992).

Finally, most students had never consumed these products prior to the intervention, but some had done so to a lesser or greater extent. Given that incentivizing the consumption of an already liked food item can undermine one’s intrinsic motivation to purchase/consume it (Cooke, Chambers, Añez, Croker, et al., 2011) and/or potentially trigger satiation as a result of over-consumption, the available dataset allowed us to assess the extent to which prior consumption moderated the impact of the intervention on students’ purchase behavior, particularly in the long term. To capture the effect of past consumption behavior heterogeneity, we assessed the share of promoted products bought in the period before the intervention at the individual level and used it as a continuous variable. Although other assessments on the use of incentives to change children’s eating habits assessed pre-intervention attitudes and behavior towards target foods (Cooke, Chambers, Añez, Croker, et al., 2011; Hendy et al., 2005; Just & Price, 2013b; Loewenstein et al., 2016; Lowe et al., 2004; Siegel et al., 2015), to our knowledge, we are the first to stratify the treatment effect across previously revealed diverse preferences.

2.5. Statistical analysis

A hierarchical linear model (Raudenbush & Bryk, 2002) was used to examine the short- and long-term influence of the intervention on the purchasing of promoted products. Repeated observations were nested within participants and participants nested within schools in a 3-level model to account for the non-independence of observations. Ordinary Least
Squares regression models with either student fixed effects or clustered standard errors at the student level were used to assess the robustness of the results.

The outcome variable was aggregated at the individual level into three periods (before, during and after the intervention) to mitigate problems of serial autocorrelation (Bertrand, Duflo, & Mullainathan, 2002)\(^1\). The independent variables included dummy variables for during- and post-treatment period, which captured the change in consumption relative to the pre-treatment period. Interactions among these dummies and demographic and behavioral covariates were considered to test for heterogeneous treatment effects.

To further improve the analysis, we identified a school that had not been treated with the intervention. In addition to being located in the same city as the treated schools, this control school also offered a similar menu. The control school allowed us to detach the effect of the intervention from seasonal variation or other unobserved events. Overall, 208 students used the startup system to buy snacks in the cafeteria of treated schools, whereas 144 used this system at the control school during the period of interest. A differences-in-differences model was estimated including data from all three treated schools and the control (non-treated) school.

3. Results

3.1. Descriptive statistics

Table 1 presents the descriptive statistics of the students within treated and control schools. The total number of children and adolescents in each school was not available. As observed, except for the number of participants, the control school presented a demographic or purchase characteristic similar to at least one of the treated schools.

\(^1\) However, results hold when daily measures are considered as well.
Table 1. Demographic and purchasing characteristics of participants across control and treated schools

<table>
<thead>
<tr>
<th>Schools</th>
<th>Number of participants</th>
<th>Gender, percent female</th>
<th>Age (years), mean (SD)</th>
<th>Items purchased per transaction, mean (SD)*</th>
<th>Total value of the purchase in BRL, mean (SD)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>144</td>
<td>46%</td>
<td>10.52 (1.91)</td>
<td>1.60 (0.83)</td>
<td>5.19 (2.77)</td>
</tr>
<tr>
<td>Treated 1</td>
<td>68</td>
<td>55%</td>
<td>11.08 (2.63)</td>
<td>1.64 (0.80)</td>
<td>5.04 (2.63)</td>
</tr>
<tr>
<td>Treated 2</td>
<td>102</td>
<td>66%</td>
<td>10.11 (2.54)</td>
<td>2.04 (2.33)</td>
<td>4.58 (3.12)</td>
</tr>
<tr>
<td>Treated 3</td>
<td>38</td>
<td>47%</td>
<td>11.00 (2.83)</td>
<td>1.32 (0.52)</td>
<td>3.71 (1.73)</td>
</tr>
</tbody>
</table>

*Values were calculated considering participants’ behavior prior to the intervention. BRL = Brazilian currency in Reais.

3.2. Overall effect

A difference-in-differences model compared the pattern of purchase of promoted products between the treated and control schools. The results indicated that the coefficient of the interaction term between the indicator of treatment and the indicator of the period during treatment was positive and statistically significant: $\beta = 0.05$, $SE = 0.02$, $p = .002$. Figure 1 qualifies the effect by demonstrating a monotonic increase from the pre- to post-intervention period in the control school and an inverted U-shape in all three treated schools. This finding supports the conclusion that the increase in the purchasing of promoted products was an effect of the intervention rather than a mere seasonal effect. Furthermore, the observed effect could not be justified by an increase in the number of school children using the system.

Figure 1. Average number of promoted products purchased daily per participant before, during and after the intervention.

---

2 A model using daily measures indicated parallel trends between treated and control schools before the intervention.
3.3. Short-term effects

A main effect of the treatment was observed in a within-subjects assessment of the three treated schools. The average number of promoted products purchased daily per participant was significantly increased during (vs. before) the intervention: $\beta = 0.06, p < .001$; see Table 2. Students bought on average 0.54 ($= 0.06 * 9$ days) more promoted products during the intervention period compared with the baseline period. To assess possible differences across the three treated schools, a likelihood-ratio test was used comparing models with and without interactions between the time periods and dummy variables representing the schools. A significant effect was observed: $\chi^2(4) = 15.58, p < .001$. This effect resulted from a steeper increase in the consumption of the promoted products at school T3. Despite this difference, the consumption pattern of the promoted products resembled an inverted U-shaped curve in every single treated school, which attests to the robustness of the effect.
Table 2. Regression models (outcome variable: average number of promoted products purchased daily per participant)

<table>
<thead>
<tr>
<th>Model</th>
<th>HLM</th>
<th>Robust SE</th>
<th>FE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect of interest (n)</td>
<td>β</td>
<td>SE</td>
<td>β</td>
</tr>
<tr>
<td>Main Effects (n=208)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During Intervention</td>
<td>0.06**</td>
<td>0.01</td>
<td>0.06**</td>
</tr>
<tr>
<td>Post-intervention</td>
<td>0.01</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>Age (n=208)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During Intervention</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Post-intervention</td>
<td>0.01</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>Younger age</td>
<td>0.01</td>
<td>0.02</td>
<td>-0.00</td>
</tr>
<tr>
<td>Younger age x During</td>
<td>0.06*</td>
<td>0.03</td>
<td>0.06*</td>
</tr>
<tr>
<td>Younger age x Post</td>
<td>0.00</td>
<td>0.03</td>
<td>0.00</td>
</tr>
<tr>
<td>Sex (n=208)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During Intervention</td>
<td>0.03</td>
<td>0.02</td>
<td>0.03*</td>
</tr>
<tr>
<td>Post-intervention</td>
<td>0.01</td>
<td>0.02</td>
<td>0.01</td>
</tr>
<tr>
<td>Female</td>
<td>-0.01</td>
<td>0.02</td>
<td>-0.02</td>
</tr>
<tr>
<td>Female x During</td>
<td>0.05*</td>
<td>0.02</td>
<td>0.05</td>
</tr>
<tr>
<td>Female x Post</td>
<td>-0.01</td>
<td>0.02</td>
<td>-0.01</td>
</tr>
<tr>
<td>Average number of promoted products bought (n=208)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During Intervention</td>
<td>0.07**</td>
<td>0.01</td>
<td>0.07**</td>
</tr>
<tr>
<td>Post-intervention</td>
<td>0.03</td>
<td>0.01</td>
<td>0.03**</td>
</tr>
<tr>
<td>Average number of promoted products</td>
<td>0.58**</td>
<td>0.08</td>
<td>0.61**</td>
</tr>
<tr>
<td>Average number of promoted products x During</td>
<td>-0.14</td>
<td>0.10</td>
<td>-0.14</td>
</tr>
<tr>
<td>Average number of promoted products x Post</td>
<td>-0.53**</td>
<td>0.10</td>
<td>-0.53**</td>
</tr>
</tbody>
</table>

Note. *p < .05, ** p < .01; During Treatment (1 = during the intervention period; 0 = before the intervention period), Post-treatment (1 = after the intervention period; 0 = before the intervention period); Age (< 13 years old/children = 1, ≥ 13 years old/adolescents = 0); Sex (1 = female; 0 = male); Average number of promoted products (continuous variable); HLM (hierarchical linear model); Robust SE (ordinary least squares regression model with students’ clustered standard errors); FE (ordinary least squares regression model with student fixed effects). Time invariant variables (age, gender, and average number of promoted products bought) are excluded from the models with participant’s fixed effects.

### 3.3.1. Addition or substitution?

The effect of the incentive on students’ behavior could elicit one of two possibilities: children and adolescents could either buy the promoted products in addition to their other
habitual choices or they could substitute a given product for the promoted ones. Although addition would be an obviously unintended consequence given the potential increase in energy intake, substitution would only push towards a healthier track if unhealthy products were being substituted for the promoted, healthier ones. However, the results revealed no compelling evidence that the promoted products were consumed predominantly in addition to or in substitution for the other products. This result is supported by the findings of non-significant changes both on the consumption of non-promoted healthy products ($\beta = 0.02, p = .217$) and non-healthy products ($\beta = 0.02, p = .339$) from the period before to that during the intervention. Therefore, we infer that a mix of both movements co-occurred.

### 3.3.2. Age and sex in the short term

The short-term impact of the intervention on healthier eating varied by age ($\beta = 0.06$, $p = .032$) and sex ($\beta = 0.05$, $p = .043$). Children had a better response to the intervention ($M_{pre} = 0.03, SD = 0.08$ vs. $M_{during} = 0.10, SD = 0.22$, $\beta = 0.08, p < .001$) compared with teenagers ($M_{pre} = 0.03, SD = 0.08$ vs. $M_{during} = 0.05, SD = 0.13$, $\beta = 0.02, p = .455$). Similarly, girls were more sensitive to the intervention ($M_{pre} = 0.02, SD = 0.07$ vs. $M_{during} = 0.10, SD = 0.23$, $\beta = 0.08, p < .001$) compared with boys ($M_{pre} = 0.04, SD = 0.10$ vs. $M_{during} = 0.07, SD = 0.16$, $\beta = 0.03, p = .070$).

### 3.3.3. Past behavior in the short term

As displayed in Table 2, the short-term impact of the incentive did not interact with past consumption ($\beta = -0.12, p = .211$). During the intervention, the incentives program was
effective irrespective of the frequency with which a participant purchased promoted products prior to the intervention.

3.4. Long-Term effects

No significant difference between pre- and post-treatment consumption was noted ($\beta = 0.01$, $p = .463$). The impact of the intervention did not outlive the duration of the intervention itself. As indicated by the inverted U-shaped curves across treated schools, on average, students returned to their baseline consumption after the removal of the intervention.

One particularity of this intervention refers to its duration period (only 9 weekdays). This is a rather short intervention period relative not only to previous work in the field, which has lasted several weeks (French et al., 1997; Loewenstein et al., 2016; Lowe et al., 2004), months (Brown & Tammineni, 2009; Hannan et al., 2002; Kocken et al., 2012) or even an entire year (Bere et al., 2015), but also relative to the post-intervention period in the current study (28 weekdays). One might argue that the disproportional duration of the post-intervention period relative to the intervention period may explain the null long-term effect. To address this issue, we collapsed the three treated schools and partitioned the post-intervention period into three periods (September 21st to October 1st, 9 weekdays; October 2nd to 15th, 9 weekdays; October 16th to 29th, 10 weekdays) to assess whether the long-term effect of the intervention on healthier eating dissipated gradually or more abruptly.

The results show that the purchasing of the promoted healthier products in the pre-intervention period ($M_{pre} = 0.03$, $SD = 0.08$, $\beta = 0.04$, $p = .032$) was the same compared with the first ($M_{post1} = 0.05$, $SD = 0.13$, $\beta = 0.02$, $p = .106$), second ($M_{post2} = -0.03$, $SD = 0.03$, $\beta = -0.01$, $p = .712$) and third ($M_{post3} = 0.04$, $SD = 0.12$, $\beta = 0.01$, $p = .487$) post-intervention periods. Additionally, a supplemental analysis identified a non-significant linear trend of the
daily amount of promoted products purchased in the post-intervention period ($\beta = 0.00, p = .080$). Put simply, the removal of a 9-weekday incentive program reduced the purchase of the promoted products to pre-intervention levels almost immediately (i.e., in the very first post-intervention period), and purchases remained at low levels in the following two post-intervention periods.

3.4.1. Age and sex in the long term

The long-term impact of the intervention on healthier eating did not vary by age ($\beta = 0.00, p = .957$) or sex ($\beta = -0.01, p = .710$).

3.4.2. Past behavior in the long term

Interestingly, the long-term impact of the intervention varied as a function of past behavior. As reported in Table 2, the coefficient of the interaction term between the average consumption of promoted products before the intervention and the post-treatment dummy variable was negative and significant ($\beta = -0.53, p < .001$). Thus, for each additional promoted product bought by the student before the intervention, the consumption in the post-treatment period (compared to the pre-treatment period) was reduced by .52 daily units of promoted products. Figure 2 exemplifies and explains the pattern of results. A positive long-term effect was observed among students who did not frequently purchase the incentivized products prior to the intervention (0 - 80th percentile: $M_{pre} = 0.00, SD = 0.12$ and $M_{post} = 0.03, SD = 0.07, p < .001$). However, for those children who were already habitual consumers of the promoted products before the intervention, a significant reduction in the consumption of the incentivized products was noted after (vs. before) the intervention (90th-100th percentile: $M_{pre} = 0.22, SD = 0.15$ and $M_{post} = 0.07, SD = 0.10, p < .001$). Note that within this group, the
intervention still increased consumption during the intervention. Thus, the decrease post-intervention cannot be attributed to a “ceiling effect”. The removal of the incentive may have indeed exerted a crowd-out effect among already habitual consumers of the healthier products. As a complementary analysis, we extended the follow-up period to assess purchase data during the following month (20 weekdays in November). The pattern suggestive of a crowd-out effect remained present ($\beta = -0.54, p < .001$). We were unable to determine whether purchasing patterns did eventually increase again and returned to baseline beyond November because of a decrease in overall consumption related to summer vacation.

Figure 2. Average number of promoted products purchased daily per participant before, during and after the intervention clustered by percentile intervals of buying frequency prior to the intervention.

![Graph showing average number of promoted products purchased daily per participant]

*Note.* Errors bars indicate standard errors of the mean.

### 4. Discussion
The present study assessed the effect of a lottery-based incentive on the purchase of healthy food by children and adolescents in school cafeterias. We found that students responded to the intervention as expected in the short term. However, no long-term effect was observed. Although the incentive promoted a temporary positive shift, it unfortunately did not form a habit. In fact, the positive change vanished immediately after the removal of the incentives program. Why was the incentive so ineffective in the long term? Several aspects might have affected the results. However, we believe that there are at least three elements to consider when compared with other studies in this area: duration of the intervention period, the format of the incentive, and the products being promoted.

The intervention used in this study lasted only 9 weekdays. This is a rather short period of time compared with studies that observed lingering effects (e.g., Bere et al., 2005, 2006, 2007; Loewenstein et al., 2016). Indeed, the higher efficacy of longer programs is supported by An (2013) who reviewed field experiments assessing the effect of economic incentives in changing eating behavior. Out of the seven studies that included follow-up periods, three studies observed sustained improvement after the intervention period (duration of the programs: 5 to 24 weeks, 24-week follow-up, none regarding school settings or children), whereas four of them did not identify any lasting effect (duration of the programs: 3 to 12 weeks, 3- to 24-week follow-up, one of them in a school setting), roughly suggesting that habits could be built after longer exposures. The intervention used in our study lasted only 9 weekdays, which is significantly less than any of the other studies. Hence, it is possible that a “minimum duration threshold” is required for any lasting effect to be observed.

In our study, the incentive was formatted as a lottery. Current literature suggests that for habits to form, responses must become tied to features of performance contexts and not to the rewarding outcomes (Wood & Neal, 2009). Dezfouli & Balleine (2012) propose that
habits tend to stick when rewards are not highly salient motivators of performance. Due to their intrinsic characteristics (the risk and uncertainty of the outcome, and the prospect of increasing the odds of winning a prize by increasing the frequency of the target response), lotteries and raffles allocate rewards on a ratio schedule (Ferster & Skinner, 1957, apud Haisley, 2008). According to Yin & Knowlton (2006), this reinforcement schedule tends to produce goal-directed behavior, which is typically associated with cessation of the behavior if the reward is omitted. This notion could partly be the reason why many of the described studies (ours included) were not able to demonstrate consistent and long-standing habit formation in the samples studied.

Finally, contrary to many studies in which the incentives were meant to increase the consumption of fruits and vegetables (Bere et al., 2015; French et al., 1997; Just & Price, 2013; Loewenstein et al., 2016), the promoted products in the current study varied from healthier versions of sandwiches and cookies to popular baked pastries. These products may be in general more liked by children and adolescents than fruits and vegetables. If this is the case, an extrinsic motivation (i.e., the incentive) is more likely to mitigate the impact of the intrinsic reasons for purchasing the product and subsequently trigger a crowd-out effect (Cooke, Chambers, Añez, Croker, et al., 2011). This could help explain why students who were already consumers of the promoted products seemed less likely to purchase those items in the long term than they were prior to the intervention period in this study.

4.1. Age

The literature has reported surprisingly mixed findings on the impact of age on behavior change. Kropski, Keckley, & Jensen (2008) found that programs including younger children (7 – 10 years) were generally not effective in reducing body mass index or obesity
prevalence, whereas older children (10 – 14 years) demonstrated positive outcomes. Budd & Volpe (2006) also suggested that programs targeting older kids were more successful potentially because older age might make students more amenable to behavior change. In contrast, a meta-analysis conducted by Cook-Cottone, Casey, Feeley, & Baran (2009) on obesity prevention in schools found that interventions targeted to elementary schools kids (5 – 10 years) were more effective than those targeted at middle school students (11 – 13 years), which were in comparison worse than interventions targeted at high school students (14 – 18 years), identifying, on its turn, younger kids as those developmentally amenable to behavior and attitude change. The systematic review by Doak, Visscher, Renders, & Seidell (2006) noticed that the majority of the ineffective interventions included younger children (in the 8- to 10-year-old age range), whereas Stice et al. (2006) found no difference across age groups. In the most recent field experiments on the effect of incentives on eating behavior (varied age ranges, roughly between 6 and 14 years), although some studies observed better responses for younger kids (Loewenstein et al., 2016; Lowe et al., 2004), others found the opposite results (Belot et al., 2016; Just & Price, 2013b; List & Samek, 2015).

In our study, the short-term effect of the incentives program was stronger for children compared with adolescents. Although the exact reasons for this effect are unclear, it is worth mentioning at least two possibilities. On the one hand, the fact that younger kids (< 13 years) responded better to the intervention is consistent with the notion that it is easier to change the behavior of younger (vs. older) people. However, we cannot exclude the alternative explanation that this particular group was simply more sensitive to the type of incentive being offered (e.g., board games such as Monopoly and Guess Who?).

4.2. Sex
Evidence from the current literature on sex-specific response to behavioral change programs toward healthier lifestyles is also inconclusive. A meta-analysis by Cook-Cottone et al. (2009) found that although mixed-gender interventions had an overall significantly positive effect, female-only oriented interventions had mixed outcomes. Some studies reported poorer outcomes for females, whereas others reported positive outcomes for females. Kropski et al. (2008) assessed the effect of school-based programs on obesity prevention and suggested that those that were based on educational components built over social learning would be more appropriate for girls, whereas structural and environmental interventions enabling physical activity would be more effective for boys. From the most recent field experiments on the effect of incentives, Loewenstein et al. (2016) did not notice sex differences during the intervention but found that boys had a slightly lower level of habit formation. Just & Price (2013b) noticed that girls responded better to the intervention. List & Samek (2015) and Belot et al. (2016)\(^3\) found no considerable sex differences.

We found that girls responded better to the intervention in the short term. One possible reason for this effect is that the message conveyed by the promotion of healthier eating habits alluded to weight- and body-image-related issues, a matter that girls are more sensitive to (Abramovitz & Birch, 2000; Stice et al., 2006). Another reason could be the alimentary nature of the intervention, which is a less appealing incentive for males. A systematic review by Doak et al. (2006) found, for instance, that programs that included the promotion of physical activity would foster greater responses for boys. Finally, the girls in our sample might also have become more interested in the reward offered.

4.3. Past behavior

\(^3\) Belot et al (2016) manipulated the conditions under which participants were rewarded. In the piece-rate treatment, boys displayed a fading response from the beginning to the end of the intervention, and girls did not respond at all. However, both girls and boys responded similarly to the competition treatment.
The only clear long-term effect observed was a crowd-out effect among those students who had habitually purchased the promoted items prior to the intervention period. This finding converges with the evidence that the use of incentives may undermine intrinsic motivation if the target product is already liked by the student (Cooke et al., 2011; Cooke, Chambers, Añez, & Wardle, 2011). This result is also brow-raising: while potentially useful to boost consumption of healthy items among newbies, this incentive program may also backfire by undermining the motivation of customers who have already settled on healthier diets. Nonetheless, it is useful to notice that the overall null long-term effect of the intervention (as depicted in figure 1) may have stemmed from its opposing consequences on these subgroups of students in this study. This heterogeneous response to incentives based on past behavior has not yet been reported in the context of school-based interventions to promote healthier eating. Further research is needed to address robustness and particularities of this phenomenon.

5. Limitations

Our study had a few key limitations. First, the causal inference was limited given the pre-post design and hence a lack of random assignment. We addressed this limitation by assessing the robustness of the phenomenon in three different schools and by adding a control condition (non-treated school). Second, no information on actual intake was available. Thus, we do not know whether students’ choices and purchases were actually eaten. However, the individual purchase, in this case, is likely to represent a sufficient proxy for consumption (French et al., 1997; Hannan et al., 2002; Jeffery et al., 1994). Third, we did not have access to purchases made in cash in the cafeteria. We are aware that the debit-card system is the preferred method of paying for snacks, but it is not exclusive. Finally, we could not measure
consumption of food out of school, which would allow us to assess, for instance, calorie compensation effects (Hawkes et al., 2015).

In any case, in addition to discreetly collecting secondary data, we believe that the debit-card system also allows for multiple simultaneous interventions to be tested in parallel and in series with low marginal costs. This may help elucidate the configurations of incentive programs that alone or in association with other interventions (Rogers & Frey, 2015) could lead to most-wanted, long-lasting behavioral change and explore boundary conditions for the crowd-out effect to occur.

6. Conclusions

This study reports the results of a lottery-based incentive program tested using data from a quasi-experiment. Within the program, we test the effectiveness of an incentive conditional on the purchase of healthy promoted items on the short- and long-term influence on healthy eating behavior. We also perform a subgroup analysis to detect different patterns of response to the program across sex, age, and previous purchasing behavior. We find evidence of a short-term effect of the intervention that is particularly effective among girls and younger students. Long-lasting effects of the intervention were not observed after the incentives were suspended, which begs the question of whether a “minimum duration threshold” is required for any lasting effect to be observed. We find a particularly intriguing crowd-out effect among those students who already used to buy the products that were then promoted during the intervention.

These results underscore the need for a better understanding of the role of economic incentives in building long-lasting behavioral change towards healthy eating. Consistent with other research that assesses the impact of incentives in health and education-related behavior,
we maintain that discussion should go beyond whether incentives work but rather when and why they do and do not work (Gneezy, Meier, & Rey-Biel, 2011) and, as important, for whom and for how long.

**Acknowledgments**

We would like to thank the people at Nutreben for their collaborative effort and the Center for Behavioral Research at FGV/EBAPE for their continuous support.

**References**


http://doi.org/10.1016/j.jhealeco.2016.07.003


Appetite, 12(3), 171–182.


http://doi.org/10.1177/0956797610394662


http://doi.org/10.3945/ajcn.2010.28450D.Am

Century-Crofts.


http://doi.org/10.1038/sj.ejcn.1601838


http://doi.org/10.1016/S0140-6736(14)61744-X


Development of healthy eating habits early in life. Review of recent evidence and


http://doi.org/10.1080/17477160600586747

Prevention Programs: Comparative Effectiveness Review and Meta-Analysis, (115).

