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The behavioralist as nutritionist: Leveraging behavioral economics to improve child food choice and consumption

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ABSTRACT

We leverage behavioral economics to explore new approaches to tackling child food choice and consumption. Using a field experiment with >1500 children, we report several key insights. We find that incentives have large influences: in the control, 17% of children prefer the healthy snack, whereas introduction of small incentives increases take-up of the healthy snack to ∼75%. There is some evidence that the effects continue post-treatment, consistent with a model of habit formation. We find little evidence that the framing of incentives (loss vs. gain) matters. Educational messaging alone has little effect, but we observe a combined effect of messaging and incentives: together they provide an important influence on food choice.

1. Introduction

While many interventions to improve nutrition have been geared toward adults, there is a growing need to address nutritional decision-making among children and adolescents. Lack of proper nourishment, such as not meeting the recommended daily allowance (RDA) requirements for fruits and vegetables, affects health and hampers growth among children and can contribute to lack of concentration and energy, resulting in poor performance in school (Whitaker et al., 2006; Jyoti et al., 2005; Weinreb et al., 2002).[1] Yet, American children consume less than 20% of the recommended amount of whole grains and just 10% of the recommended amount of dark green and orange vegetables and legumes (Just et al., 2007). The tendency to consume an unhealthy diet is learned at an early age and persists throughout adulthood, as individuals are more likely to eat familiar foods (Smith and Tasnadi, 2007). These habits are often learned in the home, which may create a cycle of unhealthy behaviors (De Bourdeaudhuij, 1997; Campbell et al., 2007; Dowda et al., 2001). Moreover, choosing to consume high quantities of low-nutrient, high-calorie foods and beverages habitually leads to obesity, a growing problem among adults and children.[2] Importantly, children from low-income families are at higher risk (Cole and Fox, 2008; Neumark-Sztainer et al., 1996).

Academics have recognized the food choice problem and have begun to take important steps in understanding its causes and consequences. For example, interventions for adults by the U.S. Department of Agriculture and the U.S. Department of Health and Human Services have included providing advice about healthy choices and requiring labeling of foods (Welsh et al., 1993). Likewise, interventions that include nutritional education for children have shown some progress in terms of increases in fruit and vegetable consumption (Reynolds et al., 2000; Perry et al., 1998; Nicklas et al., 1998).[3] Behavioral economics has touched nearly every field in economics, yet one important area with many

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[1] In another study, Belot and James (2011) find that healthier school meals improve educational outcomes in some subject areas.

[2] 17% of the nation's youth have body mass indices (BMIs) at or above the recommended 95th percentile (National Institutes of Health, 1998; Ogden et al., 2002, 2010).

[3] These studies included featuring nutrition education as a primary component, and employed the National Cancer Institute's (NCI) "5 a Day for Better Health" initiative. Our study, on the other hand, uses a short educational message.

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unresolved questions is that of food choice. Food choice is also an area where the insights gained from behavioral economics might produce the highest social benefits.

In this study, we conduct a large-scale field experiment to explore how behavioral economics can be leveraged to improve child food choice. Our experiment revolves around one major behavioral tenet: some people have reference-dependent preferences, wherein utility depends on changes relative to a neutral reference point rather than absolute levels. In certain cases, such people will exhibit behavior consistent with a notion of *loss aversion*, an insight gained from Kahneman and Tversky's (1979) prospect theory. The field experiment methodology is ideal in this setting because it allows us to infer the causal effects of treatment (see, for example, other field experiments in health economics; Okeke et al., 2012). Our experiment also investigates the impact of using short educational messaging, delivered at the point of decision either with or without incentives, on food choice. Finally, our experiment explores the effect of delivering the intervention for differing lengths of time, which has direct policy implications.

We conducted our field experiment in after school programs in the Chicago area, called 'Kids Cafes', which provide children from low-income families a USDA-sponsored free meal. Separately from this study, we conducted 24-h food recalls with a sub-set of children from the Kids Cafes and discovered that only 30–39% of children meet the RDA for fruit, while over 90% meet the RDA for grains.[4] Thus, in the field experiment, children were given a choice between a dried fruit cup (which we consider in this experiment as the healthier choice since it contributes to the RDA for fruit and does not contain added sugar) and a cookie (which we refer to as the less healthy choice since most children already meet RDA for grains, and cookies also contain added sugar).[5] Children were allowed to select only one item. We randomly assigned Kids Cafe sites to either receive a gain-frame incentive (in which the child received a small prize if and only if he/she selected and fully consumed a fruit cup), a loss-frame incentive (in which the child received a small prize but then it was taken away if he/she did not select and consume a fruit cup), a 3-min educational message delivered by the experimenter about the benefit of fruits vs. cookies, or a loss-frame incentive combined with the educational message.[6] In total, 1614 individual children and adolescents across 24 sites participated in the experiment, which lasted several weeks. We also observe children after the conclusion of treatment periods of varying lengths to explore whether the incentives or educational messages had an effect post-treatment.

We find several interesting insights. First, in the absence of incentives, about 17% of students choose the healthy snack. Yet, once an incentive is introduced, students are drawn to the healthy choice at a rate of nearly 80%. This more than four-fold increase is achieved with small incentives. Importantly, we find little evidence that a loss frame works better than a gain frame. Indeed, if anything we find some evidence that after treatment children in the gain treatment choose healthier options than those in the loss treatment.

Second, the educational message has little influence on food choice: even after providing information about the healthy choice, children are not persuaded to make the switch from cookie to fruit. This is surprising, since our educational message was crafted using the USDA *MyPyramid for Kids*[7] as a guide. Yet, what does work quite effectively is the combination of the educational messaging and loss-based incentives. In this case, not only do many children choose the healthy snack, but they ultimately consume the snack. Whereas in the education message treatment only 60% of the children who choose the fruit ultimately consume it, over 93% of children who received both the education message and incentive who choose the fruit consume it. Importantly, this effect spills-over to the post treatment period: upon returning a week after the experiment is completed, we find that children in the control group continue to choose the unhealthy snack at a low rate—around 12%. Yet, for those in the treatment that combines incentives and educational messaging, nearly twice as many children choose the healthy option.

These results suggest that there is an important place for educational messages, and that they have their greatest impact when combined with a small individual incentive. Finally, the findings have important implications for not only immediate choice, but suggest that longer-term impacts can be achieved with the correct mix of pecuniary and non-pecuniary incentives. Contrary to wide-spread concern that incentives may crowd out the intrinsic motivation to choose healthy foods, we do not find that incentives have a detrimental effect on food choice—rather, we find the opposite. While we focus specifically on the choice of a dessert, we propose that our findings on the positive impact of incentives could be generalized to other types of food choices that kids may face in the school lunchroom or in after school programs.

The remainder of our paper is organized as follows. Section 2 summarizes the underlying theoretical framework and related literature that motivates our design. Section 3 describes the experimental design and implementation. Section 4 summarizes the main results. Section 5 concludes.

2. Background

Our experiment involves an exploration of both non-pecuniary and pecuniary incentives. While the effect of information and standard pecuniary incentives on behaviors have been modeled for decades, the theory underlying why there might be behavioral differences between a standard (gain) incentive and "loss" incentive is less mainstream. Pioneered by Tversky and Kahneman's riskless framework (1991), the idea that losses and gains can yield different behaviors in our setting has its roots in prospect theory. Prospect theory conjectures that a value function exists that is (i) measured over deviations from a reference point assessed over some narrowly bracketed timeframe, (ii) convex for losses and concave for gains, and (iii) initially steeper for losses than for gains (Tversky and Kahneman, 1991). For our purposes, consider a representative agent who derives benefits and costs as follows:

$$V(c, c^r) = u(c) + R(c, c^r)$$

where u is utility over consumption, c is consumption and r is the value function of prospect theory. Let $u(.)$ be increasing and

[4] 283 consenting children from the same programs participated in the 24-h food recall surveys, which were administered by trained research assistants as part of a service to the Greater Chicago Food Depository. The data collected was translated into RDA by age. 30% of kids meet RDA for fruit if fruit juice is excluded, and 39% meet RDA for fruit if fruit juice is included. Grains included whole and refined grains.

[5] We refer to the cookie as the 'less healthy choice' and the fruit cup as the 'healthy' choice in the experiment. While using fresh fruit would be optimal (due to the high sugar content of dried fruit), it was not feasible because of the way the food operations are handled by the Greater Chicago Food Depository.

[6] Due to limitations placed on us by Kids Cafes, the randomization was done at the site level. Kids Cafes did not want different kids to receive different opportunities for incentives in the experiment. In addition, randomization at the site level reduces the likelihood of contamination.

[7] Information about MyPyramid is available here: http://www.cnpp.usda.gov/MyPyramidDevelopment.htm. Note that MyPlate replaced MyPyramid as the official USDA guide in June 2011, after our data collection had concluded.

concave in c. We define utility derived in relation to a reference point, $R(.)$:

$$R(\cdot)=\begin{cases} r(c-c^r), & \text{if } c \geq c^r \\ s(c-c^r), & \text{if } c < c^r \end{cases}$$

where r is increasing and concave and s is increasing and convex. Estimates of the ratio of r and s (when linearity is assumed) have found $-s(-x)/r(x) \cong 2$ (see Tversky and Kahneman, 1991). In the spirit of this finding, if children are loss-averse, then the negative utility they receive from a loss of x is greater in magnitude than the positive utility they receive from a gain of x for any positive x. This simple formulation provides the basis of our most novel intervention.

It is important to recognize that even though such a behavioral insight has not been taken to food choice and consumption, it has been tried in other areas. For instance, studies in the area of worker productivity (Hossain et al., 2012), teacher performance (Fryer et al., 2012), and student performance in the classroom (Levitt et al., 2012) have all attempted to use loss framing to induce greater effort in field experiments. A manifestation of loss aversion is the endowment effect, which is the concept that people demand more to give up an object than they are willing to pay to acquire it (Thaler, 1980). Harbaugh et al. (2001) provide empirical evidence for the presence of the endowment effect both among adults and children. This suggests that children may also display loss aversion.

Likewise, standard incentives have been explored. One particularly interesting concurrent study is due to Just and Price (2013), who explored the impact of small prizes or 25-cent rewards on children's choices in the school cafeteria, and found that an incentive increases the fraction of children choosing a healthy fruit or vegetable side item by 80%. Wasting of food is also reduced by 43%. The observed effects were greater at schools with a larger fraction of low-income children. Another study exploring incentives is Belot et al. (2013) who find that incentives are an effective way to encourage choice of healthy vegetable sides. While Just and Price (2013) and Beloet at al. (2013) investigate gain frame incentives, we incorporate reference-dependent preferences to investigate both gain and loss frame. In addition, we conduct a series of treatments focusing on the impact of educational messaging, alone and together with incentives, and we also consider intervention length.[8]

Incentives have also proved to be effective in changing health prevention related behavior in adults. A series of related novel studies that explore the effect of incentives on health-related behaviors have also been aimed at adults. Incentives have been shown to be effective for weight loss (Cawley and Price, 2011, 2013; Volpp et al., 2008), smoking cessation (Volpp et al., 2009), and compliance with healthy preventive behaviors (Malotte et al., 1998).

Recent concerns have been raised about the long-term impact of extrinsic incentives – Gneezy et al. (2011) suggest that in some contexts, incentives may crowd out intrinsic motivation, and literature in psychology is concerned with potential negative 'rebound effects' (Lepper et al., 1973). More work is needed to understand the long-term impact of incentives, but there is some preliminary evidence that the long-term impact could be positive in the health domain. For example, Charness and Gneezy (2009) found that adults given incentives to attend a gym continued attending the gym even after incentives were removed. Similarly, Royer et al. (2014) find positive long-term impacts of incentive and commitment contract exercise programs for adults.

Educational messaging has been an important point of interest in the literature. Gortmaker et al. (1999) utilized a field experiment to investigate the impact on weight of a 2-year, school-wide educational intervention called Planet Health. Gortmaker et al. (1999) found that Planet Health decreased the prevalence of obesity among girls. Shorter messaging has also been explored. In some studies, simple verbal prompts have been successfully used to encourage children to choose healthier meals. When cafeteria workers asked children whether they would like a fruit, the number of children consuming fruit increased significantly (Schwartz, 2007; Perry et al., 2004). In lieu of messaging, another study used posters with 'healthy heart' logos and found a positive impact on choice for high socio-economic status children ages 6–11 (Stutts et al., 2011).[9] Wansink et al. (2012) investigating giving foods exciting names and found that this increased take-up. In addition, many other potentially impactful interventions have been explored in this important area. In particular, the school cafeteria has been used in field experiments to investigate the effects of changing food presentation (Wansink et al., 2013; Wansink and Just, 2011), and making foods more convenient, attractive and normative (Hanks et al., 2013).

Our framework takes the literature in a new direction by using behavioral economics to guide our treatment set. In doing so, we simultaneously explore the effect of messaging and the effect of our treatment after the intervention concludes (varying the length of treatments). This permits us a glimpse of whether habit formation might play a role in food choice. Our study includes both urban and suburban neighborhoods, with a particular focus on how the incentives impact children and adolescents ages 6–18. Importantly, our students come from households with below average earnings.

3. Experimental setup and design

3.1. Experimental environment

The experiment was conducted at 24 different after school programs called 'Kids Cafes' in the Chicago area, with 1614 children participating at some point during the study. The majority of the sites were in the program between February and March of 2011, and the remaining sites were in the program in the second phase between April and May of 2011. Each site was visited 2 times per week for either 2.5 weeks or 4.5 weeks, depending on the randomly determined length of study at each site (which we refer to as a short or long treatment period). Over 30 different experimenters assisted in the implementation of the treatments, with 3–8 experimenters at each Kids Cafe. Experimenters were trained by the authors and were also evaluated during the study in order to ensure that the implementation was comparable across sites.

Kids Cafes are located in community centers, schools and churches in low-income areas of Chicago, where the majority of children are eligible for the Free or Reduced Lunch Program. At each Kids Cafe, children eat a meal and may also participate in homework help sessions, art projects, or other activities, depending on the site. Attendance at most Kids Cafes is not required and children participate either daily, several times a week, or sporadically. In addition, Kids Cafes vary in size: the smallest program has 17 regular participants, while the largest program has 287 participants. In the analysis, we use between-subject variation as our major indicator of differences, and within-subject variation to investigate change in choices over time. As explained in section 3.3, the field

[8] Other differences between our work and the work of Just and Price (2013) are that we randomize at the site level while Just and Price (2013) randomize at the school level, and we are able to track individual kids over time.

[9] Cassady et al. (2006) used a case study to investigate whether policy mandated changes to menus affected menu offerings, and found that such policies can be a way to increase healthfulness of menus in after-school programs.

Table 1
Timeline of implementation – phase I example.

Sample Date	Day #	Long treatments	Short Treatments
Mon., Feb. 7th	*0*	*Assent/introduction day*	
Wed., Feb. 9th	1	Pre-treatment phase	
Mon., Feb. 14th	2	Treatment phase (1)	
Wed., Feb. 16th	3	Treatment phase (2)	Post-treatment phase
Wed., Feb. 23rd	4	Treatment phase (3)	Post-treatment phase[a]
Fri., Feb. 25th	5	Treatment phase (4)	Post-treatment phase
Mon., Feb. 28th	6	Treatment phase (5)	*Survey collection*
Wed., March 2nd	7	Post-treatment phase	
Mon., March 7th	8	Post-treatment phase[a]	
Wed., March 9th	9	Post-treatment phase	

Note: The phases of the experiment are (1) a pre-treatment phase to collect choice data with no intervention, (2) a treatment phase in which the intervention was implemented based on treatment, and (3) a post-treatment phase in which data was collected with no intervention. A 'Short' treatment means that treatment was only carried out on one day (day 2). A 'Long' treatment means that treatment was carried out on 5 days (days 2–6).
[a] Observations not available for day 4 in Short and day 8 in Long for most sites, because sites were served a celery + peanut butter option instead of the usual dried fruit cup in observance of National Nutrition month. Phase II implementation is the same, but on different dates in Spring 2011.

experiment consisted of randomizing Kids Cafes to different treatments, which included interventions with incentives, education or both.

Table 1 provides a sample timeline of implementation. On the day before the experiment, experimenters arrived to acquaint themselves with the center staff, present a schedule for visits to the center, explain the distribution of the desserts, and request assent forms from the children and reverse consent forms from the parents. The forms stated that children would be offered choices of desserts throughout the study, that their choices would be recorded, and that they may have the opportunity to receive prizes or educational messaging as part of the study.[10] Children who had a completed assent on file, and no form declining consent from the parent, participated in the experiment. Most students assented either on the day of assent or the following day when the dessert was offered, while most parents did not decline to consent, so that only 12, or less than 1%, of Kids Cafe participating children are not in the data.[11]

3.2. Experimental procedures

The experiment proceeded as follows. After eating the meal provided at the Kids Cafe, children approached the experiment table and were given the choice of a dried fruit cup or a cookie. Each cookie was individually presented on a napkin on a tray full of cookies, and the dried fruit was similarly presented in small plastic cups on a tray. Both options were available at all times. Children could either choose one fruit or one cookie, were instructed not to share the fruit or cookie and were asked to eat it in the cafeteria before leaving. The experimenter read a standard message about the choice and then read a message about the incentive or education, depending on that location's treatment assignment (see Section 3.3 for treatment descriptions and the appendix for the script). We recorded the choice that was made, and research assistants also observed whether or not the food item was consumed.

The first day of the experiment involved a pre-treatment phase in which all children received the choice of fruit or cookie and results were recorded. The next 1 or 5 days (depending on whether the site was assigned to the short or long treatment period) consisted of the treatment phase, in which children made the choice of fruit or cookie and either continued in the baseline treatment or received an incentive or educational message, as described in Section 3.3. The last 2–3 days consisted of the post-treatment phase, where decisions were again recorded but no treatment was carried out.

Table 2
Fruits and cookies served.

Fruits	Cookies
Dried banana with acai	Snickerdoodle cookie
Dried mango	Lemon cookie
	Brown sugar shortbread cookie
	Chocolate chip cookie (1 site on one day only)

Note: Fruit and cookie choices alternated between the options listed above, depending on the day. Cookies were baked by partners of the Greater Chicago Food Depository.

Table 2 provides a list of the fruit and cookie options that were available throughout the study. In general, we alternated between three different cookies and two different dried fruit options. The choice of cookie and fruit for delivery was dependent on availability and was provided by the Greater Chicago Food Depository. While fresh fruit may have been preferable to dried fruit due to its superior nutritional content, unfortunately the food depository supply chain was not equipped to provide sites with fresh fruits. However, note that even dried fruits have some health benefits relative to cookies. First, dried fruit consumption increases the likelihood of meeting RDA for fruit, while most children are already meeting RDA for grains in our sample. Second, dried fruit do not contain added sugar and are low fat, while cookies do contain added sugar and are not low fat.[12]

3.3. Experimental design

The goal of the experiment was to discover whether gain-framed incentives, loss-framed incentives, an educational message, or both message and incentive would prompt children to choose and consume the healthier food item over a less healthy snack. Short and long study sessions were conducted in order to explore the possibility of habit formation. Table 3 summarizes the

[10] In this spirit, our field experiment should be considered a framed field experiment in the parlance of Harrison and List (2004).

[11] Note that children who assented but whose parents declined to consent still received a fruit or a cookie during the experiment but did not enter into the data collection process. Children who did not assent but whose parents consented, or children who did not have assent or consent on file, did not participate in any part of the experiment.

[12] Nutrition facts for the dried fruit are available by e-mail request. However, nutrition facts on the cookies are not available since these were baked for the study and were not pre-packaged.

Table 3
Summary of treatments.

	Short study session	Long study session
No Intervention – (NONE)		Yes
"Gain" Incentive Only – (GAIN)	Yes	
"Loss" Incentive Only – (LOSS)	Yes	Yes
Education Only – message only (EDU)	Yes	Yes
Education + "Loss" Incentive – Incentive + message (EDU + LOSS)	Yes	Yes

Note: This table describes the treatments that were conducted. Not all possible variations were conducted due to small sample sizes.

Table 4
Summary of treatments: children participating throughout study.

	Short study session	Long study session	Total
NONE		2 sites, $N = 192$; 80/36[a] *Sites P1 only, N = 76*[b]	4 sites, $N = 304$
GAIN	5 sites, $N = 419$ 32/34/38/232/83		5 sites, $N = 428$
LOSS	5 sites, $N = 212$ 33/35/19/62/63	1 site, $N = 108$	6 sites, $N = 390$
EDU	3 sites, $N = 137$ 45/68/24	2 sites, $N = 333$ 287/46	5 sites, $N = 482$
EDU + LOSS	1 site, $N = 45$	3 sites, $N = 168$ 63/24/81	4 sites, $N = 225$

Note: This table describes the number of sites and individual students per site who participated in the experiment. Randomization to treatment was conducted at the site level. Short and Long study sessions differ only in the number of total treated observations prior to the post-observation period.

[a] One of the two sites does not have any observations for day 1, of a delivery mishap.

[b] 2 additional sites were only visited in P1.

treatments, including the total number of unique children who participated throughout the study.

We conducted one baseline treatment (No Intervention – denoted BASELINE) in which children continued to receive a choice of cookie or fruit during treatment days. The key treatment that we explore following the theory outlined in Section 2 is whether a "gain" or a "loss" framed incentive is more effective. In "Gain" Incentive Only (denoted GAIN), the child only chooses a prize if he/she selects and consumes the fruit. In "Loss" Incentive Only (denoted LOSS), the child first chooses a prize, which is then placed in a clear plastic box and taped shut. The child can keep the box as he/she goes up to the line to select a fruit or a cookie. If the child selects a cookie, the child has to forfeit his/her prize, but if he/she chooses the fruit, he/she kept the prize. Experimenters then take the prize out of the box and give it to the child if they observe the child eating the fruit cup, or take the prize away if the child chooses not to eat the fruit cup. In Education (denoted EDU), the experimenter reads a short educational message about the benefits of fruit and displays the USDA's *MyPyramid for Kids* board (re-printed in the Appendix) prior to asking the child to select a fruit or a cookie. The message does not involve the experimenter explicitly prompting the child to choose the fruit over the cookie. In Education + "Loss" Incentive (denoted EDU + LOSS), the experimenter reads an educational message and conducts the same procedure for incentives as in LOSS. Note that we did not conduct all possible variations of treatments (for instance, we do not have an education treatment combined with gain, and we do not have long gain study sessions) due to small sample sizes.

The prizes available in the incentive treatments (GAIN, LOSS, EDU + LOSS) are displayed in Fig. 1. Children could select between a number of different items, each worth 50 cents or less, including different colored fruit key chains, pens, wristbands, small rubber ducks, and trophies. All of these items also varied in color to make sure that children in the "long" sessions continued to value the incentive throughout the experiment (for example, there were 5 different colors of wristbands, so children could collect all 5). All treatments were accompanied by a bulletin board that showcased the different prizes or showcased the food pyramid (or both, as in EDU + LOSS).

4. Results

4.1. Summary

Table 4 summarizes the total number of unique children who participated throughout the study, while Table 5 provides a snapshot of the number of children who participated in days 1 and 2. Although we have on average 323 children participating per treatment, we only have on average 186 and 160 children in each treatment in days 1 and 2, respectively. This difference in numbers is due to the high turnover of children at sites on a day-to-day basis. For instance, some children attend Kids Cafes only on days they are not participating in after-school activities, while others attend daily, and yet others only attend sporadically. Note, however, that children are not aware of their treatment assignment on day 1, or on day 2 until the treatment script is read. Therefore, whether or not a child attends on day 2 should not be correlated with their treatment assignment.

Fig. 2a and b provides a snapshot of our results for both the long and short treatment types, respectively. Significant increases in fruit selection occurred on days when an incentive was offered, raising the proportion of children choosing fruit from 17% to around 80%. In addition, despite the fact that not all children observed in later periods participated in all days of treatment, there is evidence that a greater proportion of children consumed fruit following the end of the incentives in the long treatment group.

4.2. Baseline and treatment comparison on selection

Our main comparison is selection of fruit vs. cookie between the first day (without treatment) and the second day (with treatment), pooling both short and long treatments. As summarized in Fig. 2a and b, 21% of children selected fruit on day 1, and 16% selected fruit on day 2 of BASELINE. There are no statistically significant differences in proportion of fruit chosen in day 1 across most treatments, but significantly fewer children selected fruit in EDU + LOSS as compared to the other treatments (Chi squared p-value < 0.10). Randomization is at the site level, and sites differ by location and activities provided, but our data suggest little differential selection by treatment.

We conducted Chi square tests to compare the proportion of children selecting fruit on day 2 in each treatment. On day 2, the proportion of children selecting fruit in BASELINE was 16%. Our GAIN treatment increased the proportion of children selecting fruit to 78%, while LOSS increased the proportion of children selecting fruit to 76% (p-values <0.01 for BASELINE vs. LOSS and BASELINE vs. GAIN). Our EDU treatment did not prove effective, as the proportion of children selecting fruit on day 2 dropped to 11% (p-value >0.10 for BASELINE vs. EDU). Importantly, EDU + LOSS increased the number of children selecting fruit to 86%, which is significantly higher than BASELINE, EDU, or incentive alone (p-values <0.01 when comparing BASELINE to EDU + LOSS or to EDU; p-value <0.05 when comparing EDU + LOSS to LOSS or GAIN).

Fig. 1. Photo of gift display.

The comparisons above are conducted using the child's choice as a unit of observation. However, we find similar results when using the average choice at the site as a unit of observation and conducting Wilcoxon Mann–Whitney tests. The proportion of children selecting fruit in GAIN, LOSS or EDU + LOSS is significantly different from BASELINE (p-value <0.05 for GAIN and p-values <0.10 for LOSS and EDU + LOSS). The proportion of children selecting fruit in EDU + LOSS was significantly higher than EDU (p-value <0.05). No significant effects between EDU + LOSS and LOSS were observed.

We also conducted pair wise comparison tests (sign-rank) for children who were in the program for both days. Table 6 displays the change in proportion, between day 1 and day 2, of children choosing fruit across treatments. There are no statistically significant changes from day 1 to 2 in BASELINE or EDU (p-values = 0.37 and 0.18, respectively). By comparison, there is a statistically significant improvement in fruit choice for students in GAIN, LOSS, and EDU + LOSS (p-values <0.01). These data lead to the first two results:

Result 1: Use of token incentives can induce children to select healthier foods.
Result 2: Education alone does not have a significant effect on food choice, but there is an important combined effect between education and loss framed incentives.

We also compare the relative effectiveness of our different treatments to test our theoretical model. Different from theoretical predictions, LOSS did not result in significantly different proportions of children selecting fruit than GAIN (Chi squared – p-value >0.10). Together, these two insights lead to our next result:

Result 3: The gain and loss treatment are equally effective in moving children to choose the healthy option.

We also conduct a series of logit regressions (presented in Table 7) that largely confirm results 1–3. We use dessert selection as the dependent variable (which equals 1 if a fruit was selected and 0 if a cookie was selected), include dummies for each treatment (baseline is the omitted treatment). In specifications (1) and (2) we consider only day 2 decisions, since data is available for all kids in both short and long treatments on those days. The difference between specifications (1) and (2) is that we also include the past decision of the child in (2). In specifications (3) and (4) we conduct fixed effects regression using the unique ID of the child as a random effect and including the pre-treatment and treatment periods in the analysis. Specification (3) tests days 1–2 only and includes both short and long treatment lengths, while Specification (4) tests days 1–5 and includes only long treatment lengths. All specifications cluster standard errors at the Kids Cafe site level. We find positive and significant effects on fruit selection for GAIN, LOSS and EDU + LOSS, but not for EDU. In fact, in some specifications EDU actually results in a small but significant reduction in the proportion of children choosing fruit.

Table 5
Number of observations per day – days 1 and 2 Only.

	Day 1	Day 2	Both days	% day 2/day 1	% day 2/all short	% day 2/all long
NONE	157	83	65	80[a]		43
GAIN	221	210	100	45	50	
LOSS	191	183	117	61	67	38
EDU	216	184	105	49	65	29
EDU + LOSS	145	140	111	76	60	67

Note: Since we track ID of student, we are able to determine which students attended on both pre-treatment day and the treatment day.
[a] In NONE, for day 1 we have observations from 5 sites and for day 2 we have observations from only 2 of the sites. The total number of children in NONE in cafes that we have observations for both days is 81. % day 1/day 2 is calculated as the number of children who show up on day 2 who were also present on day 1. Children were not aware of the treatment they would receive in day 2. % day 2/All is calculated by dividing attendance in day 2 over all unique participants in that treatment group. This is calculated separately for the short and long treatments because in the long treatments, we observe a larger number of kids just by coming over a longer period of time.

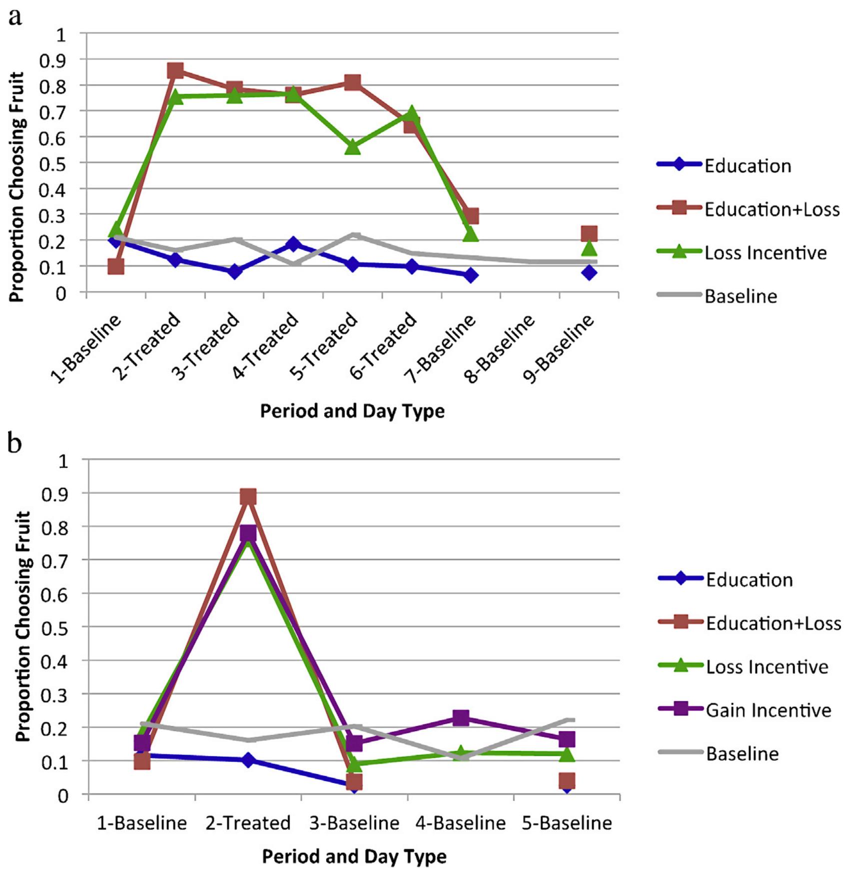

Fig. 2. (a) Proportion of children selecting fruit over study days – long. (b) Proportion of children selecting fruit over study days – short. *Note*: (a) and (b) presents the number of children selecting fruit vs. cookies, divided by the total number of children who made a selection. Data is missing for some treatments in long – day 8 and short – day 4 because on that day a fruit/cookie selection was not served at those sites due to a logistical error.

Table 6
Change in proportion of children choosing fruit, days 1–2.

	Proportion in day 1	Proportion in day 2	Change in proportion from day 1 to 2	Number of observations
NONE	0.210	0.160	−0.05	62
GAIN	0.208	0.839	0.63	89
LOSS	0.195	0.774	0.58	115
EDU	0.180	0.107	−0.07	97
EDU + LOSS	0.099	0.856	0.76	111

Note: This table reports the proportion change from days 1 to 2, using only students who participated in and have data on both days 1 and 2 of the experiment, where day 1 is a baseline day and day 2 is a treatment day.

Post-estimation tests in all specifications speak to the lack of effect of loss framing relative to gain framing (p-value >0.1 in all specifications). Post-estimation tests also provide evidence for a positive effect of education when combined with incentives. Testing EDU + LOSS = EDU plus LOSS results in p-values <0.05 in all specifications.

4.3. Effects post-intervention on selection

We follow the participants post-intervention (for 1 week) to determine whether choices are different when incentives are removed. Table 8 summarizes the proportion of children choosing fruit following the treatment for each length (long and short) and treatment type, including all children, even if they participated in only one day of the study. We find significant differences between the proportion choosing fruit in EDU + LOSS post-treatment (26%) relative to BASELINE (13%) in the long treatment sessions (Wilcoxon rank-sum p-value <0.01). This is the only significant difference we find, as the differences in Post-treatment for LOSS (20%) relative to BASELINE is not significant at conventional levels ($p < .10$).[13] In the short session treatments, we do not find significant differences in the post-treatment period.

In the short session treatments, we find improvements from BASELINE to EDU + LOSS (p-value <0.10) but not for any other treatment.[14]

These data lead to our next result:

Result 4: Combining education and loss incentives positively affected choice post-experimental treatment, whereas providing

[13] We also see a decrease for Education Only treatment with p-value <0.10.

[14] Wilcoxon ranksum test p-value has a sign in the opposite direction than expected with p-value <0.10 for Baseline vs. Education + Loss, p-value 0.00 for Baseline vs. Education, and no significant differences between Baseline and Loss Incentive alone. There are also no significant differences between Loss Incentive and Education + Loss (p-value = 0.11) or between Education and Education plus Loss.

Table 7
Logit regression models on treatment effects.

Select fruit *=1 if fruit, =0 if cookie*	(1) Select fruit Period 2	(2) Select fruit Period 2	(3) Select fruit Periods 1–2	(4) Select fruit Periods 1–5
GAIN dummy	2.891***	3.504***	3.304***	
=1 for Gain, 0 otherwise	(0.290)	(0.156)	(0.423)	
LOSS dummy	2.806***	3.123***	3.196***	2.753***
=1 for Loss, 0 otherwise	(0.383)	(0.330)	(0.349)	(0.487)
EDU dummy	−0.457	−0.279	−0.520**	−0.439**
=1 for Loss, 0 otherwise	(0.299)	(0.319)	(0.236)	(0.196)
EDU + LOSS dummy	3.489***	3.728***	4.005***	3.417***
=1 for Loss, 0 otherwise	(0.291)	(0.175)	(0.223)	(0.242)
Period			−0.0294	−0.0675
			(0.130)	(0.0679)
Select fruit lag		0.642		
		(0.443)		
Constant	−1.655***	−1.998***	−1.814***	−1.558***
	(0.259)	(0.0981)	(0.239)	(0.213)
Observations	765	474	1659	1719
Number of unique_id			1185	691

Note: Robust standard errors in parentheses, clustered at the Kids Cafe site level. Columns 1–2 are logit, columns 3–4 are random effects logit with unique subject ID as the random effect. Notice the dummy on GAIN for specification (4) is missing because the Long treatment sessions did not test GAIN.

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Table 8
Proportion of children choosing fruit post treatment.

	NONE	EDU	GAIN	LOSS	EDU + LOSS
Long	0.12 (0.33) $N = 189$	0.068 (0.25) $N = 190$	N/A	0.19 (0.39) $N = 143$	0.26 (0.44) $N = 204$
Short		0.026 (0.16) $N = 156$	0.17 (0.38) $N = 417$	0.11 (0.31) $N = 326$	0.04 (0.19) $N = 52$

Note: This table reports the average proportion of children choosing fruit following treatment, including both of the post-treatment days of observation, and including all children even if they did not attend all treatment days. Number in parentheses represents the standard deviation.

education or incentives alone did not have a significant post-treatment effect.

In Table 9, we present regressions supporting our results. We use fixed effect logit to look separately at short (specifications 1–2) and long (specifications 3–4) treatment sessions. While being treated is endogenous, in specifications 2 and 4 we constrain the sample to the kids who were in the Kids Cafe at least once during the treatment period, and (in specification 4) control for the number of times kids showed up during the treatment period. For specification 2, which analyzes the short treatment sessions, this number can be 0 or 1. For specification 4, which analyzes the long treatment sessions, the number can be any integer from 0 to 5. As before, we use logit random effects with standard errors clustered at the Kids Cafe site level. As noted from Table 9, we observe a positive and significant effect post-treatment in EDU + LOSS when the treatment length is long, but not in any of the other treatments. We do not observe either significant crowd-out or habit formation for any other treatment, except in specification (3) where the coefficient on EDU is negative and significant at the 10% level.

4.4. Consumption

Programs providing nutritionally balanced meals have been implemented on a wide scale (e.g., the USDA's Free and Reduced Lunch Program, Kids Cafes). While these programs have been successful, a direct link from choice of food to consumption cannot be taken for granted. For example, Just and Price (2013) find that in the lunchroom at school, over 44% of items taken by students are wasted.[15] Our study provides evidence of the link between selection and consumption, which is another interesting variable for our theory and for policymakers. If incentives linked to consumption help to reduce costly food waste, this provides another, financial motivation for schools and other programs serving food to implement them.

Our experimental administrators were able to observe on average 73% of all consumption by walking around the room while the dessert was being served, at the level of detail of "ate BASELINE", "ate 1/4", "ate 1/2", "ate 3/4" and "ate all."[16] Table 10 describes the amount of data available for the subsequent analysis, including all days of treatment and baseline observations. Because the consumption was recorded using visual observation (rather than more accurate measures such as weighing), the results should be interpreted with some caution.

Fig. 3a and b provide histograms of consumption amounts for day 2, while Table 11 provides proportion of consumption data by treatment. Consumption is generally clustered at the full serving, for both cookies and fruit, with 70%-90% of students consuming the full amount. The exception is the fruit consumption in BASELINE and EDU – in which almost 20% of students ate 1/4 or less of their fruit. While consumption is generally high in incentivized treatments, conditional on choosing fruit, LOSS leads to higher consumption than GAIN, with 96% consumption in LOSS but 90% consumption in GAIN (p-value = 0.10 for overall comparison, and p-value = 0.06 for those who selected only fruit). Consumption in

[15] In Just and Price's (2013) work, they find waste going down to only 26% when incentives are introduced.
[16] This is out of 4773 observations (across all days, sites and participants).

Table 9
Logit regression models on effects post-treatment.

Variables	(1) Select fruit Short sessions	(3) Select fruit Short sessions	(5) Select fruit Long sessions	(7) Select fruit Long sessions
GAIN dummy	0.365	0.706		
	(1.113)	(1.450)		
LOSS dummy	−0.155	−0.086	0.602	0.685
	(1.233)	(1.479)	(0.501)	(0.542)
EDU dummy	−2.151	−2.121	−0.755	−0.282
	(1.629)	(1.734)	(0.531)	(0.621)
EDU + LOSS dummy	−1.690	−1.368	1.052**	1.160**
	(1.713)	(1.943)	(0.449)	(0.513)
Period	0.0158	0.022	−0.137	−0.151
	(0.131)	(0.121)	(0.097)	(0.128)
Times treated × LOSS				−0.028***
				(.004)
Times treated × EDU				−0.189**
				(0.075)
Times treated × EDU + LOSS				−0.006
				(0.052)
Constant	−3.134**	−3.395**	−1.241	−1.239
	(1.388)	(1.523)	(0.798)	(0.796)
Observations	1140	805	726	632
Number of unique_id	666	424	465	392

Note: Robust standard errors in parentheses, clustered at the Kids Cafe site level. All specifications are random effects logit with unique subject ID as the random effect. Notice the dummy on GAIN for specifications (3) and (4) is missing because the Long treatment sessions did not test GAIN. NONE is used as the comparison group for both short and long treatment sessions. In the short treatment sessions, the proportion of children ever treated is 79% for EDU, 79.6% for EDU + LOSS, 64% for GAIN, and 78% for LOSS. In the long treatment sessions, the proportion of children ever treated is 90% for EDU, 99% for EDU + LOSS, 89% for LOSS, and 89% for NONE.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

EDU + LOSS is similar to that of LOSS alone. It is interesting to see that loss and gain incentives have an effect at the level of consumption but not selection.

Assuming that children who chose cookies consumed no fruit, we calculate average amount of fruit consumed in day 2 to be 0.12 servings in BASELINE, 0.06 servings in EDUCATION, 0.66 servings in GAIN, 0.74 servings in LOSS, and 0.82 servings in EDU + LOSS. All incentivized treatments have significantly higher consumption of fruit as compared to EDU and BASELINE (Wilcoxon ranksum p-values <0.01). We observe significant differences in amount of fruit consumed between GAIN and EDU + LOSS (Wilcoxon ranksum p-value = 0.02) but not between GAIN and LOSS or EDU + LOSS and LOSS. Thus, we can conclude that not just selection, but also consumption of fruit is increased through our token incentives. This brings us to our last result:

Result 5: Use of token incentives can induce children to *consume* healthy foods.

Following Just and Price (2013), we define the "rate of waste" as the average proportion of whole servings of items that were not consumed in each treatment. Rate of waste for our desserts,

Table 10
Observed consumption.

	NONE	EDU	GAIN	LOSS	EDU + LOSS
Observed w/detailed amounts	74.29%	72.7%	30%	78.7%	77.2%
Observed w/o detailed amount	24.5%	26.2%	67.6%	20.5%	22.4%
Number of observations	3007	626	210	380	545

Note: This table describes the proportion of people for whom we observed detailed consumption data. The differences in number of observations per treatment are due to the fact that some treatments were conducted only during the "Short" session (Gain Incentive) while the remaining treatments were conducted in both "Short" and "Long" versions. Moreover, the team sent to one of the "Gain" sites during the treatment day did not correctly record amount information. 'Observed w/detailed amounts' means that an RA observed the child eat the item (or not eat) and observed the amount that was discarded. 'Observed w/o detailed amount' means that an RA observed the child eat the item (or not eat) but did not observe the amount left over before the item was discarded.

Table 11
Proportion of fruit and cookies consumed.

	Fruit (%)	*N*	Cookies (%)	*N*
Baseline	81.3	8	76.2	43
"Gain" Incentive Only	89.5	50	95	10
"Loss" Incentive Only	95.7	98	92.9	28
Education Only	65	11	93.1	98
Education + "Loss" Incentive	95.4	65	80	10

Note: This table uses data on proportion consumed, for all students that consumption was recorded, for day 2 only. Consumption is conditional on first selecting fruit or cookie.

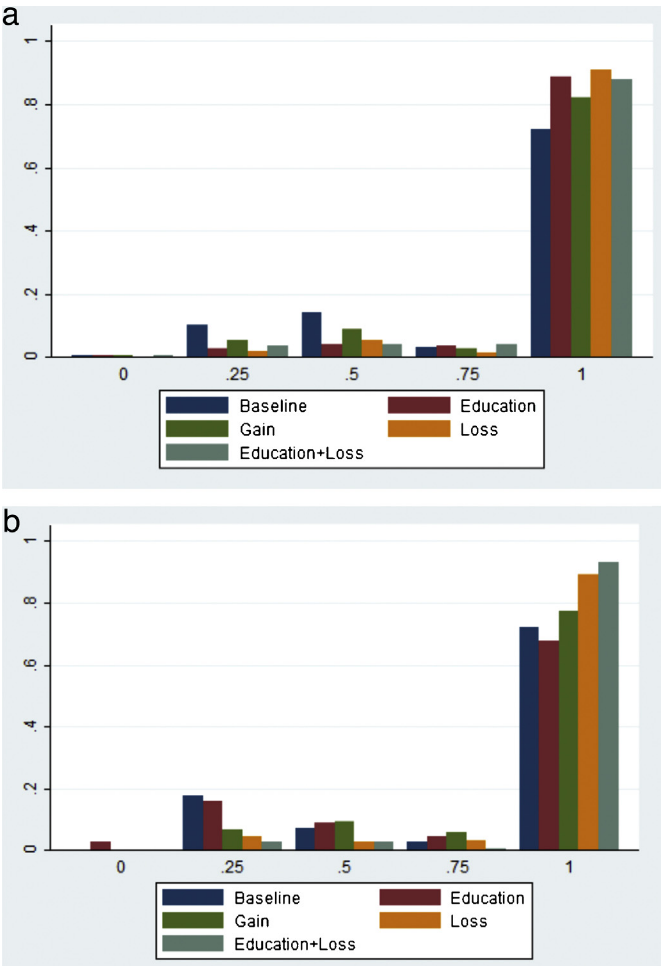

Fig. 3. (a) Proportion consumed when cookie was selected, day 2. (b) Proportion consumed when fruit was selected, day 2. *Note*: (a) and (b) represents the proportion of dessert consumed, conditional on selecting fruit or cookie. Consumption was recorded at the level of 1/4 s. Data is available for 73% of the sample (the sub-set that was observed by the research assistants).

Table 12
Overall waste rates.

	Rate of waste (%)	N
Baseline	23.0	51
"Gain" Incentive Only	9.6	60
"Loss" Incentive Only	4.9	126
Education Only	9.9	109
Education + "Loss" Incentive	6.7	75

Note: This table uses data on proportion wasted overall, defined as 1-consume amount, for all students that consumption was recorded, for day 2 only.

on average, is only 9% – a small waste rate in comparison to ∼40% waste rates in school lunchrooms. Table 12 provides waste data by treatment for both types of desserts. Notice that all of our treatments reduce the rate of waste significantly – while treatment waste rates are around 5%-10%, rate of waste in baseline is 23% (all pairwise Wilcoxon Mann–Whitney ranksum test p-values <0.05 for BASELINE vs. treatments).

Table 13 provides regression estimates of fruit consumption, conditional on seeing the fruit consumed, during the treatment period. If a child has selected a cookie, the fruit consumption is coded as 0. Our findings confirm that fruit consumption is increased through incentives, which is not surprising considering that in the incentivized treatments, incentives were tied to consuming the full amount of the fruit. We observe significant and positive effects of the GAIN, LOSS and EDU + LOSS treatment in all specifications, with no significant effects of the EDU treatment. As in the selection regressions, post-estimation tests do not show differences in GAIN and LOSS (p-values >0.10). Unlike the tests on selection, we do not observe differences in EDU + LOSS and LOSS (the additive effect of EDU is not significant), except for in specifications (3) and (4) where the post-estimation test p-values are 0.07 for the test EDU + LOSS = EDU plus LOSS (specification 3) and >0.01 for the tests EDU + LOSS = LOSS plus EDU + LOSS (specification 4).

5. Discussion and conclusion

We conducted a framed field experiment to investigate the relative impact of short, educational messages and token incentives, which have been shown to encourage positive behaviors in related settings, on child's choice to select and consume a dried fruit cup (healthier option) or cookie (less healthy option). The field experiment was conducted across 24 different after school programs that regularly serve meals to children ages 7–18 from low-income households. We randomized children to receive either gain framed incentives, loss framed incentives, short educational messages, or a certain combination.

We find some promising results. First, at baseline, only 17% of children preferred the fruit. Our incentives, framed both as gains and losses, significantly increased fruit choice, with nearly 80% of subjects choosing the healthy snack in the incentive treatments. The educational message was not significantly different from baseline, except in combination with a loss framed incentive. Importantly, one week following the intervention, children in the Education + Loss treatment continued to choose more fruit as compared to children in the other treatments.

The powerful effect of incentives we observe is in line related work on incentives in the school lunchroom (Price and Just, 2013) on incentives for exercise for adults (Charness and Gneezy, 2009; Royer et al., 2012), and incentives for smoking cessation among adults (Volpp et al., 2009). We attempted to further increase the impact of incentives by introducing incentives framed as losses. While we do not find a significant difference between loss and gain framed incentives, our study is the first to use the loss aversion theory in the food choice domain and opens the door for future work exploring theories such as this one in the food environment.

We did not observe an effect of educational messaging in isolation. This result can be interpreted as being similar to recent findings showing a limited impact of calorie labeling laws. For instance, Elbel et al. (2013) find that while individuals report being influenced by calorie labeling, receipt data shows that the policy change was largely ineffective. A similar result is observed in Vadiveloo et al. (2011) who investigate calorie labeling prior to the mandate. Taken together, such findings suggest that short educational messages alone are not sufficient drivers of behavior change.

We also find that the educational message is quite effective when paired with an incentive. Importantly, pairing the educational message with an incentive results in greater retention of good habits post-intervention. These findings have implications for the literature on the benefits of more in-depth nutritional education targeted toward children, which suggests that gearing informational interventions toward children may be quite successful (Epstein et al., 1990; Reynolds et al., 2000; Perry et al., 1998; Nicklas et al., 1998). The positive effects that we observed suggest that there is promise in pairing incentives with educational interventions of this type.

Our field experiment results should be interpreted as evidence for the impact of incentives on behavioral changes in food choice.

Table 13
Fruit consumption, conditional on seeing consumption.

Consumed fruit	(1) Consumed fruit Period 2	(2) Consumed fruit Period 2	(3) Consumed fruit Periods 1–2	(4) Consumed fruit Periods 1–5
GAIN dummy	0.396***	0.555***	0.530***	
	(0.138)	(0.132)	(0.0979)	
LOSS dummy	0.579***	0.623***	0.619***	0.572***
	(0.0878)	(0.0840)	(0.0804)	(0.0346)
EDU dummy	−0.0466	6.94e−05	−0.0646	−0.00357
	(0.0480)	(0.0267)	(0.0604)	(0.0354)
EDU + LOSS	0.653***	0.679***	0.705***	0.696***
	(0.0640)	(0.0388)	(0.0626)	(0.0409)
Period		0.145	0.0174	−0.0164
		(0.100)	(0.0618)	(0.0111)
Select fruit lag		0.145		
		(0.100)		
Constant	0.0855*	0.0385**	0.0892	0.150***
	(0.0470)	(0.0162)	(0.0719)	(0.0302)
Observations	561	330	1032	1155
Unique IDs	0.389	0.438	821	555

Note: Robust standard errors in parentheses, clustered at the Kids Cafe site level. Columns 1–2 are ordinary least squares regressions, columns 3–4 are random effects ordinary least squares with unique subject ID as the random effect. Notice the dummy on GAIN for specification (4) is missing because the Long treatment sessions did not test GAIN. Fruit consumption is coded as 0 if a cookie was chosen. The sample is constrained to consumption that was directly observed by the experimenter. The amount is coded as 0, 0.25, 0.5, 0.75 or 1.0.

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Because of limitations in the study implementation, there is not a stark difference between the relative healthfulness of the cookie and the dried fruit cup. However, the dried fruit cup can be considered more beneficial because it does help toward meeting RDA requirements for fruit, which is an area where children are often lacking. Moreover, we cannot make a direct link from the food choice behavior in the school cafeteria to weight, in particular because we do not observe food choice outside of the Kids Cafe. On one hand, it is possible that kids compensate for the 'fruit cup' choice in the Kids Cafe with a cookie at home, thereby negating the impact of our intervention on overall health. On the other hand, because children have been incentivized to eat an entire fruit cup, they may be more satiated and less likely to reach for low-nutrient foods later in the day. Despite these limitations, our research has given us important behavioral insights into choice. Future research should investigate the possible spillover effects of interventions such as ours.

Policymakers and organizations interested in improving child food choice behavior would do well to recognize the impact that incentives can have in promoting positive behavioral changes. However, they may be concerned with the added cost of incentives. Incidentally, we find that incentives or incentives combined with education increase the levels of consumption, reducing waste relative to education alone, and potentially saving the organization money. Of course, waste is not always socially optimal, for instance if a child is already satiated wasting food may be the most optimal course of action.

Could the positive impact of incentives be sustained in the long run, when applied more broadly? This remains an open question, and is important future research both for gaining a deeper understanding of behavior for academics and for proposing the best policies to improve food choice among children in practice. More generally, we believe this study demonstrates that behavioral economics can lend powerful insights into our understanding of the health production function and the design of healthy choice interventions. In addition, using field experiments to explore the rich hypotheses that behavioral economics provides should become the rule rather than the exception.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.jhealeco.2014.11.002.

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