GOT MILK? USING NUDGES TO REDUCE CONSUMPTION OF ADDED SUGAR

CHIEN-YU LAI, JOHN A. LIST, AND ANYA SAMEK

The National School Lunch Program (NSLP) is a federal food assistance program that serves over 30 million children in the United States annually. Yet the impact of NSLP on nutritional intake may be limited because children frequently do not choose the healthier offerings or waste large portions of their meal. In this article, we study whether we can improve the impact of the NSLP on child food choice through low-cost nudges. We conduct a field experiment in a school lunchroom with 2,500 children, evaluating the impact of informational prompts on milk choice and consumption over two weeks. We find that prompts alone increase the proportion of children choosing and consuming the healthier white milk relative to sugar-sweetened chocolate milk from 20% in the control group to 30% in the treatment groups. Adding health or taste messaging to the prompt does not seem to make a difference. We survey students and find that most prompts affect perceived healthfulness of the milk, but not perceived taste. Finally, we find that the prompts are nearly as effective as a small nonmonetary incentive.

Key words: Children, field experiment, food choice, information, National School Lunch Program, NSLP, prompts.

JEL codes: C72, C91.

The United States spends nearly $100 billion on food assistance programs annually.[1] These programs were initially designed to overcome food insecurity. Yet given the heightened risk of poor nutrition, obesity, and related chronic disease among the food insecure, food assistance programs now also need to address nutritional quality (Just 2006; Traill 2012). A large literature in agricultural economics and related fields has evaluated the impact of food assistance programs on a range of outcomes, including food insecurity, nutritional intake, and obesity. This literature generally finds that the programs improve food insecurity (Ratcliffe, Mckernan, and Zhang 2011), but have a mixed or limited impact on nutritional intake or obesity (United States Department of Agriculture [USDA] 2004; Meyerhoefer and Yang 2011).[2]

The National School Lunch Program (NSLP) is one federal food assistance program that is positioned to have a potentially large positive impact on the nutritional status of American children. Over 30.4 million children receive healthy free or low-cost lunch through this program at a cost of about $13

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[1] Spending in fiscal year 2018 totaled $96.1 billion, spread across fifteen assistance programs. https://www.ers.usda.gov/data-products/ag-and-food-statistics-charting-the-essentials/food-security-and-nutrition-assistance/?topicId = 14832, Last accessed July 9, 2019.

[2] Meyerhoefer and Yang (2011) provides a summary and explains that the complex relationships between participation in the programs and food intake make it difficult to draw robust conclusions about impact. Participation in the Supplemental Nutrition Assistance Program (SNAP) is shown to increase obesity in some demographic groups (Gibson 2003, 2004; Chen, Yen, and Eastwood 2005) and decrease obesity in children (Burgstahler, Gundersen, and Garasky 2012). One study found no impact of the program on obesity once controlling for misreporting (Almada, Mccarthy, and Tchernis 2016). The Women, Infants, and Children (WIC) program seems to have a positive impact on child health (Carlson and Senauer 2003) and nutritional intake (Yen 2010). Campbell et al. (2011) finds no impact of the program on nutrient intake. Smith (2017) finds positive impact for the most food insecure children.

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billion annually.[3] Despite recent updated standards for the nutritional content of school meals, children who participate in the NSLP often still do not meet these standards due to poor food choice and food waste (30–40% of food is wasted, see Smith and Cunningham-Sabo 2014). Identifying ways to improve child food choice in the NSLP could have significant impacts on child nutritional intake and increase the effectiveness of this program.

Researchers have begun to explore ways to use behavioral economics to "nudge" children to make healthier food choices (Just 2006; Just, Mancino, and Wansink 2007; Just and Gabrielyan 2016). Just (2017) provides a useful discussion of the welfare and ethical implications of nudges for policy. Such tools may include clever labeling, displaying healthy foods in a more accessible or attractive manner, increasing variety, allowing pre-ordering, or providing incentives to make the healthy choice.

We contribute to this literature by using a field experiment to study the impact of verbal prompts on children's choices in the school lunchline. Our field experiment was conducted in nine school lunchrooms with over 2,500 children in kindergarten to eighth grade. Our outcome measure was the choice of white milk, which we call the "healthier choice," or chocolate milk, which we call the "less healthy choice," due to the higher sugar content.[4] We evaluated the impact of informational prompts on milk choice and consumption over a two-week period. Children received one of several informational prompts, no prompt, or a small incentive, as they proceeded through the school lunchline. We investigated (1) the impact of health-related messaging, which promotes salience of future health benefits of the white milk; (2) the impact of taste-related messaging, which promotes perceived immediate enjoyment of white milk; and (3) the impact of a prescriptive verbal prompt to choose white milk with no additional information. A separate treatment incentivized choosing the white milk. This treatment allows us to study the relative impact of prompts to incentives.

Our hypotheses are that prescriptive verbal statements (e.g., "try the white milk") may be effective due to the social pressure associated with compliance. We assume that children discount the future, so that information about present costs or benefits (such as taste) will be more effective than information about future costs or benefits (such as impact on health outcomes). Incentives associated with choosing white milk are effective because they increase the (immediate) benefit of choosing white milk.

We found that prompts increased the proportion of children choosing and consuming the healthier white milk relative to sugar-sweetened chocolate milk from about 20% of the control group to about 30–45% of the treatment groups. Adding health or taste messaging to the prompt did not seem to make a difference. We also found that the health prompts increased the perceived healthfulness of white milk and decreased the perceived healthfulness of chocolate milk, with no impact on perceived taste. Finally, we found that the prompts were about 60% as effective as a small incentive.

Background

The school lunchroom provides a "teachable moment" for policy makers to reach children and improve food choice and consumption. While one could simply dictate what foods go on a child's plate in this setting, research finds that children who choose foods on their own consume more than if they were required to take the foods (Hakim and Meissen 2013). Therefore, we propose that the impact of NSLP on the nutritional intake of low socioeconomic status (SES) children could be increased by prompting children to make healthier choices in the lunchroom.

In the following, we sketch out our hypotheses and describe supporting literature that was used to derive our hypotheses.[5] Rational choice theory predicts that children should make food choices that maximize their utility.

[3] See https://www.ers.usda.gov/topics/food-nutrition-assistance/child-nutrition-programs/national-school-lunch-program.aspx, last accessed July 9, 2019.

[4] We consider chocolate milk the less healthy choice due to its higher added sugar content relative to white milk. Moreover, school officials prefer for children to take white milk, yet most children take the chocolate milk at baseline. According to the National Dairy Council, chocolate milk has about 4 teaspoons of added sugar per 8 oz. serving, compared to 6 teaspoons in an 8 oz. serving of Coca-Cola. Since we are not nutrition experts, we refrain from providing additional evidence for or against each type of milk. Rather, we aim to provide some evidence for the use of prompts and incentives to encourage take-up of foods that school officials may believe are more appropriate.

[5] A formal model is outlined in the online Supplementary Appendix A1.

In our setting, we propose that children have preferences over aspects of food such as taste (experienced immediately) and nutritional value (which, if it affects health, is experienced in the future).

We first evaluate the impact of point-of-purchase prompts; that is, verbal encouragements to choose the healthy food. We are aware of only one study that has evaluated this type of nudge among children. Schwartz (2007) conducted a pilot study and found that the proportion of children taking a serving of fruit increased 2–4 times when the cafeteria worker asked, “would you like fruit or juice with your lunch?” However, this study included one grade at two high-income schools (therefore; few children were participating in NSLP), did not collect baseline data, and did not speak to what kinds of prompts might be most effective. Studies of verbal prompts among adults are also scarce, but the results are promising. Van der Zanden et al. (2015) found that prompting hospital patients to order protein-rich side items increased selection of the item. Ebster, Wagner, and Valis (2006) found that prompts to purchase of sides with the main meal at a restaurant resulted in greater sales. And Schwartz et al. (2012) found that prompting consumers to downsize a fast-food meal decreased calories consumed.

We propose that prompts work by inducing social pressure if they are prescriptive, for example, if they include a request to choose a healthy item. Social pressure, in turn, increases the likelihood of choosing a healthy item since saying “no” to the request incurs a loss in utility, which we call the social pressure cost.[6] In this study, we cannot distinguish the impact of social pressure when the message comes from a person of authority (e.g., the research assistant dressed as cafeteria worker) from social pressure from another source. As such, one could interpret this social pressure effect as the effect of a prescriptive message from a person of authority.

On the other hand, neutral verbal messages that contain information only may not incur social pressure cost. This could explain, for example, why the neutral educational message used in List and Samek (2015) (also delivered by a research assistant working alongside a cafeteria worker) did not affect food choice, while the prompt by the cafeteria worker to choose a healthy side item used in Schwartz (2007) did. This brings us to our first hypothesis:

> Hypothesis 1: *Verbal prompts that induce social pressure to choose the healthy food increase the likelihood of choosing the healthy food.*

We next consider the role of information. We start with health-related information, which is one of the most common informational policy interventions carried out in practice. Examples of informational policies include packaged food nutrition labels or calorie labeling in restaurants. Studies generally conclude that calorie labels are low-cost but may not be particularly effective (Long et al., 2015).[7] New ways to communicate nutrition information to consumers may be needed. Ellison, Lusk, and Davis (2014) found that calorie labels in restaurants had no impact on purchases, unless combined with a traffic light symbol. Similarly, traffic light food labels were shown to improve food purchases in hospital cafeterias (Levy et al. 2012; Sonnenberg et al. 2013).

The evidence on the impact of health-related information on children is more scarce. One experiment used “healthy heart” logos on fast-food items to investigate the impact on choice for children ages 6–11, and found that nutrition information was only effective for high-SES children (Stutts et al. 2011). Another study found that providing Go-Slow-Whoa nutrition information about lunch entrees was effective only for older students (Graham, Vestal, and Guerrero 2015). And a short, neutral message about how snacks fit with USDA nutrition recommendations had no impact on choices (List and Samek 2015).

The premise of interventions focused on delivering health and nutrition information is that children are not aware of the health benefits or costs of certain foods. If this assumption is correct, then a prompt that a food is “good for you” (i.e., healthy) will increase the likelihood of choosing that food. However, a potential reason for the limited

[6] Social pressure costs have also been identified in other contexts. For example, saying ‘no’ to a charitable request may induce social pressure cost (DellaVigna, List, and Malmendier 2012; Chuan and Samek 2014).

[7] Examples include Loureiro, Yen, and Nayga (2012), who found a correlation between reading nutritional labels and obesity, but this relationship was not causal. Ellison, Lusk, and Davis (2015) studied calorie labels in restaurants and found that they had no impact on purchases, unless combined with a traffic light symbol.

effects of health information is that eating healthy has delayed and often vague benefits (Rick and Loewenstein 2008). In addition, the benefits of eating a healthy diet accrue in the future, which kids may heavily discount (Andreoni et al. 2017). This may make the health prompt less effective. This brings us to the next hypothesis:

HYPOTHESIS 2: *Information about health benefits from consuming the healthy food will increase the likelihood of choosing the healthy food.*

If information about future benefits is discounted, then providing information about immediate benefits may be more effective. For example, Buscher, Martin, and Crocker (2001) found that messages emphasizing taste, convenience, and energy increased the selection of healthy snacks in a university cafeteria.

How could information about taste affect food choice? Children may not try healthier foods because they are unfamiliar with them and cannot assess their expected level of enjoyment from these foods. This brings us to our third and fourth hypotheses:

HYPOTHESIS 3: *Information about taste benefits will increase the likelihood of choosing the healthy food.*

HYPOTHESIS 4: *Due to time discounting, information about taste benefits will have a larger impact than information about health benefits, which accrue in the future.*

Finally, related work has explored the impact of incentives on food choice. A prominent example is the Healthy Incentive Pilot (HIP), which provided incentives to consumers to purchase targeted fruits and vegetables. This program increased the purchase of these foods by nearly 25% (Klerman et al. 2014). Another example is List et al. (2015) who found that small incentives more than doubled the proportion of dollars spent on produce at the grocery store.

Incentives have been effective in school cafeterias as well, sometimes doubling or quadrupling the consumption of the target food (Just and Price 2013; List and Samek 2015, 2017; Angelucci et al. 2018; Loewenstein, Price, and Volpp 2016). Like taste prompts, incentives provide an immediate benefit (e.g., a small toy or monetary reward for making the healthy choice). However, unlike informational prompts, the benefit is realized regardless of whether children already have information about the health and taste of a food. Hence, incentives may have an even greater impact on food choice. This brings us to our last hypothesis:

HYPOTHESIS 5: *Incentives tied to choosing the healthy food will increase the likelihood of choosing the healthy food.*

The above hypotheses rely on the assumption that our interventions do not provide additional signaling value. For instance, learning about the health benefits of a food should not affect a child's perception of its taste, and vice versa. To evaluate this assumption, in the experiment we also conduct surveys in which we ask children about the perceived health and taste of the milk they selected.[8]

Our article provides several contributions relative to past work. Our article is the first to systematically investigate the effect of manipulating different channels—social pressure, and information about costs and benefits—on food choice. We also benchmark the relative effect of information by comparing the impact of our informational prompts to the impact of a non-monetary incentive. Finally, the intervention we propose is relatively low-cost and could be easily implemented in most school cafeterias.

Experimental Design

We next describe the experimental setup, explain the timeline of the experiment, and summarize the experimental treatments.

Experimental Setup and Data

Our field experiment was conducted in the spring of 2012 during nine days in the school lunch program in the Chicago Heights, Illinois School District with nine schools, grades K–8 and a total of 2,650 children participating. Chicago Heights, Illinois, is a low SES area with a mean household income of \$14,963. Over 95% of students in this district

[8] This assumption may or may not hold. For example, Maimaran and Fishbach (2014) found that giving children ages 3–5.5 information about the health benefits of a food caused the children to consume *less* of the food, potentially because they thought healthy food would not taste good.

qualify for free or reduced-price school lunch through NSLP. This district also has significant populations of minority students, including African American (37.5%), and Hispanic (23.8%) students.[9]

It is important to describe the relationship of this data with other data that has been collected in school lunchrooms in the Chicago area. List and Samek (2017) is a short article reporting on the impact of incentives on milk choice, which uses a subset of the same data that is presented here (control and incentive treatments only). The intervention in Angelucci et al. (2018) and Samek (2016) occurred after the data collection described here. List and Samek (2015) conducted an intervention in after-school programs in Chicago, Illinois, which is a different population from the set of Chicago Heights schools we report on here. Finally, the Chicago Heights Early Childhood Center (CHECC) was an intervention aimed at improving the educational attainment of three and four year-old children conducted in 2010–14 (Fryer, Levitt, and List 2015). Some of the children who participated in CHECC went on to attend Chicago Heights public schools. We do not believe that this program should interact with food choice in the lunchroom since it focused on academic skills and did not have a nutrition component; moreover, only a small number of children would have been attending K–8 at the time of our experiment (most were still preschool age or younger).

During a typical lunch period, as children go through the cafeteria line, they receive the day's main menu item, required side items, and then proceed to select milk; see figure 1. According to guidelines set by the USDA, schools are required to provide students with two milk options—while options are left to the district, many districts choose to provide a white and a chocolate milk option. The choice of milk is the only decision that students in our district make in the lunch line.

We recorded the selection and consumption of milk, as well as consumption of other food items served at lunch. We tracked children at the individual level throughout the experiment using ID numbers marked on lunch trays. We stood at the end of the lunch line to record

Figure 1. The lunchroom

selection as children walked past. We collected lunch trays at the end of the lunch period and recorded consumption after children left the lunchroom. Milk consumption was measured by weight, while consumption of other foods was measured by visual inspection.

Each day, we also conducted surveys with a subset of children asking about perceptions of health and taste of the milk selected. Because we did not have the manpower to survey all children, we randomly selected a subset of children to survey each day. As children were eating lunch, we asked them to check their tray for a hidden sticker that indicated they had been randomly selected for the survey (we prelabeled trays in advance, and children do not have the opportunity to choose their tray). The data we collected thus include children who were in the middle of eating lunch and who had already selected either white or chocolate milk. The survey questions we asked mirrored the prompts. For the taste question, we asked: "how good does your milk taste?" and for the health question, we asked: "how good for you is the milk?" Children responded by pointing to the corresponding smiley face on a visual of a 5-point Likert scale with smiley faces, from very bad to very good. We provide a description of our protocol, including language of the surveys used, in the online supplementary appendix A2.

Experimental Design, Timeline and Data Construction

Figure 2 summarizes the experimental design and timeline. We randomized children at the lunch period level to one of five treatments: Control (no intervention), Prompt ("try the white milk"), Health Prompt ("try the white milk, it is good for you"), Taste Prompt ("try the white milk, it tastes good"), and Incentive

[9] Sources: US Census Bureau - State and County QuickFacts. Data derived from Population Estimates, 2000 Census of Population and Housing, Illinois NSLP Eligibility Percentage, https://www.cyberdriveillinois.com/departments/library/libraries/pdfs/il-nslp-eligibility.pdf, last accessed July 9, 2019.

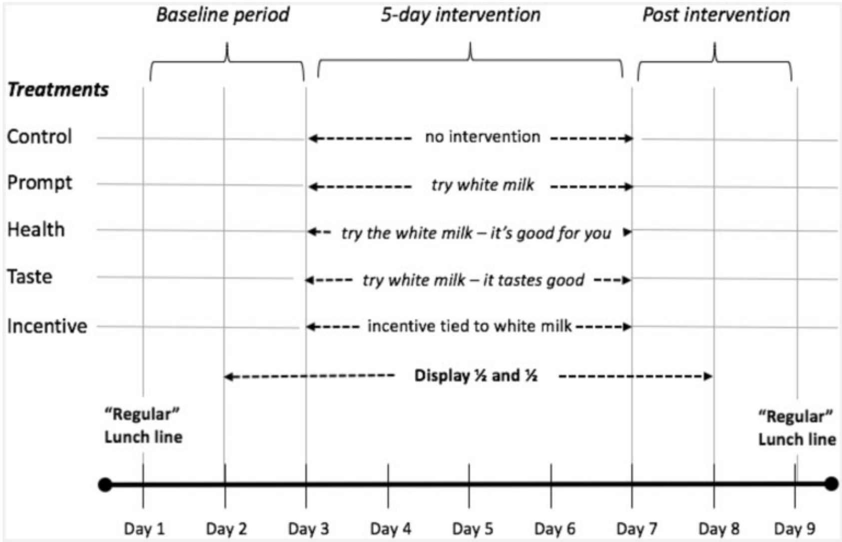

Figure 2. Experimental timeline

(whereby a glow-in-the-dark bracelet valued at \$0.20 was attached to each white milk carton but not to any chocolate milk cartons). Children remained in the same treatment for the duration of the study.

We call the first two days of the study the baseline period. On day 1, we recorded milk choice without changing the environment. We noted that since chocolate milk was chosen more often, cafeteria workers often put out more chocolate milk than white milk. And white milk would often run out before the end of lunch. We didn't want to constrain the effects of our intervention, and we wanted to maintain consistency in the milk display across schools and treatments. Hence, on day 2, we had a research assistant replenish milk throughout the lunch period such that equal amounts of chocolate and white milk were always available in the line.

The next five days (3–7) are the intervention period. During this period, we continued to make sure that equal amounts of chocolate and white milk were available in the lunch line. In Control, we did not make any changes to the environment. In the prompt treatments (Prompt, Health Prompt, and Taste Prompt) our research assistant prompted each child with the scripted message as he or she went through the lunch line. In the Incentive treatment, we made sure prior to lunch that all white milk cartons had the glow-in-the-dark bracelet attached to them but did not prompt the children. Only one intervention was conducted per lunchroom period.

The final two days are the postintervention period. We did not prompt or provide incentives to children on either of these days. On the penultimate day (8), we continued to make sure that equal amounts of chocolate and white milk were available in the lunchroom. On the final day (9) we allowed the lunch line to go back to normal operations; that is, we did not make sure that equal amounts of milk were available.

Field experiments can result in messy data. We started with 17,364 observations, but dropped 18.5% of the data in the analysis due to errors or incomplete data entry. For example, sometimes we ran out of one type of milk during the school lunch period and could not record choices for children or made some other experimenter error ($N = 3,216$); other times we were unable to record the child's name quickly enough, and some other times either we recorded inaccurately—or children chose—no ($N = 43$) or more than one ($N = 337$) milk. We dropped all of these cases from the analysis; a more detailed diagram listing these drop rules as well as numbers by treatment is available in the online supplementary appendix A2.

Results

We next summarize the sample, discuss the treatment effects on selection and consumption, and finally we discuss mechanisms.

Table 1. Summary of Sample

Treatment	Number of Observations (Total Unique)	Number of Observations (Typical Day)	% Female (Typical Day)	Median Grade (Typical Day)
Control	466	319	51.74	2nd grade
Prompt	548	315	51.22	5th grade
Health prompt	582	339	50.76	4th grade
Taste prompt	515	329	49.16	3rd grade
Incentive	539	280	54.43	3rd grade
Total/average	N = 2,650	N = 1,582	51.34	3rd grade

Note: "Total unique" refers to the total number of children who were ever in the study. "Typical day" refers to how many kids we observe on average in each day, including only children for whom an ID is available. Typical is considerably lower due to field trips, absences, and days that we do not have sufficient quantities of milk and stop data collection early. We use only the subsample for whom we are able to identify by ID number.

Summary of Sample

Table 1 provides a summary of the number of children who participated in each treatment, with additional descriptive statistics. We obtained child gender, race, and grade from school records. In sum, 51.34% of children in the experiment were female, and the median grade of all children at the time of the intervention was third grade. 57.0% are Hispanic, 38.9% are African American, 4% are white, and 1.2% are multiracial. The composition of age differs somewhat by treatment. The most apparent difference is the slightly older ages for Prompt and Health treatments and slightly younger ages for Control.

As demonstrated by table 1, since randomization is at the school lunch period level, the composition of age differs somewhat by treatment. Children in Prompt and Health treatments are slightly older than average, and children in Control are slightly younger than average. As discussed later, there are also some differences in the proportion of children choosing white milk at baseline. Hence, in what follows, we present results both as regressions using subject fixed-effects to account for these differences, and as nonparametric two-way *t*-tests comparing treatments. We note that the fixed-effects approach does not completely fix the problem, which is one limitation of the approach to randomize at the group level.

Treatment Effects on Selection

Figure 3 shows the proportion of children choosing white milk, by treatment, over the nine study days. This figure suggests that all treatments had a large impact at increasing the proportion of children choosing white milk, relative to the control group. It also appears that the impact of the Health Prompt and Taste Prompt was not different from the impact of the Prompt alone. Displaying one-half white milk and one-half chocolate milk results in slight increases in white milk selection.

Table 2 estimates a fixed-effects logit model with dependent variable white milk choice (=1 if white milk is chosen; 0 otherwise). We include the treatment dummies Prompt, Health Prompt, Taste Prompt and Incentive (=1 if treated with that treatment in days 3–7; 0 otherwise), a period trend, and a dummy for whether we displayed one-half white and one-half chocolate milk during the baseline and postintervention periods (=1 on days 2 to 8; 0 otherwise). We include individual fixed effects and cluster at the school-lunch period level. Specification (1) displays results from days 1–7, which excludes the postintervention period. Specification (2) includes days 8–9, and Post-Treatment * Prompt, Post-Treatment * Health Prompt, Post-Treatment * Taste, and Post-Treatment * Incentive are dummies for treatment groups in post-treatment period.

We find a strong and statistically significant effect of social pressure: the coefficient on Prompt in table 2 is positive (2.22) and statistically significant ($p < .01$). Additionally, Wilcoxon Mann-Whitney nonparametric two-way comparison tests using white milk choice averaged by individual in prompt treatments to control yield p-values < 0.01.[10] This brings us to

[10] Wilcoxon Mann-Whitney non-parametric two-way comparison tests of control to prompt, health, taste, and incentive using white milk choice by individual averaged across treatments all yield p-values $< .001$. When using the lunch-period level as an independent

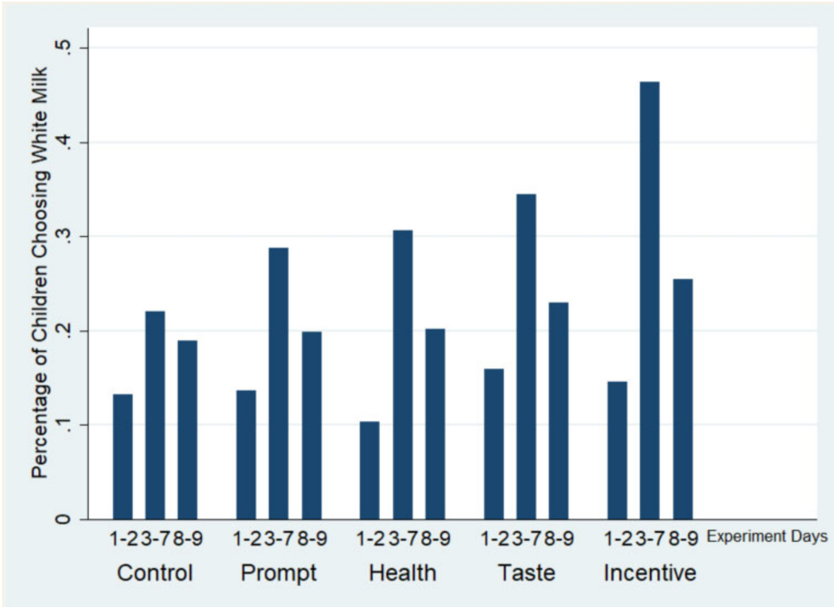

Figure 3. Percentage of children choosing white milk over course of study

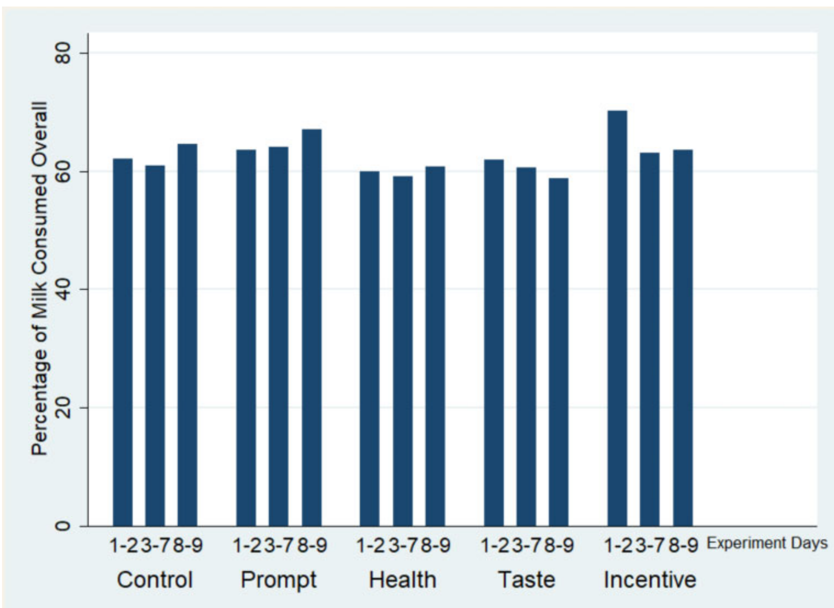

Figure 4. Overall milk consumption by day and treatment

observation, the corresponding *p*-values are .142, .088, .023, and .019. Comparing prompt to health, taste, and incentive results in *p*-values of .941, .055, and .000 at the individual level and .855, 0.291, and .100 at the lunch-period level. The two-way comparison tests between incentive and health and incentive and taste both yield *p*-values of <.001 at the individual level and .055 and .391 at the lunch-period level on the first day of treatment. Note that the incentive treatment was not implemented in some of the schools on some days, which results in a decreased power for this treatment.

our first result, which is in support of Hypothesis 1:

RESULT 1: *Prompts to choose white milk significantly increase the proportion of children choosing white milk.*

Table 2. Statistical Tests of Selection (Dependent Variable: White Milk Choice)

	Days 1–7	Days 1–9
Prompt	2.22***	2.18***
	(0.59)	(0.58)
Health	2.16***	2.18***
	(0.65)	(0.55)
Taste	1.52**	1.56**
	(0.69)	(0.67)
Incentive	2.52***	2.78***
	(0.37)	(0.40)
Display 1/2 white, 1/2 chocolate	0.78	0.56***
	(0.51)	(0.22)
Period trend	−0.04	−0.01
	(0.06)	(0.05)
Post-treatment * prompt		1.39***
		(0.39)
Post-treatment * health		1.31***
		(0.48)
Post-treatment * taste		0.80
		(0.49)
Post-treatment * incentive		1.45***
		(0.45)
Observations	4,846	6,810
Randomization units (school *lunch periods)	28	28

Note: (1) The omitted group contains observations in control group for day 1–9 and observations in all four treatment groups for day 1–2 (pre-treatment). (2) Prompt, health, taste, and incentives are dummies showing that the observation is in the corresponding treatment group and in day 3–7 (treatment days). Post-Treatment * *X* is the dummy indicating that the observation is in *X* treatment group and in day 8–9 (post-treatment days). Robust standard errors clustered at the school*lunch period-level in parentheses. The above coefficients are point estimates from a Logit individual student fixed effects regression in STATA. Post-treatment interaction effects are dummies at post-periods, while treatment effects are dummies at treated days. ***$p < .01$, **$p < .05$, *$p < .1$.

Next, we address the question of which type of information is most important for nudging behavior by investigating the effect of the additional taste or health message added to the prompt. Post-estimation tests comparing the impact of the Health Prompt (Coefficient = 2.16, p-value < .01) or Taste Prompt (Coefficient = 1.52, p-value = .02) to Prompt show no statistically significant differences (p-value = .94, .41, respectively). The Health Prompt and Taste Prompt treatment coefficients are also not significantly different from each other ($p = .44$). Wilcoxon Mann-Whitney tests do show some differences by treatment (p-value of .04 comparing Taste to Health and p-value of .06 comparing Taste to Prompt); however, these results should be interpreted with caution given some initial imbalance across groups. Overall, the result that all prompts work about as well is in contrast to Hypotheses 2–4, where we speculated that health and taste information should also increase white milk choice, and that taste information would have a greater impact than health information. This brings us to our next result:

> RESULT 2: *Incorporating health or taste information into the prompt does not increase the proportion of children choosing white milk relative to the prompt alone.*

Next, we investigate the effect of the Incentive treatment. The coefficient on Incentive in table 2 is positive (2.52) and statistically significant ($p < .01$). In addition, averaging across all treatment days we find strong and significant effects in the incentive treatment as compared to control: choice of white milk increases by over 10% for Incentive relative to Control (Wilcoxon Mann-Whitney nonparametric two-way comparison tests using white milk choice averaged by individual in Incentive versus Control yield p-value < .01). Again, we also observe a significant difference when treating the lunch-period level (randomization level) as an independent observation (p-value = .02). We can also directly investigate the effect of incentives as compared to prompts. We find that incentives are somewhat more effective than the prompts, but postestimation tests show no significant differences between the Incentive treatment and the Prompt, Health Prompt, or Taste Prompt treatments (p-values > .10). This brings us to our next result, which is also discussed in List and Samek (2017):

> RESULT 4: *Prompts are nearly as effective as small, nonmonetary incentives at increasing selection of white milk.*

Finally, Specification (2) in table 2 includes data from days 1–9, which allows us to explore the impact of the interventions in the postintervention period. We find that Post-Treatment * Treatment Dummy coefficients are about half the size of the coefficients during the treatment period (0.8–1.45) and significant (p-value < .01 except Post-Treatment * Taste Prompt p-value = .11). Importantly, this allows us to rule out a potential "crowd-out" effect commonly hypothesized in the psychology literature, which posits that a negative effect of incentives is that they reduce the intrinsic motivation for a target behavior and decrease the prevalence of target behavior relative to the baseline after incentives are removed. This result also provides suggestive evidence in support of a habit formation story, meaning that kids continue to choose the healthier white milk for several days even after the intervention in that study. Of course, since we only followed children for two days following the intervention, we do not know how these habits would fade out over time. This brings us to our last result:

> RESULT 5: *The prompt and incentive treatments continue to show positive effects in the two days after the intervention is removed.*

Since we conducted an experiment with four treatment arms and a control group, we also conduct the robustness test discussed in List et al. (2015) to account for multiple hypothesis testing (MHT). To do so, we first average selection (proportion of times each person selects white milk) across all treatment days by individual in the experiment and conduct nonparametric *t*-tests comparing treatment and control groups. We obtain *p*-values of less than .01 when comparing control to any of the treatment groups (Prompt, Taste, Health, or Incentive). Next, we adjust the *t*-tests for MHT using the statistical package supplied by List et al. (2015). Adjusted for MHT, we continue to obtain *p*-values of less than .01, suggesting that our treatment effects results are robust to MHT. We do a similar exercise averaging selection across all post-treatment days. We obtain *p*-values of .29 when comparing Prompt to Control, .34 when comparing Health Prompt to Control, .12 when comparing Taste Prompt to Control, and .01 when comparing Incentive to Control. Next, we adjust the *t*-tests for MHT using the statistical package supplied by List et al. (2015). Adjusted for MHT, only the comparison of the incentive treatment with control remains significant at the 5% level. One of the reasons why we may observe stronger effects in the regressions is that there we control for baseline selection and other background characteristics of participants.

Consumption

While prompts and incentives may change the targeted selection behavior, we may worry that they will have a negative effect on consumption. This is important to investigate for several reasons. First, if children do not actually consume the healthier item, then we cannot claim that the intervention improves health. Second, from a practical standpoint, school administrators and policy makers care about decreasing food waste—in our experiment, at baseline almost 40% of milk is thrown out.

Figure 4 reports the average consumption of milk by treatment, calculated as *(Total weight of milk with carton)-(weight at end of lunch) / (Total weight of milk with carton).* Children consume about 60% of their milk, on average, with no perceptible differences for most treatment groups. This is good news, since it means that despite being nudged to choose the white milk, children were still getting the same amount of dairy with their meal.

We next study the impact of our treatments on the nutritional profile of children's milk consumption. Recall that our main focus was on decreasing consumption of added sugars. The white milk used in our study contains 0 grams of added sugar, and the chocolate milk contains 7 grams of added sugar in each carton. Table 3 includes a regression where the outcome measures are the macronutrients (calories, grams of carbohydrates, grams of protein, and grams of total fat) and other nutritional characteristics (grams of added sugar and calcium). We find that all treatments show a decrease in the consumption of added sugars relative to control (p-values $< .05$). In addition, we find that all treatments show an increase in total fats consumption (p-values $< .05$), which is explained by the fact that the white milk option was "low fat," whereas the chocolate milk option was high in added sugar but "fat free." We do also observe a decrease in overall milk consumption during treatment in the Incentive group, with children consuming about eleven milk calories less in this group.

> RESULT 6: *Prompts and incentives are effective at decreasing the consumption of added sugars.*

Mechanisms

In this section, we investigate whether our treatments had an impact on the perceived

Table 3. Regressions of Nutrition Consumption-Calories and Protein

	Milk Consumed (mL)	Calories	Total Carb (g)	Protein (g)	Total Fat (g)	Added Sugar (g)	Calcium (%)
Prompt	−7.20	−4.09	−0.91	−0.24	0.11***	−0.52**	−0.76
	(7.17)	(3.65)	(0.63)	(0.24)	(0.04)	(0.25)	(0.76)
Health	−5.57	−3.54	−0.97	−0.19	0.18***	−0.66**	−0.59
	(11.31)	(5.59)	(0.86)	(0.38)	(0.06)	(0.27)	(1.20)
Taste	−4.56	−3.03	−0.88	−0.15	0.18***	−0.63**	−0.48
	(7.00)	(3.58)	(0.63)	(0.24)	(0.06)	(0.28)	(0.74)
Incentive	−20.16***	−11.60***	−2.67***	−0.68***	0.34**	−1.56***	−2.13***
	(6.58)	(3.70)	(0.85)	(0.22)	(0.14)	(0.53)	(0.70)
Display 1/2 white, 1/2 chocolate	−0.23	−0.36	−0.19	−0.01	0.06***	−0.18	−0.02
	(5.13)	(2.59)	(0.43)	(0.17)	(0.02)	(0.15)	(0.54)
Period trend	1.06	0.54	0.09	0.04	0.00	0.03	0.11
	(0.87)	(0.43)	(0.07)	(0.03)	(0.01)	(0.03)	(0.09)
Post-treatment * prompt	3.88	1.73	0.16	0.13	0.06	−0.05	0.41
	(5.81)	(2.87)	(0.46)	(0.20)	(0.06)	(0.18)	(0.61)
Post-treatment * health	−4.67	−2.65	−0.59	−0.16	0.07	−0.34	−0.49
	(11.66)	(5.92)	(1.00)	(0.39)	(0.05)	(0.38)	(1.23)
Post-treatment * taste	−13.24	−7.03	−1.34	−0.45	0.08	−0.61*	−1.40
	(11.31)	(5.63)	(0.90)	(0.38)	(0.08)	(0.32)	(1.19)
Post-treatment * incentive	−24.76**	−12.91**	−2.34**	−0.84**	0.09	−0.98**	−2.62**
	(10.03)	(5.17)	(0.94)	(0.34)	(0.10)	(0.44)	(1.06)
Constant	148.92***	74.78***	12.07***	5.04***	0.19***	3.88***	15.74***
	(2.61)	(1.34)	(0.24)	(0.09)	(0.02)	(0.10)	(0.28)
Observations	14,130	14,130	14,130	14,130	14,130	14,130	14,130

Note: (1) The omitted group contains observations in control group for day 1–9 and observations (These regressions are not conditioned on choosing white milk) in all four treatment groups for day 1–2 (pre-treatment). (2) Prompt, health, taste, and incentives are dummies showing that the observation is in the corresponding treatment group and in day 3–7 (treatment days). Post-Treatment * X is the dummy indicating that the observation is in X treatment group and in day 8–9 (post-treatment days). ***$p < .01$, **$p < .05$, *$p < .1$.

health and taste benefits of the milk. Specifically, we are interested in learning whether the informational prompts had the intended consequence (i.e., that health prompts improve perceived healthfulness and taste prompts improve perceived taste) and whether the treatments had spillover effects onto nontargeted perceptions (e.g., that taste prompts improved perceptions of healthfulness).

Table 4 displays the results to these survey questions. The questions were asked of children conditional on already selecting white or chocolate milk. This means that the results include both a treatment effect (changing perceptions) and a selection effect (changing respondents). The results of the treatments can therefore be interpreted as the perceptions of children who would normally choose this milk, in addition to children who choose the milk as a result of the prompt or incentive.

We have three overarching findings. First, as expected, the Health Prompt increases the perceived healthfulness of the white milk (Specification [3] Coefficient = 0.45, $p = .02$). But interestingly, the Taste Prompt also increases the perceived healthfulness of the white milk (Specification [3] Coefficient = 0.42, $p = .02$). This suggests that children infer health information even from prompts that are not aimed at imparting this information. Second, we find that the Prompt and Incentive treatments decrease the perceived healthfulness of chocolate milk (Specification [4], Coefficient = −0.43, $p = .00$ and Coefficient = −0.63, $p = .01$, respectively). This suggests that children further infer from these treatments that they should not be consuming chocolate milk. Third, we find that it is more difficult to change perceived taste. None of the treatments, including the Taste Prompt treatment, has an impact on this perception (Specification [1], Coefficient estimates −0.32 to 0.07, all p-values > .10). This could be because taste perceptions are inherently difficult to change, or because children had already tasted their chosen milk at the time they were surveyed.

Table 4. Perceived Taste and Perceived Health, Conditioned on Milk Choice

Milk Choice	Perceived Taste White Milk	Perceived Taste Chocolate Milk	Perceived Health White Milk	Perceived Health Chocolate Milk
Prompt	−0.26	0.13	0.13	−0.43***
	(0.20)	(0.11)	(0.19)	(0.15)
Health	−0.14	−0.11	0.45**	−0.15
	(0.26)	(0.13)	(0.19)	(0.14)
Taste	0.07	0.04	0.42**	0.04
	(0.17)	(0.12)	(0.19)	(0.13)
Incentive	−0.32	0.18	−0.15	−0.63***
	(0.22)	(0.14)	(0.26)	(0.24)
Display 1/2 white, 1/2 chocolate	0.12	−0.07	0.03	0.00
	(0.23)	(0.09)	(0.19)	(0.10)
Period trend	0.01	0.00	0.02	0.00
	(0.04)	(0.02)	(0.04)	(0.02)
Post-treatment * prompt	−0.12	−0.19	−0.19	−0.28
	(0.32)	(0.21)	(0.36)	(0.19)
Post-treatment * health	0.39	0.07	0.23	−0.00
	(0.31)	(0.17)	(0.31)	(0.19)
Post-treatment * taste	0.40	0.20	0.74***	0.01
	(0.28)	(0.14)	(0.21)	(0.20)
Post-treatment * incentive	−0.13	−0.25	0.40	−0.55**
	(0.46)	(0.23)	(0.25)	(0.23)
Constant	4.22***	4.44***	4.01***	4.14***
	(0.28)	(0.08)	(0.25)	(0.10)
Observations	274	809	282	822

Note: (1) The omitted group contains observations (answering the question) in control group for day 1–9 and observations (answering the question) in all four treatment groups for day 1–2 (pre-treatment). In specification 1 and 3 only observations choosing white milk and answering the question are included. In specification 2 and 4, only observations choosing chocolate milk and answering the question are included. (2) Prompt, health, taste, and incentives are dummies showing that the observation is in the corresponding treatment group and in day 3–7 (treatment days). Post-Treatment * X is the dummy indicating that the observation is in X treatment group and in day 8–9 (post-treatment days). (3) Days 1–9 are all included in the regression. ***$p < .01$, **$p < .05$, *$p < .1$.

Since the prompts are delivered by a person of authority, it could be that children take these interventions as signals about what is good for them. This is potentially important since it suggests that interventions may operate through the health channel, even when the intervention does not provide health information.

We also investigated social norms by asking "if five kids today went to pick up milk, how many of them do you think picked the chocolate milk?" We find that children receiving the prompt and choosing white milk over chocolate milk are also significantly less likely to believe that others chose chocolate milk (see online supplementary appendix Table A1). This is interesting since it suggests that prompts can affect beliefs about the social norm.

Conclusion

The United States spends about 13 billion dollars a year on the NSLP. Yet the benefits of this program on nutritional intake are mixed, partly because children do not choose the healthy foods or throw out much of the food offered in the program. We set out to discover low-cost, scalable nudges that could improve child nutritional intake and the effectiveness of the NSLP. We found that short verbal prompts (e.g., "try the white milk") were effective at increasing the proportion of children choosing white milk. These prompts did not impact the amount of milk ultimately consumed, and therefore lead to decreases in added sugar intake. Information about health or taste of the white milk did not further improve the proportion of children choosing white milk but did affect the perceptions of the healthfulness of white milk.

We also compared the impact of the prompt to a small, nonmonetary incentive to benchmark the impact of the effect. Incentives are one of the most effective behavioral economics tools for improving food choice. We find that the prompt was nearly as effective as the incentive. This is important because prompts may be a more scalable solution to improving food selection and consumption than an incentive that must be given out daily.

Our study has several limitations. First, the limited time frame means that we were unable to consider the long-term effects of the intervention. The impact of the intervention could fade quickly after the intervention is removed. However, note that because this intervention is so low-cost, it is one of the few interventions that one could continue to implement throughout a school year. On the other hand, we also do not know if the effects of the intervention would fade out in the long-term if it was repeated. This is an interesting direction for future work.

Second, we do not have data on food intake outside of school, so it is unknown whether children who are nudged to choose the healthier milk at lunchtime end up consuming more sugar-sweetened beverages outside of school. A useful direction for future work would be to couple this or similar interventions with other measures of dietary intake, such as food diaries, food frequency questionnaires, or twenty-four hour food recalls. These may be difficult to implement with younger subjects.

Third, we chose to combine the prompt with the information because it felt more natural, and because prior work suggests that information alone is less effective (e.g., List and Samek 2015). However, this design does not allow us to investigate whether the health or taste information alone, without a prompt, would have changed behavior. An alternative set of treatments could have included information without the prompt (i.e., "white milk is good for you" or "white milk tastes good"). We did not have the required sample size to implement these treatments. Therefore, we leave this to future work.

Fourth, we interpret the impact of the prompt as a social pressure effect. However, a limitation is that we cannot distinguish the effect of the message delivered by a research assistant dressed as a cafeteria worker (who may be interpreted as a person of authority) from a message delivered by someone else. And an alternative interpretation of the effect could be that children do not care about health benefits, but prompts of any kind simply draw attention to the white milk and increase choice. However, we also do observe meaningful changes in perceptions related to the different messages, which suggests that children do pay attention to the content of the message.

Our findings have practical relevance for policy makers looking to improve the impact of the NSLP and other food assistance programs. First, policy dollars may be better spent on encouraging greater interaction between cafeteria staff and children, since this interaction, especially if it is in the form of social pressure through a prompt or "ask," is very important in child decision making in our setting. Such interventions seem to affect children through changing the perceived healthfulness of food, even when a direct "health" message is not part of the intervention.

Supplementary material

Supplementary materials are available at *American Journal of Agricultural Economics* online.

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