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Sweet or not: Using information and cognitive dissonance to nudge children toward healthier food choices[☆]

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ABSTRACT

In the interest of public health, it is important to nudge children toward healthier food choices (e.g., beverages with less added sugar). We conducted a field experiment in a peri-urban region in Vietnam to evaluate the effects of information and cognitive dissonance on the food choices of children. Our sample consisted of more than 1200 primary school children, randomly assigned into three groups: control, health information, and health information plus hypocrisy inducement. The third group was intended to raise cognitive dissonance by illustrating the gap between what people know they should do (socially desired behaviors) and what they actually do (transgressions). The results indicate that health information increased the likelihood of selecting milk with less sugar by around 30 %, as compared to the control group. Hypocrisy inducement did not make any additional contribution to healthier food choices. The treatment effects declined when there was a delay between the treatment and the behavioral choice. We discuss the practical implications of our findings for short-term intervention field studies.

1. Introduction

Poor food choices can have detrimental health consequences. Various scholars have linked unhealthy diets to an increased risk of non-communicable diseases, which are on the rise throughout the world, including in low and middle-income countries (LMICs) (Kelly, 2016; Popkin, 2003). Excessive sugar consumption, especially from sugar-sweetened beverages, has been associated with dental caries, metabolic syndrome, Type 2 diabetes, and weight gain (Khan and Sievenpiper, 2016; Le Bodo et al., 2015; Morenga et al., 2013). The consumption of added sugar and sugar-sweetened beverages has been associated with higher body mass index (BMI) in pre-school and school-aged children across various settings (Laverty et al., 2015; Liberali et al., 2020; Millar et al., 2014; Wang et al., 2018; Yu et al., 2016). Childhood obesity is a risk factor for several non-communicable diseases (e.g., cardiovascular disease, dyslipidemia, metabolic syndrome). It also increases the risk of psychological problems, including discrimination, social isolation, and low self-esteem (Yanovski, 2015), which can continue to affect health even into adulthood (Liberali et al., 2020). Despite limited evidence on relationships between the consumption of snack foods and sugar-sweetened beverages and the overall dietary outcomes in LMICs, the high consumption of such foods could potentially contribute to undernutrition in the form of micronutrient dilution. Given the nutrient-poor diets that are common in LMICs, it could also increase the risk of overnutrition (Pries et al., 2019). In light of these risks, the World Health Organization (WHO) recommends reducing added sugar in diets to mitigate the risk of non-communicable diseases in adults and children, as well as to prevent and control unhealthy

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weight gain and dental caries (World Health Organization, 2015).

In Viet Nam, an LMIC undergoing rapid nutrition transition (Harris et al., 2020; Khan and Ha, 2008), high consumption of foods high in sugar and calories has been blamed for the rise of overweight and obesity status among children. According to a study by the National Institute of Nutrition, 42 % of children in the urban areas of Vietnam[1] are overweight and/or obese, relative to 35 % in rural areas (An, 2019). In acknowledgement of issues relating to the nutrition transition, Vietnamese health policy includes targets for obesity reduction (Harris et al., 2020). According to the same study, many Vietnamese students engage in unhealthy food habits, including the consumption of sugar-sweetened drinks or foods. Moreover, in 2018, the average daily consumption of free sugar in Vietnam was about 46.5 g per capita. This amount is close to the maximum daily intake (50 g) and almost twice the recommended daily intake (< 25 g) for individuals, as specified by the WHO (Anh, 2018). Given the high average level of sugar consumption in the country, it is critical to understand how to steer children toward choosing healthier options (e.g., foods and beverages with less added sugar). Information on effective ways of promoting healthier eating in Vietnam could have relevant implications for containing the growth of obesity during the nutrition transitions of other LMICs.

Behavioral economists have introduced nudges as a potentially powerful and increasingly trusted public-policy tool for improving human behavior, including eating a healthier diet (Bauer and Reisch, 2019; Sunstein et al., 2019; Thaler and Sunstein, 2008). For example, there is evidence that the activation of health goals when people are making decisions can help them to overcome impulsive unhealthy food decisions (Wilson et al., 2016). In other studies, researchers have manipulated social norms (e.g., health messages about the behavior of others) when implementing interventions aimed at inducing people to eat healthier foods (Robinson, 2013). To overcome mistaken judgements concerning long-term costs and short-term benefits when making health-related decisions, researchers have also attempted to link healthier choices to immediate rewards. Incentives have been a popular medium for steering children toward healthier choices. For example, Just and Price (2013) report that incentives can increase the proportion of children eating a serving of fruit and vegetables while reducing food waste. In another study, Belot et al. (2016) found that competition enhanced the effectiveness of in-kind rewards in encouraging children to eat more fruit and vegetable at lunchtime. In contrast, List and Samek (2015) found that framing in terms of gains and losses made no difference in encouraging children to select healthier snacks. The literature also provides evidence of incentives to make unhealthy choices that counteract the positive effects of nutritional training (Mora and Lopez-Valcarcel, 2018).

One behavioral tool that can help to change food-related attitudes and food choices (Ong et al., 2017; Worsley, 2002) is cognitive dissonance, which relates to the internal discomfort that people feel when their beliefs, emotions, attitudes, and actions conflict with each other. Given that people have the urge to reduce this tension by adjusting their beliefs or actions, arousing dissonance could help to achieve behavioral change. Although researchers have tested and successfully scaled up many concepts from the behavioral sciences concepts, few have investigated cognitive dissonance in relation to attitudes and behaviors within the domain of food and nutrition. While very few studies examine the potential of cognitive dissonance to influence healthy food behaviors (Ong et al., 2017), empirical evidence suggests that it can be effective in changing behavior toward socially desirable ends, including reducing water usage (Dickerson et al., 1992), increasing condom use (Aronson et al., 1991) and charitable giving (Kessler and Milkman, 2018), and reducing hypothetical bias in contingent valuation studies (Alfnes et al., 2010).

One major paradigm associated with the arousal of cognitive dissonance involves inducing hypocrisy. This paradigm involves arousing cognitive dissonance in two steps. First, individuals are induced to make public statements that are consistent with normative standards, after which they are reminded of times when they did not act according to such standards. Individuals are consequently nudged toward resolving this dissonance by taking the proper action. As supported by a recent meta-analysis, that inducing hypocrisy can have a moderate positive effect on both behavioral intentions and behavior (Priolo et al., 2019). Of the studies included in that review, however, only one involved children (Morrongiello and Mark, 2008). In the current lab-in-the-field experiment, we examine whether the "hypocrisy" condition can nudge children in Vietnam toward choosing healthier foods for their snacks.

We conducted our pre-registered experiment took place in 12 primary schools in Dong Anh district, a peri-urban[2] district on the outskirts of Hanoi, Vietnam.[3] We randomly assigned each of 136 classrooms to one of three experimental conditions: an information treatment, an information plus hypocrisy-inducement treatment, and a control condition. Ten randomly selected children from each classroom participated in the experiment. In the first treatment, the children watched a short animated video on healthier eating. In the second treatment, after watching the animation, the children were asked to record a message about eating less sugar to share with others and were reminded of their actual sugar eating habits. We intended this "hypocrisy-inducement" procedure to make children aware that they were not following their own advice. At the end of the experiment, we offered cartons of milk to all participating children as a thank-you gift. They could choose from among three options: sweetened milk, reduced-sugar milk, and unsweetened milk. We recorded the choice of milk as an outcome measure of healthier eating behavior.

Our study makes three contributions to the literature on behavioral health economics. First, we evaluate whether the dissonance-arousal nudge improved the use of the information-provision nudge. Although providing information is an inexpensive and scalable approach, evidence is mixed concerning its effectiveness in changing behavior (Bauer and Reisch, 2019). In several studies, educational messages have failed to influence food-choice behavior (List et al., 2015; List and Samek, 2015). In our experiment, we added a hypocrisy-inducing procedure to the information-provision condition and compare its effects to those obtained in the information-only condition. Studies using a hypocrisy paradigm to motivate good behavior among younger subjects have yielded ambiguous results concerning the relative importance of hypocrisy, educational aspects, and the provision of information. For example, in a study by Morrongiello and Mark (2008), children 7–12 years of age viewed a poster about safe playground activity, after which they were asked to sign the poster and read the message headings aloud in a radio commercial. In another example (Ager et al., 2008), a group of children 10–12 years of age participated in weekly sessions on video skills and substance abuse.

A second contribution of our study is that it adds to the scant body of knowledge concerning the effects of a dissonance-arousal nudge on the food choices of children. Previous research has used the same tactic to prevent children from engaging in other harmful behaviors, including risky behavior on the playground (Morrongiello and Mark, 2008) and substance abuse (Ager et al., 2008). Third, our research adds to the

[1] In Vietnam, municipalities (cities or provinces) are further subdivided into two tiers. The second tier consists of urban districts (*quận*), towns (*thị xã*), and rural districts (*huyện*). In the third tier, urban districts are divided into wards (*phường*), towns are divided into wards (*phường*) and communes (*xã*), and rural districts are divided into townships (*thị trấn*) and communes (*xã*).

[2] It is officially classified as a "rural" district, and it is therefore known as "*huyện*" in Vietnamese. Because it is adjacent to urban Hanoi, we refer to Dong Anh as a peri-urban district.

[3] Registration number 20191201AA on the egap.org Registry. The study was approved by the Internal Review Board of IFPRI and the Hanoi School of Public Health Institutional Review Board (HSPHIRB), Vietnam.

nascent body of experimental work on children's food choices, especially in LMICs. To date, the majority of publications involving school-based food-choice experiments have been conducted in high-income countries (e.g., the United States and various European countries). In a recent review of experimental research on children's eating behavior, DeCosta et al. (2017) report that only two of the 120 studies mentioned were conducted in LMICs. In addition to contributing to this body of literature, the results of our study provide valuable input for Vietnam's National Nutrition Strategy, in which nutrition education at school and the control of overweight/obesity/NCDs are key target projects. Given that other LMICs are also undergoing a nutritional transition, the lessons generated by this strategy could potentially be applied within the context of other developing countries.

The remainder of this article is structured as follows. After providing the conceptual frameworks and motivation for our hypotheses (Section 2), we outline the experimental design, including treatment descriptions. We present the findings in Section 4, followed by discussion and conclusions in Section 5.

2. Conceptual framework

2.1. Information provision

The consumption patterns of children are driven in part by their beliefs about whether consuming specific foods (e.g., those with added sugar) can be beneficial, neutral, or harmful to them. If we assume that children prefer sweetened foods, their consumption of healthier options (e.g., unsweetened and reduced-sugar milk) could be considered a function of their effort to overcome that preference and a set of other predetermined characteristics (Avitabile and de Hoyos, 2018). The provision of health information could help children to update their beliefs regarding the costs of consuming sweetened foods, including those associated with excessive consumption, thereby leading them to choose healthier options. Given that consumers usually do not have full information about calories and nutrients at the point of consumption (Cawley, 2015), the provision of information could also be regarded as an initiative to supplement incomplete information among consumers. Although nutrition education is part of the curriculum in many schools, the knowledge conveyed is usually generic and abstract, making it difficult for children to relate it to their daily food choices. In this study, we used a brief educational message that was directly related to the targeted behavior of choosing healthier milk, thereby nudging children toward selecting better food.

Evidence on the use of quick educational messages to affect the food choices of children in the school environment has been mixed. For example, in a field experiment on low-income school children in the US, short educational messages delivered by research assistants alone did not affect the dessert choices of children, unless they were explicitly prompted to choose the healthier option (List and Samek, 2015). Results from a more recent experiment involving similar subjects suggests that health-information messages from teachers have a positive impact on student behavior when choosing milk (Samek, 2019). The author explains this positive result by the fact that the educational message was delivered by an authority figure (the teacher). The manner in which educational messages are delivered can also play an important role in the efficacy of such intervention. For example, Lai et al. (2017) report that prescriptive prompts (telling children to choose healthier options), either with or without health messaging, increased the proportion of children choosing and consuming healthier white milk, as opposed to sugar-sweetened chocolate milk.

In our study, children in both treatment groups watched a short educational video about healthy food choices. The video messages included the consequences of eating excessive sugar (informative messaging) as well as practical suggestions for reducing the consumption of added sugar (prescriptive messaging). It was produced in a child-friendly manner, with lively animation and colors. Its preparation was similar to that of social marketing videos, with a spokes-character as the predominant marketing technique (Elliott and Truman, 2019). The children in the treatment groups should therefore have been more likely to choose healthier food options, as compared to those in the control group. Our first prediction is thus as follows:

Prediction 1: The provision of information decreases the likelihood that children will choose the least healthy food option.

2.2. Cognitive dissonance and hypocrisy paradigm

The discrepancy between cultural mores and behavior arouses cognitive dissonance (Festinger, 1957). Individuals generally strive for consistency, competence, and morality in their perceptions of themselves, and they are therefore likely to experience psychological discomfort when they behave in ways that run counter to these goals (Aronson, 1992). Economic agents often incorporate these psychological costs into their utility maximization problems (Gosnell, 2018). Cognitive dissonance has been associated with a range of social phenomena, including increased levels of immoral activities (Rabin, 1994) and stickiness in voting (Mullainathan and Washington, 2009).

In addition to explaining behavior, social scientists have manipulated cognitive dissonance to cause behavior change through the use of different paradigms (Ong et al., 2017). One of the most frequently utilized paradigms in this regard is that of "induced hypocrisy," as first developed by Aronson et al. (1991). The researchers designed a sequential procedure for achieving cognitive dissonance by illustrating the gap between what individuals know they should do in certain situations (socially desired behaviors) and what they actually do (transgressions). To make this gap salient and maximize the effectiveness of cognitive dissonance, people should asked to publicly advocate the value of a target behavior (Step 1) and privately reminded of their own recent personal failures to perform that behavior (Step 2). As demonstrated by a body of empirical evidence, this state of dissonance can be reduced by changing behavior (Gosnell, 2018).

Cognitive dissonance does not apply only to adults. A few studies have discussed how cognitive dissonance differs between adults and children, and scholars have documented evidence of decision rationalization due to cognitive dissonance in preschoolers and non-human primates (Egan et al., 2007). This evidence suggests that the mechanisms underlying the reduction of cognitive dissonance in human adults may have originated at earlier developmental and evolutionary stages.

Although the inducement of hypocrisy has been successfully applied to children (Ager et al., 2008; Morrongiello and Mark, 2008), it does not always bring about behavior change. When faced with cognitive dissonance, behavior change is not guaranteed, as individuals could also change their attitudes and beliefs (Akerlof and Dickens, 2009; Rabin, 1994). People can resolve cognitive dissonance by choosing from a variety of reduction modes. For example, they can adjust their attitudes or behavior, depending on the characteristics of the mode (e.g., availability, likelihood of success, effort required, habits) (McGrath, 2017). In a field experiment on cognitive dissonance and environmental behavior (switching from traditional to environmentally friendly billing), Gosnell (2018) found that hypocrisy-inducing messaging did not work for some individuals with higher education. One possible explanation was that the level of dissonance experienced is affected by the level of cognitive skill and that the intervention was not strong enough to trigger cognitive dissonance in the participants with more education. Moreover, instead of changing their behavior, individuals could alter their attitudes toward the issue as a way to justify their socially undesirable action (Gosnell, 2018).

In our experiment, we expected that behavior change would be the most accessible and require the least effort when children were offered the choice of milk immediately after the treatment inducing cognitive dissonance. In line with evidence in the literature on hypocrisy inducement, we predicted that the children in Treatment 2 ("information provision plus induced hypocrisy") would be less likely to select sweetened milk than those in Treatment 1 (“information provision only”). Similar to Gosnell (2018), we did not attempt to measure a “pure” effect of hypocrisy inducement, but rather an “additional” effect of making cognitive dissonance particularly salient. Providing health messages may already play a role in creating cognitive dissonance, given that children are commonly informed about the consequences (i.e., “costs”) of their unhealthy eating habits. Our second prediction is thus as follows:

Prediction 2: Inducing “hypocrisy” creates cognitive dissonance, thereby increasing the likelihood that children will choose the healthier food option.

2.3. Timing and cognitive dissonance

In everyday contexts, people can experience cognitive dissonance without having the possibility to reduce it immediately by performing “good” behavior. Such delays in reducing dissonance through actions might activate other modes of reduction, thereby decreasing its influence on behavior. For example, Rubens et al. (2015) conducted an experiment in a Parisian market to examine whether cognitive dissonance would cause participants to reduce their use of plastic bags. They found that the effects of the hypocrisy paradigm were sensitive to the delay between the intervention and the moment at which the behavior was observed, when the respondents in the hypocritical condition failed to take fewer plastic bags. Instead of shifting to environmental behavior, the participants had time to trivialize and rationalize their “bad” behavior.

In addition to behavior change and trivialization, one very convenient strategy for reducing cognitive dissonance involves distraction and forgetting. Distraction diverts attention away from dissonant thoughts, thus allowing individuals to avoid the negative affective state caused by dissonance (McGrath, 2017). Forgetting can be a way to avoid information (Golman et al., 2017). Given that children are thought to be prone to distraction and forgetfulness, we explored whether our subjects adopted these modes. To this end, we varied the timing of the experimental procedure, such that one group was occupied with another task (answering a questionnaire related to a study on the consumption of fruit and vegetables) after watching the video but before making the food choice.

If children forget the information to reduce cognitive dissonance, this is likely to reduce the additional effect of the hypocrisy procedure (in addition to the educational treatment) on behavior. Our third prediction is therefore as follows:

Prediction 3: When there is a delay between the intervention and the target behavior, children in Treatment 2 will be equally likely to choose healthier milk relative to those in Treatment 1.

Prediction 3 is closely related to Prediction 2. More specifically, if Prediction 2 cannot be confirmed, the hypocrisy inducement will not cause any additional effect, such that the delay will have a similar influence on the effects of both treatments. If that is the case, Prediction 3 will still hold, but the explanation that the treatment effect erodes due to activated dissonance resolution will no longer apply. Instead, the treatment effects may erode equally over time for both treatment groups due to the reduction in pressure resulting from the demands of the experimenter and the distant memory of the information provided.

Prediction 4: When there is a delay between the intervention and the target behavior, children in both treatment groups will be less likely to select the healthier food option relative to the no-delay condition.

3. Experimental design

3.1. Participants and random assignment

Our sample for this experiment consisted of 1274 pupils in the fourth and fifth years of formal education in 136 classrooms at 12 schools in Dong Anh, Hanoi, Vietnam. The district was pre-selected based on the requirements of an overarching CGIAR research program (Agriculture for Nutrition and Health, or A4NH) aimed at developing a representative picture of food systems across a transect of urban, peri-urban, and rural areas in North Vietnam (de Haan et al., 2017). Located 15 km to the north of central Hanoi, Dong Anh is a suburban district characterized by rapid urbanization. Given the government’s expectation to reclassify Dong Anh as urban by 2025, overnutrition is an increasing concern. In 2018, a survey of two representative primary schools in the district indicated that a substantial share of students in this district were either overweight (25 %) or obese (34 %) (Dong Anh School Health Offices, 2018).

As part of the A4NH research program, the sample was also used for another randomized study testing the use of short lessons, appropriately designed materials, and healthy snacks (Nguyen et al., 2021). That study focused on children in primary school, as they had started to receive formal lessons on nutrition and healthy eating as part of the science curriculum. Of the 28 primary schools in Dong Anh, the local Department of Education and Training proposed 12 schools dispersed throughout the district for inclusion in the RCT. The research sample consisted of 10 children randomly selected from all third-year through fifth-year classrooms in all 12 of these schools. These year groups were selected to ensure that the children could absorb the knowledge intervention in the trial, as the relationship between emotions and food choices has been found to be more salient at around 10 years of age than it is for younger children (Blissett et al., 2010). Given that science lessons on nutrition and health are also introduced to this age group in Vietnam, the information in the experiments was appropriate to their level of cognitive development. The original sample design is detailed in Nguyen et al. (2021). The current study ran parallel to the RCT endline data collection. Although the RCT started with three year groups, the endline was conducted in the new school year when the pupils who had been in the final year of primary education in the previous school year had moved on to secondary schools, leaving the endline with only two year groups (fourth-year and fifth-year pupils). The fieldwork took two weeks to complete, with enumerators spending around 30 min with each child on the experiment. For this survey, the children answered a few questions on the consumption of fruit and vegetables.

The treatment assignment was randomized at the classroom level. This helped to minimize diffusion of the treatment, as it nearly eliminated the possibility that children from different classrooms would interact with one another during the experiment. Our experimental set-up also helped to eliminate peer effects within classrooms, as the children were not allowed to observe the choices made by their peers (Appendix 1). We used year groups (fourth-year and fifth-year) and schools (1−12) as block strata for the random assignment, with year group serving as a proxy for age and school serving as a proxy for commune-level characteristics. Each pupil was then assigned to one of three experimental groups: Control (“placebo education;” 45 classrooms), Treatment 1 (“information only;” 46 classrooms), and Treatment 2 (“information and hypocrisy;” 45 classrooms).

3.2. Treatment descriptions

A detailed description of the experimental procedure is available in Appendix 1. In summary, all participating children completed a questionnaire containing general questions about eating fruit and vegetables, as well as specific questions about their milk-drinking habits. They were also exposed to the “treatment” stage, which differed among the treatment groups. The key characteristics of the treatments are described below.

Children in the Control group watched a placebo video about traffic safety. In Treatment 1, children watched a short animated educational video about reducing sugar in their diets. The video included practical examples (e.g., replacing flavored and sweetened milk with plain milk; eating natural rice crackers instead of honey-flavored rice crackers; choosing bubble milk tea with less sugar). The video lasted one minute and 15 s, using child-friendly animation to emphasize the risks of eating excessive sugar and the growing health standard of eating less sugar.

In addition to watching the same video as in Treatment 1, children in Treatment 2 were exposed to a dissonance-arousal procedure based on the hypocrisy paradigm (Dickerson et al, 1992; Gamma et al., 2020). Following the video, the children were asked to recite what they had learned. The enumerator recorded each child's message and said that it would be sent to children in other schools to promote healthy eating. In a second step intended to induce dissonance, children answered a brief set of simple questions on paper concerning their own habits with sweetened foods.

To vary the timing of the experimental procedure among the subjects, we divided the schools into two groups based on the data-collection timeline, which had been arranged in consultation between the data-collection team and each of the school principals. In the first half of the data collection, children in the first six schools made a milk choice immediately after watching the video (and being exposed to the hypocrisy procedure). In the second six schools (the "delay" group), the children performed another task after seeing the video but before making the milk choice. This filler task involved answering the endline questionnaire for the school study, which took around 15 min. An overview of treatment groups is available in Table 1.

For the outcome measure, we used a simple choice between unsweetened milk, reduced-sugar milk, and sweetened milk. Milk consumption is promoted throughout Vietnam as a means of increasing dairy consumption throughout the national population (Hoang et al., 2021). Our data indicate that packaged milk is a popular snack among children, both at school and at home. At home, 32 % of the children in our sample reported drinking sweetened milk as a snack, while only 3 % reported drinking plain milk. The children were neither frequent consumers nor fans of healthier milk products. Only 15 % of the sample reported drinking healthier milk products (with less sugar) as the milk they most commonly consumed. In contrast, more children preferred sweetened milk (51.2 %), flavored milk (18.1 %), and other sweetened non-dairy kinds of milk (15.8 %). Our data also indicate that the children in the sample had only limited familiarity with healthier milk choices. Virtually all the children (99.4 %) reported having tried sweetened milk, and more than half had never tried unsweetened (57 %) or reduced-sugar (59.9 %) milk.

Under the school milk program, children are provided exclusively with sweetened milk, as "it suits the taste of the majority" (Focus group discussion with teachers in Dong Anh, 2018). As an initial step toward reversing this unhealthy pattern, we offered children the opportunity to select healthier options and nudged them toward these choices. Given that food safety is a major concern in Vietnam, we used branded milk cartons. We selected TH true Milk, as the packages are almost identical for all three types of milk, thereby ensuring that children would not select a certain milk due to the attractiveness of the packaging or because they did not want others to know what they had chosen (Fig. 1). Because the brand is not as common as other brands (e.g., Vinamilk, Nestlé, or Friesland Campina), the children were less likely to be able to tell which flavor of milk their peers had chosen. During the pilot study, we ascertained that the children indeed selected the types of milk that corresponded to their preferences, despite the similar packaging.

Table 1
Summary of treatment groups: Number of classes (number of students).

	Number of classes	Number of students
Control group	45	430
Treatment 1 (information only)	46	421
Treatment 2 (information and hypocrisy)	45	423
Total	**136**	**1274**
No delay between treatment and milk selection	55	518
Delay between treatment and milk selection	81	756

Fig. 1. Milk choices: Unsweetened milk, sweetened milk, and reduced-sugar milk (from left to right).
Source: thmilk.vn.

3.3. Analytical model

As registered in the pre-analysis plan, we estimated the effect of the information and hypocrisy treatment on the children's milk selection at the individual level according to the following formula:

$$y_{ij} = \beta_0 + \beta_1 I_j + \beta_2 IH_j + \beta_3 D_j + \beta_4 D_j I_j + \beta_5 D_j IH_j + \sum_{k=1}^{12} \alpha_k S_k + \alpha_{13} G_4 + \alpha_{14} G_5 + \delta X_i' + \epsilon_{ij} \quad (1)$$

In (1), y_{ij} represents the milk choice of the child *i* in classroom *j*. It is a binary variable, with a value of 0 for full-sugar milk and a value of 1 for reduced-sugar or unsweetened milk, which is considered the healthier option. Although we offered the children three kinds of milk to better reflect the range of products available to children in reality, from a health perspective, a shift from full sugar to a reduced-sugar option would already be an improvement.

The effects of the information treatment (I) and the information plus hypocrisy treatment (*IH*) are represented by β_1 and β_2, respectively, with D_j being a dummy variable indicating is the presence or absence of a delay between the intervention and the milk choice. The individual effect of the hypocrisy-inducement procedure (in addition to information provision) is represented as $\beta_2 - \beta_1$. The school-level dummy variables are represented as $S_1 \ldots S_{12}$, with G_4 and G_5 representing year-group level dummies–the stratum we included in the random assignment. The symbol X'_i represents a vector of self-reported covariates (controls), which includes demographic variables and self-reported milk preferences before the experiment. We also included this vector of covariates for balance checks, in measuring heterogeneous effects, and for sensitivity analysis (Appendix Table 2).

The hypotheses corresponding to the predictions made above are as follows:

H1 : $\beta_1 > 0, \quad \beta_2 > 0$

H2 : $\beta_2 > \beta_1$

H3 : $\beta_1 + \beta_4 = \beta_2 + \beta_5$

H4 : $\beta_4 < 0, \quad \beta_5 < 0$

Table 2
Balance check among treatment arms: Pairwise comparison tests.

Variables	All (N = 1274) Mean	St. Dev.	Control mean	P-values of pairwise t-tests: Info only - Control	Info + Hypocrisy - Control	Info + Hypocrisy - Info only	Delay - No delay
Tried unsweetened milk before	0.43	0.50	0.42	0.00	0.01	0.01	0.09 *
Tried sweetened milk before	0.99	0.08	1.00	-0.01	-0.00	0.00	0.00
Tried reduced sugar milk before	0.40	0.49	0.36	0.08 * *	0.03	-0.05	-0.02
Age	10.51	0.51	10.55	-0.05	-0.05	-0.00	0.01
Male	0.56	0.50	0.55	0.00	0.02	0.02	-0.00
Household size	4.53	1.21	4.63	-0.13	-0.19	-0.06	-0.21
Income level	2.37	1.17	2.44	-0.08	-0.15	-0.08	-0.12
Treated in the RCT	0.52	0.50	0.48	0.07 *	0.02	-0.05	0.35 * **

Note: * ** $p < 0.01$, * * $p < 0.05$, * $p < 0.1$. St. Dev. stands for Standard Deviation. All assumptions required to conduct pairwise difference in means tests were met.

4. Results

4.1. Balance among treatment arms

To assess the homogeneity of the groups, we started by performing balance checks. We used two approaches to compare the characteristics of the treatment and control groups. First, we performed a series of pairwise t-tests (and z-tests for proportions) comparing average values for those characteristics among Treatment 1, Treatment 2, and the Control group, using self-reported past milk consumption and demographic variables. The milk-consumption variables came from the questionnaire and served as a pseudo-baseline prior to the experiment. The demographic variables for the child's age, sex, household size, and household income level came from data from another study involving the same subjects. We also included the treatment status of the child in the school RCT. Second, we performed a joint test of orthogonality using a χ^2 test. We ran a multinomial logit with the treatment variable on the left-hand side, alongside milk consumption and demographic controls as explanatory variables on the right-hand side. The null hypothesis was that all the regression coefficients across two models (for three treatment values) would be simultaneously equal to zero.

The pairwise t-tests yielded only two statistically significant differences ($p < 0.05$) between the Treatment 1 and Control groups, out of 28 comparisons (Table 2). This result suggests that the randomization procedure was successful in generating balance among the treatment arms. The second approach yielded a similar conclusion. With a p-value > 0.05 (Prob $> \chi^2 = 0.12$), we could not reject the null hypothesis, thus implying that the three groups were similar on all explanatory variables (Appendix 3).

We used the same method to assess balance between the groups with and without delay in terms of both treatment and behavioral choice. We observed one notable imbalance between the two school groups. Compared to the “with delay” group, the “without delay” group had a significantly higher percentage of children who had previously tried unsweetened milk (48.26 % vs 39.42 %). Using a joint orthogonality test, with a p-value < 0.05 (Prob $> \chi2 = 0.002$), we rejected the null hypothesis, thus suggesting that the average for all explanatory variables was not the same across groups (Appendix 3). This slight imbalance might be expected, given that the delay was randomized only between two groups of schools (last column in Table 2).

4.2. Main treatment effects

Table 3 displays the results of the ordinary least square (OLS) regressions with clustered standard errors (classrooms as clusters). The linear probability model in Column 1 includes only the treatment-indicator variables. The coefficients obtained confirm the differences between Treatment 1 vs Control and Treatment 2 vs Control, as detected in the descriptive statistics (Appendix Table 4a). The children in

Table 3
Effects on healthier milk choice (OLS Regression).

Variables	(1) Treatments	(2) (1) + delay, interactions with delay	(3) (2) + demographic controls	(4) (3) + self-reported milk choice controls
Treatment 1 (Information only)	0.27 * **	0.37 * **	0.42 * **	0.39 * **
	(0.04)	(0.06)	(0.07)	(0.06)
Treatment 2 (Information & hypocrisy)	0.29 * **	0.36 * **	0.35 * **	0.32 * **
	(0.03)	(0.05)	(0.06)	(0.06)
Delay	–	0.24 * *	0.27 * *	0.18 *
		(0.11)	(0.11)	(0.10)
Treatment 1 x delay	–	-0.18 * *	-0.22 * *	-0.17 * *
		(0.08)	(0.09)	(0.08)
Treatment 2 x delay	–	-0.12 *	-0.10	-0.06
		(0.07)	(0.08)	(0.07)
Demographic controls	No	No	Yes	Yes
Self-reported milk-choice controls	No	No	No	Yes
Observations	1274	1274	999	999

Notes: The models also included school and year group fixed effects (not reported).
Clustered standard errors in parentheses: * ** $p < 0.01$, * * $p < 0.05$, * $p < 0.1$

Treatment 1 and Treatment 2 were more likely to select healthier milk options (26.6 % and 29.4 %, respectively) than were those in the Control group. Columns 2–4 of Table 3 display the results obtained by analyzing the data according to the linear probability model under Specification (1).[4] The results of the logistic regressions are available in Appendix Table 4b, along with the odds ratios and marginal effects.

Both treatments increased the likelihood that children would select healthier milk by about 30 % points (p-value < 0.0001). We can therefore accept H1 and conclude that the provision of information decreased the likelihood that children would choose full-sugar milk, with or without the inducement of hypocrisy. Regarding Hypothesis 2, we found no significant difference between the effects of Treatment 1 and Treatment 2 on milk choice. The F-test of equality between the coefficient estimates for Treatment 1 and Treatment 2 suggests that the

[4] Fewer observations were available for the specification that including demographic control variables. Data for these variables came from the parental questionnaire in the overarching school-intervention project. This questionnaire was administered by telephone and expectedly had a higher attrition rate.

Table 4
Heterogeneous effects on healthier milk choice (OLS).

	(1)	(2)
VARIABLES	Interactions with affinity for sweetened milk	Interactions with pre-treatment knowledge score
Treatment 1 (Information only)	0.21 * *	0.38 * **
	(0.09)	(0.07)
Treatment 2 (Information + hypocrisy)	0.21 * *	0.39 * **
	(0.09)	(0.07)
Delay	0.19 *	0.24 * *
	(0.10)	(0.11)
Treatment 1 x delay	-0.15 * *	-0.17 * *
	(0.07)	(0.08)
Treatment 2 x delay	-0.10	-0.12 *
	(0.07)	(0.07)
Treatment 1 x sugar affinity	0.08 *	_
	(0.04)	
Treatment 2 x sugar affinity	0.09 *	_
	(0.05)	
Sugar affinity	-0.30 * **	_
	(0.03)	
Treatment 1 x knowledge	_	-0.02
		(0.05)
Treatment 2 x knowledge	_	-0.03
		(0.05)
Knowledge	_	0.03
		(0.04)
Observations	1274	1274

Notes: The models also included school and year group fixed effects (not reported).
Cluster standard errors in parentheses. * ** p < 0.01, * * p < 0.05, * p < 0.1.

null hypothesis cannot be rejected (p-value = 0.5). When added to information provision, hypocrisy inducement did not appear to affect the likelihood that children would or would not choose healthier milk.

For both treatments, the treatment effects declined when there was a delay between the treatment and milk choice. The values for $\beta_4$andβ_5 (the coefficients for the interactions between Treatment 1 and delay, and between Treatment 2 and delay, respectively) were both negative and statistically significant. We therefore accept H4 and conclude that the delay between the treatment and target behavior led to a decline in healthier food choices. The influence of the delay on the treatment effect appears to have been smaller for Treatment 2 (−0.12) than for Treatment 1 (−0.18), although this difference was not statistically significant (p-value = 0.46). We obtained qualitatively similar results when including the demographic variables and self-reported past milk consumption to Specification (2). The results were also robust to a different method of constructing the outcome measure (Appendix Table 4.c–e, corresponding model specifications), and the inclusion of enumerator fixed effects (Appendix Table 4.f).

Interestingly, we observed that the delay had a main effect on the choice of healthier milk. Although we assumed that the questionnaire presented to children during the delay would not influence children's choices by itself, it might have had an effect. As an evaluation for a study on the consumption of fruit and vegetables, the questionnaire included questions about healthy eating habits. Although it did not mention eating less sugar and consuming milk directly, the questionnaire may have led the children to think about healthier diets in general. Given that participation in the RCT treatment itself could have had a similar effect, we ran additional regressions in which the RCT treatment was included as an independent variable, a control variable, and in interactions with both main treatment variables. We found a small, but statistically significant negative effect (Appendix Table 4e), but the magnitudes of estimated effects of the education and hypocrisy treatments remained unchanged in this specification.

4.3. Heterogeneous effects

Following the pre-analysis plan, we ran additional regressions to investigate the moderating effects of two factors: affinity for sweetened products and initial knowledge about the health issues associated with excessive sugar consumption. Appendix 2 explains how the values for these two variables were computed. We added the interaction terms between these variables and the treatment dummies to the child-level analysis. Table 4 displays the coefficients obtained from the two regressions. As expected, affinity for sweetened products was negatively correlated with the choice of healthier milk. Children who preferred sweetened milk were more sensitive to the treatments. Raising the sugar-affinity index by 1 point (with a maximum score of 3) increased the likelihood the children would choose healthier milk by 0.08–0.09, although this estimate was not statistically significant.

Although initial knowledge before the treatments had a positive influence on milk choice, this influence was not statistically significant. Notably, the majority of children (83.52 %) could recite only one health issue related to excessive sugar consumption, thereby supporting our assumption that they were not adequately aware of the health consequences of excess sugar consumption. In light of the overall low knowledge scores before the experiment, it was not surprising to find that the few children with better knowledge were not more responsive to the treatment, given the limited size of the sample (and sub-samples).

Our pre-analysis plan also called for analyzing the moderating effects of the children's health status and their level of information retention. Unfortunately, we could not collect adequate data for these variables. The majority of children could not reliably recall their weight and height, and the schools could not provide data on health indicators. We also decided to skip measuring information retention after the treatments, as we observed that the children were asking each other for help instead of answering the questions themselves. As a result, any knowledge data collected would not reflect the actual knowledge level of individual children. Even more problematically, the task diverted the children's attention away from the milk choice at hand, and it even gave them the opportunity to see the milk choices made by others while they lingered to answer the information-retention question after having made their own choices.

We also subjected our tests of significance to the Benjamini-Hochberg correction, which controls for false discovery rate (FDR). The results discussed above still held after this correction for multiple hypothesis testing (Appendix 5).

Appendix 6 provides an overview of deviations from the pre-analysis plan.

5. Discussion

Our work fits into a growing base of evidence base that "nudge-for-good" interventions can encourage behaviors that could improve the welfare of those being nudged (Thaler and Sunstein, 2008), particularly within the context of children's food choices (Belot et al., 2016; List and Samek, 2015; Loewenstein et al., 2016). Our results corroborate the findings of field experiments involving children, which also provide evidence that educational prompts have a positive impact on food choices (Lai et al., 2017; Samek, 2019). In those studies, research assistants or teachers served as the messengers of health information. One advantage of our study is that the use of video to convey the health information was much less costly, with the main expense being the small amount of money needed to produce the video (around €300). Our video-based approach is also child-friendly, with considerable potential for facilitating the communication of health messages to youth in a variety of local contexts throughout Vietnam, given the feasibility of adapting the animation. Although the positive results could arguably have been due to social desirability bias and the experimenter-demand effect, we believe that our experimental set-up helped to avoid such problems. The milk choice was not presented to the children as part of the experiment. They simply selected milk as a thank-you present for participating in the overall study. To minimize experimenter-demand effects, we adopted several practices discussed by Zizzo (2010). First, we limited peer pressure by offering milk products with almost identical appearance, such that the children did not have to pretend to select a certain milk product to look "appropriate" to others. In addition, children made their choices individually and out of sight of other children and the enumerators who were conducting the interviews. Second, the enumerators were not authority figures, and they were largely unknown to the students. Third, we obfuscated the experimental objective by conducting the study as part of a larger project.

Inducing hypocrisy had no significant additional effect on food choice beyond that of information provision alone. Our results are thus not consistent with those reported by Gosnell (2018) in a study on the effects of inducing hypocrisy in the promotion of environmentally friendly behavior. Interestingly, while Gosnell's treatment backfired among the sub-group of individuals with high levels of education, the same treatment failed to produce any impact among the primary-school children in our study. This result helps to rule out the possibility that people with higher cognitive skills experience higher levels of dissonance (Gosnell, 2018). If this had been the case, younger children would have been less tolerant of cognitive dissonance and therefore more likely to take action to resolve the discrepancy. A more likely explanation is that, by the time they finished watching the video, the children had already experienced cognitive dissonance by reflecting on their own unhealthy behavior. The information alone was therefore sufficient to nudge the children toward corrective action. For this reason, when they subsequently encountered the hypocrisy inducement, the children had already decided to select a healthier choice. This explanation would have been better substantiated if we had collected a measure of cognitive discomfort or discrepancy, or one associated with hypocritical feelings (e.g., guilt). As argued in the Methods section, however, manipulation checks and similar measures could potentially affect experimental conclusions (Hauser et al., 2018). It is even more challenging for children who have difficulty sustaining concentration and articulating their thoughts and feelings. Future studies should explore innovative measurements that could mitigate these problems and substantiate the explanations.

Our results do not necessarily challenge those of previous studies that have found that inducing hypocrisy is effective in promoting behavior change among children. Although prior studies (e.g., Morrongiello and Mark, 2008; Ager et al., 2008) have noted the effectiveness of inducing hypocrisy in correcting behaviors, the interventions on which they are based also educated the participating children through their activities. One contribution that our study makes to the literature is that it provides an indication of the added value of inducing hypocrisy relative to education alone. Within this context, our two-step hypocrisy-inducement procedure did not provide a successful paradigm for nudging children further toward healthier choices. This finding suggests a positive pedagogical message: "guilt-tripping" may not be a desirable approach to educating children, not so much because of its potential for causing emotional harm, but simply because it is inherently ineffective.

We tried to capture the persistence or erosion of the treatment effect by introducing a small delay between the treatment and the choice behavior. A 15-min delay reduced the effect by half (for Treatment 1) and by one third (for Treatment 2) relative to the no-delay condition. The interpretation of this erosion effect calls for particular caution in terms of external validity. Once the treatment ended, the children might have forgotten the information and might have no longer felt motivated to make healthier food choices. Alternatively, they might have found other means of resolving the cognitive dissonance (e.g., active forgetting or distraction) (McGrath, 2017). To convert a one-time healthier choice (e.g., selecting milk with less sugar) into sustained healthy behavior (e.g., eating healthier foods), communication aimed at behavior change requires consistent reminders to induce habit formation. At the same time, however, treatments that refresh the applicability of considerations or provide new information tend to persist longer (Coppock, 2017). Our treatment focused on providing simple practical tips on healthier eating, in addition to introducing healthier options to children. We could therefore expect that our treatments could potentially have positive effects in the long term. Future experiments in studies conducted over longer periods could test the extent to which such optimism is justified. For example, simply returning to the school after one week could help to assess how much of the effect of the information treatment persists and how the cognitive-dissonance treatment might have affected the persistence of the information shock. Future research could also test whether the repetition of health tips could support habit formation and how often such reminders should take place. Given its scalability, however, our approach remains an attractive option to combine with other habit-forming interventions. For example, health tips could be included in a more comprehensive curriculum that has been proven effective in reducing children's BMI in the long term, such as a school-based health education program developed in Spain (Mora et al., 2015).

Although it was not the focus of our study, our results suggest that the sheer availability of healthier products might play a role in promoting healthier eating among children. Unlike children in high-income countries, the children in our experiment had less experience with healthier products (e.g., reduced-sugar and unsweetened milk). While more than 80 % of the children reported usually consuming sweetened milk, only 70 % of the control group selected sweetened milk when presented with healthier options in the experiment. This might have been because the children were attracted to novelty or simply because they had the opportunity to exercise their own choices in light of greater variety. We make no causal claims concerning either of these possible explanations, as our only option for measuring milk consumption prior to the experiment was self-reported answers and a simple before-after comparison. Nevertheless, parents and educators could benefit from this observation in their attempts to experiment with delivering healthier products to their children.

One limitation to our study is its lack of power to detect interaction effects. As stated in our pre-analysis plan, our results might not have sufficient power to test hypotheses regarding interactions between the delay and the treatments. Such lack of power is unfortunately common in studies involving interactions (Muralidharan et al., 2019). Although the presence of a delay seemed to have less of an effect in the hypocrisy-inducement condition, this difference was not statistically significant. For this reason, we could not make any statistical inferences concerning the relative effectiveness of hypocrisy inducement in the longer term. Future research could strive to adjust this limitation (e.g., by increasing the sample size or by focusing on long-term effects).

Finally, the concurrent implementation of this research with the endline data collection of a larger study had several important implications. On one hand, it allowed us to use the larger context to conceal our intention to measure behavioral outcomes, thereby reducing potential bias due to social desirability and experimenter demand. The data-collection process also allowed us to add a condition (i.e., the delay) to our experiment. On the other hand, this delay, which was simply intended as a "filler" task, actually introduced noise into the results. Analysis of the data revealed that simply answering the questions for another study on a related topic (i.e., consumption of fruit and vegetables) during the delay had nudged the children toward healthier choices. The information provided during this delay might have acted as a priming device for attention to health, thus becoming a substitute for our information treatment and reducing the main treatment effect. Although this did not change the results in our study, researchers must be transparent about such add-on studies in order to draw valid inferences. The implementation constraints also prevented us from introducing additional measures (e.g., ex-post beliefs about sugar; level of guilt) that would have allowed us to offer better explanations of the mechanisms underlying our results.

6. Conclusion

In this field experiment, we assessed the effects of information and cognitive dissonance on nudging children toward healthier food choices. We found that the short educational messages had a large effect on the milk choices of children, thus increasing the likelihood that a child would select healthier milk options by more than 30 % (under the no-delay condition) and by more than 15 % (under the delay condition) from the pre-treatment status of about 30 %. The one-minute animation almost doubled the proportion of children selecting healthier milk. We initially hypothesized that arousing cognitive dissonance by inducing hypocrisy would improve the food choices of children. We also examined whether the effects were sustained in the (slightly) longer term by adding a delay between the treatment and behavioral choice. Contrary to our predictions and pre-registered hypotheses, the inducement of hypocrisy had no significant additional effect on the food choices of children, compared to information provision alone. Future studies should seek to overcome the limitations of this study: the lack of power to detect the interaction effects, the risk of contamination with other studies, and the short-term nature of the procedure.

CRediT authorship contribution statement

Trang Nguyen: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Project Administration, Software, Writing – Original Draft, **Alan de Brauw**: Conceptualization, Funding Acquisition, Formal Analysis, Investigation, Methodology, Project Administration, Resources, Supervision, Writing – Review and Editing, **Marrit van den Berg**: Conceptualization, Formal Analysis, Methodology, Supervision, Writing – Review and Editing.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ehb.2022.101185.

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