

# Testing the Effectiveness of In-Home Behavioral Economics Strategies to Increase Vegetable Intake, Liking, and Variety Among Children Residing in Households That Receive Food Assistance

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## ABSTRACT

**Objective:** To test the effectiveness of behavioral economics strategies for increasing vegetable intake, variety, and liking among children residing in homes receiving food assistance.

**Design:** A randomized controlled trial with data collected at baseline, once weekly for 6 weeks, and at study conclusion.

**Setting:** Family homes.

**Participants:** Families with a child (9–12 years) will be recruited through community organizations and randomly assigned to an intervention (n = 36) or control (n = 10) group.

**Intervention:** The intervention group will incorporate a new behavioral economics strategy during home dinner meal occasions each week for 6 weeks. Strategies are simple and low-cost.

**Main Outcome Measure(s):** The primary dependent variable will be child's dinner meal vegetable consumption based on weekly reports by caregivers. Fixed independent variables will include the strategy and week of strategy implementation. Secondary dependent variables will include vegetable liking and variety of vegetables consumed based on data collected at baseline and study conclusion.

**Analysis:** Mean vegetable intake for each strategy across families will be compared using a mixed-model analysis of variance with a random effect for child. In additionally, overall mean changes in vegetable consumption, variety, and liking will be compared between intervention and control groups.

**Key Words:** vegetable, behavioral economics, low-income, children, protocol (*J Nutr Educ Behav.* 2015;47:e1-e9.)

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## INTRODUCTION

Childhood obesity remains a significant public health concern in the US, especially among populations with low socioeconomic status.<sup>1,2</sup> Although the direct relationship between vegetable intake and weight

status among children remains unclear, replacing high energy-dense foods with vegetables has the potential to lower dietary energy intake, thereby reducing the risk of obesity.<sup>3</sup> According to National Health and Nutrition Examination Survey (NHANES) data (2007–2008), approxi-

mately 95% of children aged of 9–13 years do not meet the dietary recommendation for total daily vegetable intake.<sup>4</sup> To address this concern, the National School Lunch Program provides nutritious meals, including vegetable choices, to low-income children at a free or reduced cost.<sup>5</sup> Although programs such as the National School Lunch Program address the issue of availability in schools, additional efforts are necessary to encourage vegetable selection and consumption among children at home.

The relatively new field of behavioral economics is proposed as a means to improve dietary behavior based on the effectiveness of small, environmental changes known as nudges to alter choice behavior.<sup>6</sup> Nudges are made by someone with control over the choice environment,

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but not in a way that imposes objectionable restrictions. They guide the consumer into making particular choices (eg, healthier foods), often without the consumer noticing. Nudges work best when they address behaviors based on quick, automatic decisions that may represent a departure from a strictly rational model of beliefs, preferences, and decision making. Behavioral economics strategies have strong appeal because they are potentially easy to implement and inexpensive, and influence desired choices. Nudges have been successfully applied to change food choice and intake among children in school cafeterias, but these strategies have been explored less often in the home setting.<sup>7</sup> Children consume

about two-thirds of their daily calories from foods prepared in the home<sup>8</sup>; therefore, using behavioral economics strategies at home has the potential to affect overall vegetable intake.

The purpose of the current study is to test the effectiveness of 9 behavioral economics strategies or nudges (Table 1) for improving vegetable intake, liking, and variety of vegetables consumed by children (aged 9–12 years) during dinner. Researchers will use the socioecological model as a framework for addressing eating behavior based on how individual, social, physical, and macro-level environments influence food choices.<sup>9</sup> Caregivers will implement the behavioral strategies or nudges to improve the food choice set for chil-

dren by manipulating the home physical and/or social environment (Table 1). The goal of the study is to select 6 of these 9 strategies for incorporation into future Cooking Matters for Families courses conducted in the Minneapolis/Saint Paul area. Cooking Matters for Families is a program implemented in many states in the US in which parents and children learn to prepare food together.<sup>10</sup>

## METHODS

### Participants

Researchers will recruit caregivers of at least 1 child (aged 9–12 years) and the 9- to 12-year-old child through local agencies and organizations such as

**Table 1.** Behavioral Economics Strategies Tested for Effectiveness

Strategy/Example	Rationale
Pair vegetables with other foods the child already likes. For example, add beans (less liked) to tacos (liked).	Associative conditioning (flavor–flavor learning) has promoted vegetable intake among middle school children. <sup>27</sup>
Make vegetables more easily available and visible than other foods at the dinner meal. For example, place the vegetable serving dish on the dinner table and keep other foods in another room and/or out of sight.	Increasing the prominence and convenience of certain foods while decreasing the accessibility and convenience of other foods has resulted in changes in intake of each food. <sup>28</sup>
Serve vegetables before the rest of the meal. For example, serve vegetables while dinner is being prepared.	Removing competition with other foods or decreasing non-fruit or vegetable options improved fruit intake among preschool children. <sup>29</sup>
Use a dinner plate that shows the amount of vegetables to eat for a meal. Use paper plates provided for all family members for 3 meals with sections printed according to MyPlate (MyPlate Paper Portion Plate, Positive Promotions, 15 Gilpin Ave, Hauppauge, NY).	Use of assortment allocation cues (pictures in school lunch tray compartments) has improved selection and consumption of vegetables among school-aged children. <sup>30</sup>
Offer the child 2 vegetable options for dinner, 1 liked and 1 less liked. Then let the child choose what is served.	Contrasting a liked option against the competition of a less liked option (asymmetric dominance) has resulted in changes in consumer decision making. <sup>31</sup>
If the caregiver puts vegetables on the child's plate, give more than usual. If children typically serve themselves, put a larger spoon than normally used with the vegetable so they get more than usual.	Using a larger serving spoon makes the default option a larger serving and has increased ice cream intake among nutrition experts. <sup>32</sup>
Eat dinner together with an adult(s) modeling vegetable consumption.	Decision making may be influenced by parental social (descriptive) norms representing a departure from the assumption of rationality. Associations have been established between parental normative influence and vegetable intake of children. <sup>33</sup>
Serve at least 2 vegetables with dinner meals. Include 2 different vegetables as side dishes OR 1 side dish of vegetables plus another food item with vegetables.	Increasing variety of vegetables offered has increased selection and consumption among children. <sup>34,35</sup>
Let the child help prepare vegetable dishes. For example, ask the child to get vegetables out and wash them.	Individuals have liked and preferred products they made themselves over those made by others. The mere act of preparing a certain food enhanced liking and consumption among adults. <sup>36</sup>

community centers, churches, and after-school/summer programs. In addition to having a child aged 9–12 years, inclusion criteria include (1) being the caregiver primarily responsible for food preparation for the child; (2) preparing dinner at home at least 3 times weekly; and (3) reporting use of food assistance (eg, participating in the Supplemental Nutrition Assistance Program). Caregivers who report not feeling comfortable speaking, reading, and writing in English will be excluded. Families from diverse backgrounds will be included to reflect the race/ethnicity distribution of those participating in the Minnesota Cooking Matters for Families program.

### Compensation and Research Ethics

To enhance study retention, caregivers will receive a total of \$100 (\$25 at baseline, \$25 at mid-study, and \$50 at the final in-home visit) and children will receive a total of \$20 (\$10 at baseline and \$10 at the final in-home visit). Researchers will also distribute newsletters to caregivers and small gifts (eg, water bottles) to children to enhance retention. The University of Minnesota Institutional Review Board approved the study.

### Selection of Behavioral Economics Strategies

The 9 behavioral economics strategies that will be tested in this study (Table 1) were identified through a literature review/expert panel review process followed by in-home observation sessions. A multidisciplinary team with expertise in nutrition, food science, health psychology, marketing, and economics conducted a literature search to identify previously tested behavioral economics strategies that aimed to improve dietary behaviors. Based on the reviewed literature and consensus discussions among the team, a survey was constructed listing 20 commonly reported strategies, each with rating scales for feasibility in the home and potential impact on vegetable consumption and liking. The survey was sent via e-mail to 48 experts who had (1) auth-

ored publications in the area of behavioral economics applied to food choice or factors affecting home vegetable intake among children; (2) made presentations at conferences regarding behavioral economics research and food choice; and/or (3) received funding to apply behavioral economics strategies to child feeding programs. Responses from 24 experts were used to reduce the list of 20 strategies to 16 considered to be feasible and potentially effective.

Observation sessions with 20 families receiving food assistance were conducted during dinner meal preparation and consumption to identify barriers and facilitators to implementation of the 16 strategies in home settings. Observation sessions were conducted to assess availability of cooking utensils and tools, vegetable availability, cooking skills, typical menus, and potential family responses. Based on these observations, 9 behavioral economics strategies were selected for further evaluation in the current study.

### Study Design and Intervention

A randomized, controlled trial will be conducted over 6 weeks, with intervention families implementing 1 new strategy each week during at least 3 dinner meals. Caregivers will be randomly assigned 6 of the 9 strategies to implement over the 6-week intervention period. To assess effectiveness of the individual strategies, weekly phone calls will be made by a research team member to (1) estimate the frequency with which the assigned strategy was used; (2) document the manner in which the strategy was implemented during each attempt to determine whether the caregiver implemented the strategy as defined by researchers; (3) identify barriers and facilitators to use; (4) collect information about the type and amount of vegetables the child consumed at the dinner meal on the assigned days using a food record completed by the caregiver; and (5) provide detailed instructions for implementing the next week's strategy. Instructions will include specific information about how caregivers should implement the strategy in the home with their child, including a dis-

ussion of overcoming barriers to using the strategy. The fourth weekly contact will be conducted in person instead of by phone to enhance retention. Caregivers in the control group will not be assigned strategies and will be asked to prepare dinner as they normally would. They will complete the same food record form to report the child's dinner meal vegetable intake on 3 days each week for a total of 6 weeks.

### Baseline and Final Outcome Measures

Two research team members will meet with each family (both intervention and control groups) in their home at baseline, at the fourth week, and at the conclusion of the study. At the baseline home visit, after informed consent or assent is obtained, a research team member will measure the child's height and weight according to standard procedures.<sup>11,12</sup> The caregiver and child will then be separated while completing several questionnaires. The caregiver will complete demographic, vegetable liking and variety,<sup>13,14</sup> and household food insecurity questionnaires.<sup>15</sup> After caregivers complete their questionnaires, a research team member will provide instructions to caregivers about how to record the child's dinner meal vegetable intake using a food record form (for 3 dinner meals during the week). At this time, the caregiver will practice completing the food record form by indicating the type and amount of vegetables the child ate the night before. Caregivers will be encouraged to use the visual aids provided, such as the Nutrition Data System for Research (NDSR) food amount booklet and the Center for Disease Control and Prevention *What Counts as a Cup* guide, to improve the accuracy of amounts reported.<sup>16,17</sup>

The child will complete vegetable liking<sup>13</sup> and physical activity questionnaires<sup>18</sup> with a research team member. To assess dietary intake, that same team member will conduct a 24-hour dietary recall with the child following an amended version of the NHANES *Dietary Interviewers Procedures Manual*.<sup>19</sup> Caregivers will assist their 9- to 12-year-old child with the 24-hour dietary recall, especially for

**Table 2.** Description of In-Home Data Collection Surveys, Questionnaires, and Procedures

Data Collection Tool	Schedule	Description	Analysis
<b>Completed with caregiver</b>			
Demographic questionnaire	Baseline in-home visit	Age, gender, race/ethnicity, household composition, education, employment, and participation in food assistance programs	Means and SD (or frequencies) as appropriate
Exit questionnaire	Final in-home visit	Intervention families' perceptions about effectiveness of behavioral economics strategies and control families' perceptions about whether participating in study affected child vegetable intake	Means and SD (or frequencies) as appropriate
Vegetable liking/variety questionnaire	Baseline and final in-home visit	Adapted from existing validated questionnaire <sup>14</sup> including 36 vegetable items. Caregivers will indicate if they consumed the vegetable in the past 30 d (yes/no) to assess variety. Liking of each vegetable will be assessed using a 10-point hedonic labeled scale.	Mean variety scores will be determined as the sum of the 36 vegetable items where 1 point is assigned for each yes response. Liking of each vegetable will be rated on a 10-point labeled hedonic scale from <i>Hate it</i> (1) to <i>Like it a lot</i> (10) or <i>Never tried</i> . <sup>37</sup>
Household food security	Baseline	Household food security status will be assessed using an amended version of the 6-item US Department of Agriculture Food Security Survey, where questions AD1 and AD1a are combined. <sup>15</sup>	Participants who respond with 0 to 1 affirmative responses will be classified as food secure, 2 to 4 affirmative responses low food security, and 5 to 6 affirmative responses very low food security.
<b>Completed with the child</b>			
Height and weight of child	Baseline	Trained researchers will collect data according to standard procedures. Height will be measured twice barefoot using a stadiometer (Model 202, Seca, Hanover, MD) to the nearest 0.1 cm. Weight will be measured twice barefoot and in light clothing on a digital scale to the nearest 0.1 kg (Model BWB-800P, Tanita, Arlington Heights, IL).	Mean height and weight will be calculated from the 2 measurements. Body mass index z score and body mass index percentile for sex and age will be calculated using Centers for Disease Control and Prevention growth curves. <sup>38</sup>
Vegetable liking questionnaire	Baseline and final in-home visit	The same questionnaire that adults complete will be used, except that children will not be asked about vegetables consumed in the past 30 d as a measure of variety.	Liking of each vegetable will be rated on a 10-point labeled hedonic scale from <i>Hate it</i> (1) to <i>Like it a lot</i> (10) or <i>Never tried</i> . <sup>37</sup>
Physical activity	Baseline	Youth Risk Behavior Surveillance System questions with well-established reliability. <sup>18</sup>	Will assess whether children meet physical activity recommendations (ie, > 60 min of moderate or vigorous intensity aerobic activity). <sup>39</sup>
24-h dietary recalls and variety evaluation	Baseline and final in-home visit	Three nonconsecutive 24-h dietary recalls (the first recall conducted in person followed by 2 via telephone). Changes in dietary intake: vegetable servings, energy, energy density (kcal/g), and foods/nutrients expected to vary with vegetable intake. Vegetable variety for the child will be measured with 3 24-h dietary recalls.	Intake will be analyzed using NDSR software and averaged across the 3 d of intake data. The number of NDSR vegetable groups consumed over 3 d of dietary recall will be used to assess variety of vegetables consumed. <sup>20</sup>

**Completed by researchers**

Home vegetable inventory	Baseline and final in-home visit	A validated home food inventory form was adapted and will be used to record the availability of vegetables in the home. <sup>22</sup> Revisions were made to estimate amount (ounces) of vegetables present.	A count of different types of vegetables will be made based on all forms of the same vegetable (fresh, canned, or frozen). One point will be assigned for each vegetable regardless of its form. Mean vegetable counts will be calculated.
Observation checklist	Baseline and final in-home visit	An observation checklist was developed and includes information on cooking supplies present in the home as well as a description of the home dining environment (eg, presence of dining room table).	A count of specific equipment for use in vegetable preparation will be made based on its presence in the home (eg, knives, strainers, peelers). <sup>40</sup>
<b>Completed by caregiver after baseline visit</b>			
Daily food record	Weekly phone calls	Form includes information on days/dates the intervention was implemented in the home and lists names and amounts of vegetables eaten by child at the dinner meal on that day.	Names of specific vegetables eaten and quantity eaten (cups)
Weekly strategy record script–follow-up call	Weekly phone calls	A questionnaire script for interviewing the caregiver regarding the experience of implementing the strategy.	Open-ended questions addressing the manner in which the strategy was implemented and facilitators and barriers.

eating occasions in which the caregiver was present. Two additional 24-hour recalls will be completed with the child by phone within the next 10 days, similar to NHANES procedures.<sup>19</sup> Recalls will be collected on nonconsecutive days and will also be used to evaluate child vegetable variety.<sup>20</sup> Recall data will be entered into the NDSR software (University of Minnesota Nutrition Coordinating Center, Minneapolis, MN) and dietary output data will be analyzed. To increase the accuracy of the recalls, food models in addition to the NDSR food amount booklet will be used at the first recall collected during the in-home visit. The children will also participate in measurement exercises in which they practice measuring liquids in glasses that they frequently use. The research team member will take notes of these measurements in case the child references these glasses during the telephone recalls. Finally, a research team member will conduct a home vegetable inventory and complete an observation checklist regarding cooking supplies and equipment and take notes about the layout of the kitchen and dining area.<sup>21-33</sup>

At the final home visit, the same procedures and instruments will be used for data collection, except that data on demographics, food security, child's height and weight, and child's physical activity data are collected only at baseline. Also, at the final in-home visit, caregivers will complete an exit questionnaire to assess reactions to their experience and whether household composition changes during the study. [Table 2](#) described data collection and schedules.

**Pilot Testing**

Data collection protocols were developed to maintain consistent data collection procedures throughout the study for all families. Study personnel experienced in community research methods trained other research team members to improve skills through repeated demonstration, modeling, and critiquing and in-home practice sessions. The protocols were first pretested with 6 families using 6 strategies to refine data collection procedures and instructions for study participants. After the pretest, the

research team conducted a pilot test with 16 families (11 in the intervention group and 5 in the control group) for the entire length of the study (implementation of 6 strategies per family). At the conclusion of the pilot test, 3 of the 9 strategies were revised to improve consistency because implementation of these 3 strategies widely varied across families. The instructions for most strategies were also clarified and simplified. To improve the accuracy of food and vegetable amounts reported, additional resources (eg, a pre-measured serving spoon) were provided to families and the food record form was simplified.

### Data Analyses for Intervention

Mean dinner vegetable intake will be calculated over the 3 days each strategy will be implemented in its assigned week. Mean vegetable intakes for the strategies will then be compared using a mixed-model analysis of variance with a random effect for child. Fixed independent variables will include the strategy and the week of strategy implementation. Additional covariates will be considered as listed below; only covariates that lower the Akaike information criterion will be included.

The number of days each strategy was implemented and the ratings of the ease of applying the strategy will be compared among strategies in a similar way, except that the number of days will be modeled using a logistic mixed model. Considerations for determining which 6 strategies will be implemented in the next phase of the project will include the mean increase in vegetable intake for each strategy, ratings of ease of use, and ratings of the extent to which the strategies were applied.

### Data Analyses for Baseline and Final Outcome Measures

Differences between intervention and control groups from baseline to study conclusion for the following measures will be assessed with ANCOVA: mean number of vegetable servings per day; energy, and nutrient intakes per day over the 3 24-hour recall days; variety of vegetables consumed; and liking scores. A Bonferroni corrected signifi-

cance level of .05 per number of tests will be used.

### Covariates

Several covariates will be included in analyses to control for possible differences observed between strategies as well as differences observed between the intervention and control groups. Demographic variables considered in analyses will include the caregiver's age and race/ethnicity, the highest level of formal education achieved by the caregiver, the caregiver's employment status, and the number of individuals residing in the household (ie, the number of children and adults). Other covariates will be household food security, household vegetable availability, caregiver vegetable intake, child's body mass index, and vegetable liking for both the child and caregivers.

### Sample Size Calculations

Calculations will assume an SD of 0.25 cups, based on findings of Wengreen et al,<sup>24</sup> who reported a mean intake of 0.22–0.40 cups and SD of 0.19–0.30 cups. To detect strategies that would increase the response by 0.225 cups (0.9 SD) from the control with 80% power, 33 intervention families and 15 control families are needed, using a level of significance of .05. In addition, for the aim of simply detecting the 6 best strategies, if 3 strategies increase the response by 0.25 cups (1 SD), 3 increase the response by 0.15 cups (0.6 SD), and 3 have no effect, there will be 80% power to correctly identify the 6 with a positive effect. The minimal detectable difference for the 3 paired *t* tests between baseline and study conclusion is 0.275 cups (1.1 SD), using a Bonferroni corrected significance value. To account for a possible 25% dropout rate, the goal is to enroll 44 families in the intervention group and 20 in the control group. All computations will be performed in R<sup>25</sup> and simulations will be used for the mixed-model computations.

## DISCUSSION

A major strength of the study includes the effort to recruit and retain partici-

pants for the entire length of the randomized controlled trial. A high dropout rate (about 25%) is expected because this audience tends to be extremely mobile (ie, changes housing often) and telephone numbers change frequently. To address this issue, the research team will oversample to account for dropouts, compensate caregivers and children for their time, and conduct sessions at times convenient for the family. The research team will also collect information for an alternate contact person in case they lose contact with the participant. Reasons for dropouts will be recorded and addressed as much as possible to enhance retention. The contacts at baseline, the fourth week, and study conclusion will be conducted in participants' homes to allow researchers to build rapport with the family and enhance retention. Also, a monthly newsletter will be mailed to each family's home to enhance retention.

Another strength is that the research team will inquire about facilitators and barriers to caregivers' experience, as well as how they actually implement each behavioral economics strategy during dinner meals. This information will be considered when selecting the subset of 6 behavioral economics strategies for the next phase of the project and will help the research team to determine how to revise the instructions provided to caregivers for implementing the strategies.

Strengths and limitations exist with respect to conducting 24-hour dietary recalls with children and using food records provided by caregivers as a proxy for child's dinner vegetable intake. Although dietary recalls are criticized because they rely on memory, especially among children, they are less burdensome and an appropriate option when researchers are interested primarily in the mean intake of vegetables.<sup>26</sup> Collection of this information over 3 days (1 day in person) using the NDSR multi-pass approach with visual portion-size estimation aids will minimize misreporting error. Also, the use of the food models, NDSR food amount booklets, and measurement exercises completed during the first recall at the in-home visit should improve the accuracy for the child 24-hour

dietary recalls. Similarly, the practice food record completed with the caregiver at the first in-home visit will help minimize reporting errors.

Limitations for this study will include the use of a non-representative convenience sample, with caregivers residing in the Twin Cities or surrounding areas who have a similar sociodemographic background. Furthermore, before participating in the study, caregivers must report preparing dinner meals in the home at least 3 times weekly. Thus, findings cannot be generalized to a broader group of caregivers and children. Caregivers may provide socially desirable responses, because those interested in nutrition may be more likely to volunteer and have higher compliance rates throughout the study. Finally, this study will not address the outcome of weight change, only the potential proximal outcome of dinner meal vegetable intake.

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### **CONFLICT OF INTEREST**

The authors have not stated any conflicts of interest.