Influence of Screen-Based Peer Modeling on Preschool Children’s Vegetable Consumption and Preferences
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ABSTRACT
Objective: To determine the influence of screen-based peer modeling on children’s vegetable consumption and preference.
Methods: A total of 42 children aged 3–5 years were randomly assigned to view individually a video segment of peers consuming a modeled vegetable (bell pepper), vs a nonfood video segment or no video. Analysis of covariance models examined bell pepper preference and consumption during initial video exposure (day 1) and without video exposure (days 2 and 7), adjusted for age, sex, body mass index, and initial bell pepper consumption.
Results: Children in the vegetable condition ate more bell peppers (15.5 g) than did those in the control condition (5.9 g; \( P = .04; \eta^2 = 0.85 \)) on day 7, with no differences on days 1 or 2. Among children who ate the modeled vegetable, those in the vegetable DVD condition reported greater preference for eating the vegetable again (\( P = .01 \)).
Conclusions and Implications: Screen-based peer modeling is a promising tool to influence children’s vegetable consumption.

INTRODUCTION
One-third of American children aged ≤ 4 years consume no vegetables on a typical day. Increased vegetable consumption is linked to improved diet quality and decreased total energy intake. Food neophobia, or the fear of unfamiliar foods, may account for many preschoolers’ low vegetable consumption. Early life experiences involving vegetables may have a lasting positive impact on future dietary habits.

Peer modeling influences preschoolers’ food choices. In a prior trial, 17 children aged 2–4 years tasted and reported preference for 9 vegetables; then each child was seated in a lunchroom with 3 or 4 peers who selected the target child’s least preferred vegetable to eat. By the fourth day of peer modeling, the majority of target children selected the previously least preferred vegetable to model peer behavior. Because digital screens have become ubiquitous in children’s lives, peer models are now being integrated into media platforms including DVDs. The Food Dudes DVD, which displays cartoon animated peers who enjoy eating fruits and vegetables in conjunction with an external rewards system (ie, stickers given for tasting or eating the fruit), significantly increased consumption of the modeled fruits and vegetables among children aged 4–11 years. It is unknown whether screen-based authentic peers (ie, not animated) will influence younger viewers’ food choices and preferences without an external rewards system that is contingent on behavioral response.

The current study was modeled on social learning theory, because children develop new patterns of behavior both by observing others and by direct experience. The primary purpose was to examine the efficacy of screen-based authentic peer modeling on preschoolers’ vegetable preference, selection, and consumption. It was hypothesized that children randomly assigned to view a DVD of peers consuming a modeled vegetable would be more likely to prefer, select, consume, and request the modeled vegetable, compared with children viewing a nonfood video segment or no video, during the initial exposure and 1 day and 1 week later.

METHODS
Study Design
This was a randomized controlled trial in which children were randomly assigned to 1 of 3 conditions: the Copy-Kids Eat Fruits and Vegetables DVD, the Copy-Kids Brush Teeth DVD, or a no-DVD control.
Participants and Recruitment

A total of 42 children, aged 3–5 years and attending 1 of 2 full-day preschools, were recruited as participants. Pennington Biomedical Research Center’s Institutional Review Board approved all study procedures and parents provided written informed consent. All procedures were explained in child-friendly terms, and a child could refuse to take part in the study at any time. Figure 1 shows the CONSORT diagram.

Procedures

After the consenting process, parents completed a survey that reported children’s demographic information and eating behaviors. The researchers used block randomization to distribute age and sex evenly across conditions using a randomization schedule generated with SAS programming (SAS PROC PLAN, SAS Institute Inc., Cary, NC, 2013). Each of the 3 study visits lasted 15 minutes and occurred at the preschool during the child’s normal morning snack time in a separate area that was quiet and free of distractions. Children attended study visits on 2 consecutive days (days 1 and 2) and a final visit 1 week later (day 7 ± 2 days).

Depending on the condition, on day 1 the child viewed 1 of 2 video clips or sat quietly for 7.5 minutes. Two plates of snacks (the modeled vegetable and a comparison food) were placed in front of the participant in a standardized format (green bell peppers on the right and dry cereal on the left) on separate, identical white Styrofoam plates (Figure 2). Children were instructed to eat as much or as little as they wished during this time. The video segments were played concurrently during the food presentation; a timer was set for 7.5 minutes for the control condition. Study staff weighed 0.5 cups of the modeled vegetable (ie, approximately 80 g of raw, sliced green bell pepper) and 0.5 cups of the comparison food (ie, approximately 16 g of Multi Grain Cheerios; General Mills, Minneapolis, MN) using a transportable scale before and after snack presentation on days 1, 2, and 7. The nutrient composition of bell peppers and Multi Grain Cheerios was as follows: 18 kcal, 0.2 g fat, 3 mg sodium, 4.3 g carbohydrates, 2.2 g sugar, and 0.8 g protein; and 54 kcal, 0.6 g fat, 58 mg sodium, 11.8 g carbohydrates, 3.1 g sugar, and 1.2 g protein, respectively.

On days 2 and 7, food items were presented for 7.5 minutes without the concurrent video presentation. At the end of each visit, children were allowed to select a sticker as a token of appreciation. Researchers did not inform parents regarding which foods were presented to the children.

DVD Stimuli

The Copy-Kids DVD series (Santa Monica, CA) is commercially available and designed to encourage positive eating habits in young children (aged 6 months to 5 years). The Copy-Kids Eat Fruits and Vegetables DVD contains individual segments for 6 vegetables and 6 fruits. The bell pepper segment features individual clips of 5 similarly aged toddlers (80% aged 3–4 years; 60% female; 40% non-white) happily eating and vocally interacting with the food item (eg “bell peppers” stated 4 times; creatively playing with bell peppers by building a roller coaster out of slices). The Copy-Kids Brush Teeth DVD was produced by the same company and features 8 children of similar ages (88% aged 3–4 years; 50% female; 37% non-white) modeling tooth brushing. Both segments were spliced to be 7.5 minutes in duration. The DVD was displayed on a Dell Latitude E6540 laptop with a 15-in screen (Dell Inc., Round Rock, TX). The sound level and laptop distance from the child were standardized within each school.

Measurements

The parent pre- and postsurvey collected: (1) child demographic information; and (2) dietary habits and purchasing trends, including the child’s usual appetite (measured on a scale from 1 to 4, in which 1 = excellent and 4 = poor), current dietary habits (On an average day, how many cups of fruits does your child eat?), and home availability (ie, How many fruits and vegetables are available in the home?). Parents selected fruits and vegetables consumed by their children on a regular basis, eaten in the past week, mentioned or requested in the past week, and purchased or available in the home during the past week, from a 12-item list of various fruits and vegetables (including bell pepper, the food featured in the 7.5-minute Copy-Kids DVD stimulus). A handout was provided with examples of fruits and vegetables apportioned into 1 cup to aid parents. Finally, media
use was reported, including the child's frequency of television use during mealtimes (using a scale from 1 to 6, in which 1 = always and 6 = never) and total daily screen time (using a scale from 1 to 3, in which 1 = < 1 hour, 2 = 1–2 hours, and 3 = > 2 hours).

On day 1, children were asked whether they had previously eaten a bell pepper. Children who viewed the Eat Fruits and Vegetables DVD were asked to point to the food from the video segment and verbally express the name of the food item immediately after watching the video, to measure comprehension. Before the food selection task, a subset of children (n = 22) was asked to describe how hungry they felt, using a 3-point Likert-like scale featuring figures with stomachs of varying fullness. After the food selection task, children were asked to describe how they felt while watching the video and eating the food items, using a 3-point Likert-like scale featuring faces of varying levels of enjoyment (items labeled yummy, okay, and yucky) using an adapted version of the validated Preschooler Food Preference Assessment Tool. Children were asked how they would feel about eating the modeled food again at a later time. Assessments were repeated on days 2 and 7.

**Statistical Analysis**

The researchers analyzed data using SAS, version 9.4. Body mass index z score (BMIz) was calculated based on parental report of child's height, weight, and date of birth and categorized as overweight or obese if BMI was ≥ 85th percentile. One participant was missing self-reported height and was excluded from BMI analysis. One BMIz was imputed to be −4.0 because the participant's parent-reported BMIz was outside the Centers for Disease Control and Prevention bounds of BMIz (< −4.0).

Differences in baseline characteristics were examined using t tests or chi-square tests. The researchers examined differences in outcomes between conditions using ordered logistic regression analysis (preference for modeled vegetable) and logistic regression analysis (selection of modeled vegetable and request of modeled vegetable), controlling for relevant covariates (age, sex, BMIz, and regular bell pepper consumption). ANCOVA was used to examine differences in consumption of the modeled vegetable among the 3 conditions, controlling for the same covariates plus initial bell pepper consumption on day 1. Separate models were conducted for the immediate effects (day 1) and longer-term effects (days 2 and 7) using the full sample and the subset of children who consumed the bell pepper. Effect sizes were reported as partial eta-square ($\eta^2$) and were classified as small (0.01), medium (0.06), or large (0.14).

**RESULTS**

Most participants were white (73.8%) and half were girls. The Table lists descriptive characteristics. There were no significant differences by condition in age, sex, race, ethnicity, or BMI status. At baseline, the majority of parents reported their child's appetite as good to excellent (67.3%). Most parents reported having vegetables in the home most of the time or always (88.1%). Parents reported that the family did not frequently watch television during meals (54.8% rarely or never, 31.0% sometimes, and 26.2% most of the time or always). Parents reported that their child spent < 1 h/d in total screen time (38.1%), 1–2 h/d (47.6%), or > 2 h/d (14.3%). There were no differences by condition in children's baseline eating, screen time, or hunger.

**Exposure Verification**

Among the 14 participants in the vegetable DVD group, 10 correctly identified the modeled food as bell pepper, 2 pointed to bell pepper but did not identify it by name, 1 child said “pepper” but refused to point to a food item, and 1 child refused to answer.

**Sensitivity Analysis**

At baseline, 9 children were reported as regular bell pepper eaters by parents (21.4%). When children were asked whether they had eaten bell peppers before, 11 answered yes, 27 answered no, and 4 answered “Don't know.” Parents' report of their child's bell pepper consumption was discrepant from children's report of whether they had eaten bell peppers before: Of the 9 children who were reported by parents to have eaten bell peppers regularly, 6 reported never having eaten bell peppers before. Children whose parents reported them to be regular bell pepper eaters consumed more bell peppers on days 1 ($P = .02$), 2 ($P = .05$), and 7 ($P < .01$). Therefore, regular bell pepper consumption was included as a covariate.
Selection and Consumption of Modeled Vegetable

In multivariable-adjusted analysis, selection and consumption of the modeled vegetable and the comparison food did not differ by condition. The condition effect sizes were small (day 1, $\eta^2 = 0.02$; day 2, $\eta^2 = 0.02$; and day 7, $\eta^2 = 0.004$). However, when controlling for the amount consumed on day 1, there was a significant condition difference in the amount of the modeled vegetable consumed on day 7 ($P = .05$). Post hoc Tukey tests indicated that children in the vegetable DVD condition ate significantly ($P = .04$) more bell peppers (15.5 g) compared with children in the no-DVD control condition (5.9 g); children in the control DVD condition were in the middle (11.8 g) (Figure 3). The model effect size was large ($\eta^2 = 0.85$) and the condition effect size was small ($\eta^2 = 0.02$).

Children in the vegetable DVD condition ate significantly less green bell pepper and dry cereal during day 1 while they were watching the video, compared with during the follow-up visits when they did not view the video, on day 2 ($P = .05$ for bell peppers and $P = .006$ for cereal), and on day 7 ($P = .05$ for bell peppers and $P = .003$ for cereal). There were no differences across time for children in the other 2 conditions.

Preference for Modeled Vegetable

In ordered logistic regression models, there was no significant difference by condition for children’s liking of bell peppers (ie, Touch the face you made when you ate the bell pepper) on days 1, 2, or 7. Among those who ate bell peppers, children in the vegetable DVD condition were significantly more likely to report preference for eating bell peppers in the future (ie, Touch the face that you would make if you ate the bell pepper again sometime) on day 7 ($P = .01$) and were marginally more likely to report liking bell peppers compared with the control condition on day 7 ($P = .05$).

Request for Modeled Vegetable

After the experiment, there were no significant differences in parent-reported requests by the child for bell peppers ($P = .09$), for parents purchasing or having bell peppers available in the home ($P = .10$), or parent-reported child vegetable or fruit consumption for the past week.

DISCUSSION

This study examined the influence of screen-based peer modeling on preschool children’s food choice behaviors. Consumption of the modeled vegetable and preference for eating the modeled vegetable again were higher 1 week after children viewed screen-based peer modeling compared with the nonfood control DVD and no-DVD control conditions, after

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<th>Table. Sample Characteristics for Preschool Children Enrolled in Screen-Based Peer Modeling Study (n = 42)</th>
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BMI indicates body mass index.

Figure 3. Least-squares adjusted means of modeled vegetable consumption after experimental manipulation. Variance bars represent standard error.
controlling for baseline consumption. However, consumption and preferences in the short term (during DVD exposure and 1 day afterward) did not differ based on screen-based modeling, nor were there transfer effects of screen-based peer modeling on children's overall vegetable consumption or requests at home. Importantly, this study examined the effect of authentic screen-based modeling on children's food choices without an external reward system, unlike prior studies.5

For children in the vegetable DVD condition, food consumption was lower on day 1 while children viewed the vegetable DVD vs on days 2 and 7 when they did not view the video. The video segment was potentially a distraction from energy intake. Previous studies presented the DVD immediately before but not during snack times, thus avoiding this competing interest effect.5

Young children's food preferences are positively correlated with the frequency of encounters with those foods.1,2 Preschool children who were repeatedly exposed to an initially disliked vegetable exhibited significant increases in liking by the sixth exposure.2 Therefore, future studies should examine the effects of repeated exposure to the vegetable DVD to examine enhanced motivation from repetitive peer modeling. Other future research directions include investigating different energy intake responses based on preference for the comparison food, the context of the snack, and the characteristics of the peer model. For instance, the children in the video ate green, red, and yellow bell peppers, whereas the experimental food provided was only green bell peppers; more closely replicating the color of the snack may improve modeled behavior.3 Another consideration is that many of the children had been previously exposed to bell peppers; selecting a food that is novel to all children may yield different results.

The strengths of this study include the equal sex distribution and the randomized controlled design. Furthermore, the intervention was low in cost, time, and effort. Limitations include the potential for within-school contamination across conditions, the small sample size, and the short measurement time frame. Neophobia was not explicitly measured and should be considered in future studies as an important influence on food selection. Children's consumption and requests outside the experimental setting were captured by parental report using questions adapted from other sources.9

IMPLICATIONS FOR RESEARCH AND PRACTICE

Screen-based peer imitation should be replicated with a larger and more diverse population of preschool-aged children to increase statistical power, so as to identify between-group differences and improve generalizability of the findings. Screen-based peer imitation may emerge as a low-cost, minimally invasive, and effective behavior change strategy to improve children's vegetable consumption for use in preschool settings or as a tool in obesity prevention programs.

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REFERENCES

CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.