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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—Forty-two children aged 3 to 5 years were randomly assigned to individually view a DVD segment of peers consuming a modeled vegetable (bell pepper) vs. a non-food DVD segment vs. no DVD. Analysis of covariance models examined bell pepper preference and consumption during initial DVD exposure (Day 1) and without DVD 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 (15.5g) than the control condition (5.9g; $p=0.0397$; model $\eta^2=0.85$) at Day 7, without differences at Days 1 or 2. Among children who ate the modeled vegetable, those in the vegetable DVD condition reported higher preference towards eating the vegetable again ($p=0.01$).

Conclusions and Implications—Screen-based peer modeling is a promising tool to influence children's vegetable consumption.

Keywords

food preferences; child, preschool; videotape recording

INTRODUCTION

One third of American children aged 4 years and younger consume zero vegetables on a typical day.¹ Increased vegetable consumption is linked to improved diet quality and decreased total energy intake.² Food neophobia, or the fear of unfamiliar foods, may account for many preschoolers' low vegetable consumption.³ Early life experiences involving vegetables may have a lasting positive impact on future dietary habits.^{4,5}

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Peer modeling influences preschoolers' food choices. In a prior trial, seventeen children ages 2 to 4 years tasted and reported preference for nine 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 the target children selected the previously least preferred vegetable to model peers' behavior.⁴ With digital screens becoming ubiquitous in children's lives, peer models are now being integrated into media platforms including DVD. The "Food Dudes" DVD, which displays cartoon animated peers who enjoy eating fruits and vegetables in conjunction with an external rewards system (i.e. stickers given for tasting/eating the fruit), significantly increased consumption of the modeled fruits and vegetables among children aged 4 to 11 years.⁶ It is unknown whether or not screen-based authentic peers (i.e. not animated) will influence younger viewers' food choices and preferences without an external rewards system that is contingent on behavioral response.

The present study was modeled on social learning theory, as children develop new patterns of behavior by both observing others and direct experience.⁷ 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 to children viewing a non-food DVD segment or no DVD, 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 one of three conditions: the "Copy-Kids™ Eat Fruits and Vegetables" DVD, the "Copy-Kids™ Brush Teeth" DVD, or a no-DVD control.

Participants and Recruitment

Forty-two children, aged 3 to 5 years and attending one of two full-day preschools, were recruited as participants. All study procedures were approved by Pennington Biomedical Research Center's Institutional Review Board, 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. See Figure 1 for the CONSORT diagram.

Procedures

Following the consenting process, parents completed a survey that reported child's demographic information and eating behaviors. Block randomization was used to evenly distribute age and sex across conditions using a randomization schedule generated with SAS programming (SAS PROC PLAN). Each of the three 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 two consecutive days (Day 1, Day 2) and a final visit one week later (Day 7 ± 2 days).

Depending on condition, on Day 1 the child viewed one of two DVD 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 right, dry cereal 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 DVD segments were played concurrently during the food presentation, or a timer was set for 7.5 minutes for the control condition. Study staff weighed 0.5 cups of the modeled vegetable (i.e. approximately 80g of raw, sliced green bell pepper) and 0.5 cups of the comparison food (i.e. approximately 16g of Multi Grain CheeriosTM; General Mills, Minneapolis, Minnesota) using a transportable scale before and after snack presentation at Days 1, 2, and 7. The nutrient composition of bell peppers and Multi-Grain CheeriosTM were as follows: 18 kcal, 0.2g fat, 3mg sodium, 4.3g carbohydrates, 2.2g sugar, and 0.8g protein and 54 kcal, 0.6g fat, 58mg sodium, 11.8g carbohydrates, 3.1g sugar, and 1.2g protein, respectively.⁸

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

DVD Stimuli

The Copy-KidsTM DVD series (Santa Monica, CA) is commercially available and designed to encourage positive eating habits in young children (ages 6 months to 5 years). The Copy-KidsTM “Eat Fruits and Vegetables” DVD contains individual segments for six vegetables and six fruits. The bell pepper segment features individual clips of five similarly aged toddlers (80% 3-4 years old; 60% female; 40% non-White) happily eating and vocally interacting with the food item (e.g. “bell peppers” stated 4 times; creatively playing with bell peppers by building a roller coaster out of slices). The Copy-KidsTM “Brush Teeth” segment was produced by the same company and features eight children of similar ages (88% 3-4 years old; 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” screen. The sound level and laptop distance from the child was standardized within each school.

Measurements

The parent pre- and post-survey 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 where 1 is “Excellent” and 4 is “Poor”), current dietary habits (“On an average day, how many cups of fruits does your child eat?”), and home availability (i.e. “How many fruits and vegetables are available in the home?”).⁹ 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/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-KidsTM DVD stimulus). A handout was provided with examples of fruits/vegetables apportioned into 1 cup to aid parents.¹⁰ Finally, media use was reported, including the child’s frequency of television usage during meal times (using a scale from 1

to 6 where 1 is “Always” and 6 is “Never”) and total daily screen time (using a scale from 1 to 3 where 1 is “<1 hour,” 2 is “1-2 hours,” and 3 is “>2 hours”).

On Day 1, the child was asked whether he or she had previously eaten a bell pepper. Children who viewed the “Eat Fruits and Vegetables” DVD were asked to point to the food from the DVD segment and verbally express the name of the food item immediately after watching the DVD to measure comprehension. Before the food selection task, a sub-set of children (n=22) were asked to describe how hungry they felt using a 3-point Likert-like Scale featuring figures with stomachs of varying fullness.¹¹ After the food selection task, children were asked to describe how they felt while watching the DVD 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.¹² 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

Data were analyzed 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/obese if BMI ≥ 85th percentile.¹³ One participant was missing self-reported height and excluded from BMI analysis. One BMIz was imputed to be −4.0 because the participant’s parent-reported BMIz was outside the CDC bounds of BMIz (<−4.0).¹³

Differences in baseline characteristics were examined using t tests or chi square tests. Differences in outcomes between conditions were examined using ordered logistic regression analysis (preference towards 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). Analysis of covariance was used to examine differences in consumption of the modeled vegetable among the three conditions, controlling for the same covariates plus initial bell pepper consumption at Day 1. Separate models were conducted for the immediate effects (Day 1) and longer-term effects (Day 2 and Day 7) using the full sample and the sub-set of children who consumed the bell pepper. Effect sizes were reported as partial eta-square (η^2) and classified as small (0.01), medium (0.06), or large (0.14).¹⁴

RESULTS

Most participants were White (73.8%), and half were girls. Descriptive characteristics are reported in Table 1. 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 less than 1 hour/day in total screen-time (38.1%), 1 to 2 hours/day (47.6%), or more than 2 hours/day (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, ten correctly identified the modeled food as bell pepper, two participants pointed to bell pepper but did not identify it by name, one child said “pepper” but refused to point to a food item, and one child refused to answer.

Sensitivity Analysis

At baseline, nine children were reported as regular bell pepper eaters by parents (21.4%). When the child was asked whether or not he/she had eaten bell pepper 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 or not they had eaten bell pepper before: of the 9 children reported by parents as regular bell pepper eaters, 6 children reported having never eaten bell peppers before. Children whose parents reported them as regular bell pepper eaters consumed more bell peppers at Day 1 ($p=0.018$), Day 2 ($p=0.048$), and Day 7 ($p<0.01$). 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, $\eta^2=0.02$; Day 7, $\eta^2=0.004$). However, when controlling for the amount consumed at Day 1, there was a significant condition difference in the amount consumed of the modeled vegetable at Day 7 ($p=0.047$). Post hoc Tukey tests indicated that children in the vegetable DVD condition ate significantly ($p=0.0397$) more bell pepper (15.5g) compared to children in the no-DVD control condition (5.9g), with children in the control DVD in the middle (11.8g) (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 DVD compared to the follow-up visits when they did not view the DVD, at Day 2 ($p=0.049$ for bell peppers and $p=0.006$ for cereal) and Day 7 ($p=0.047$ for bell peppers and $p=0.003$ for cereal). There were no differences across time for children in the other two conditions.

Preference for Modeled Vegetable

In ordered logistic regression models, there was no significant difference by condition for children’s liking of the bell pepper (i.e. “Touch the face you made when you ate the bell pepper”) at Days 1, 2, or 7. Among those who ate the bell pepper, children in the vegetable DVD condition were significantly more likely to report preference towards eating the bell pepper in the future (i.e. “Touch the face that you would make if you ate the bell pepper again sometime”) at Day 7 ($p=0.01$) and were marginally more likely to report liking the bell pepper compared to the control condition at Day 7 ($p=0.052$).

Request of Modeled Vegetable

After the experiment, there were no significant differences in parent-reported requests by the child for bell peppers ($p=0.09$), for parents purchasing or having the bell peppers available in the home ($p=0.096$), 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 versus the non-food control DVD condition and no-DVD control condition, after controlling for baseline consumption. However, consumption and preferences in the short-term (during DVD exposure and 1-day after) did not differ based on screen-based modeling, nor were there transfer effects of the 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.⁸

Interestingly, for those children in the vegetable DVD condition, food consumption was lower at Day 1 while children viewed the vegetable DVD versus at Days 2 and 7 when they did not view the DVD. The DVD segment was potentially a distraction from energy intake. Previous studies presented the DVD immediately prior to, but not during snack times, thus avoiding this competing interest effect.¹⁵

Young children's food preferences are positively correlated with 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 on the DVD ate green, red, and yellow bell pepper, whereas the experimental food provided was only green bell pepper; 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. Further, 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 timeframe. 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 of 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 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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Figure 1.
CONSORT diagram of study enrollment.

Figure 2.
Standardized layout for food selection task and DVD viewing.

Figure 3. Least squares adjusted means of modeled vegetable consumption following experimental manipulation.

Table 1

Sample Characteristics for Preschool Children Enrolled in Screen-Based Peer Modeling Study (n = 42).

Child	Vegetable DVD (n = 14)	Control DVD (n = 14)	No DVD (n = 14)	Overall (n = 42)
Age (years)	4.5 ± 0.8	4.1 ± 0.6	4.3 ± 0.8	4.3 ± 0.7
Sex (% girls)	50%	50%	50%	50%
Race				
White	8	10	13	31
African American	1	1	0	2
Asian	4	0	0	4
Other	1	2	1	4
Not Reported	0	1	0	1
Hispanic	2	1	1	4
Height (cm)	104.7 ± 8.7	102.9 ± 9.2	100.1 ± 11.3	102.5 ± 9.8
Weight (kg)	17.8 ± 4.0	16.6 ± 2.9	16.7 ± 2.6	17.0 ± 3.2
BMI z-score	-0.1 ± 2.0	-0.1 ± 1.9	0.6 ± 1.4	0.1 ± 1.8
BMI percentile	58.8 ± 34.6	58.0 ± 36.8	63.4 ± 34.4	60.1 ± 34.5
% Overweight/Obese	23.1	35.7	42.9	34.2
Vegetable Intake (cups/day)	1.0 ± 0.4	1.3 ± 1.1	1.4 ± 1.1	4.4 ± 0.8
Fruit Intake (cups/day)	1.2 ± 0.7	1.6 ± 1.3	2.1 ± 0.7	1.7 ± 1.0

Note. BMI indicates body mass index.