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Jennifer Schindler

Denise Corbett

Catherine A. Forestell

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Highlights

Eating Behaviors xxx (2012) xxx–xxx

Assessing the effect of food exposure on children's identification and acceptance of fruit and vegetables

Jennifer M. Schindler [a], Denise Corbett [b], Catherine A. Forestell [a,*]

[a] The College of William & Mary, Williamsburg, VA, 23187, United States
[b] School Health Initiative Program, Williamsburg James City County Public Schools, Williamsburg, VA, 23188, United States

► Children (group FV-EXP) were exposed to healthy foods during a nutrition program. ► A control group ~~(FV-EXP)~~ participated in the program but did not get food exposure. ► Both groups identified more fruit, but not vegetables, after the nutrition program. ► Group FV-EXP, tried more fruit, but not vegetables, after the nutrition program. ► Programs should expose children to healthful foods to increase their acceptance.

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Assessing the effect of food exposure on children's identification and acceptance of fruit and vegetables

Jennifer M. Schindler [a], Denise Corbett [b], Catherine A. Forestell [a,*]

[a] The College of William & Mary, Williamsburg, VA, 23187, United States
[b] School Health Initiative Program, Williamsburg James City County Public Schools, Williamsburg, VA, 23188, United States

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ABSTRACT

Currently, fewer than 15% of children between the ages of 4–8 years consume the recommended levels of fruits and vegetables. In order to address this serious public health issue, a variety of nutrition programs have been implemented across the country, which have varied in their success. The present research analyzed the effectiveness of providing fruit and vegetable exposure as part of a school nutrition program. Kindergarten students at two schools were (N = 59) exposed to interactive activities about healthy eating and physical activity. In addition, those at one school ($n = 29$) were exposed to a variety of fruits and vegetables as part of this program. Assessment of children's ability to identify and their willingness to try fruits and vegetables before and after the program indicated that while all children were better able to identify a range of fruit, only those who received exposure to healthful foods were more willing to try fruit after the program. There were no changes in their identification or willingness to eat vegetables. These results suggest that schools should provide exposure to a variety of healthy foods as part of their nutrition programs. Such programs should focus specifically on exposing children to vegetables because increasing children's willingness to try foods that are typically considered unpalatable may be especially challenging.

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1. Introduction

Nutrients from a diet that is rich in fruit and vegetables can contribute to the prevention of cancer and cardiovascular disease and may displace other less healthy foods, thereby reducing fat consumption (Hu et al., 2000; Liu et al., 2000). However, fewer than 15% of children between the ages of 4–8 years consume the recommended levels of fruits and vegetables (Guenther, Dodd, Reedy, & Krebs-Smith, 2006). This is a serious public health concern given that eating habits established in childhood track into adulthood (Mikkila, Rasanen, Raitakari, Pietinen, & Viikari, 2004).

Barriers exist that make it especially difficult for young children to improve their eating habits. From a biological perspective, children tend to prefer energy-dense foods, which are often sweet and salty, as opposed to healthier foods, such as vegetables and fruit, which may be bitter or sour tasting (Desor, Mallor, & Greene, 1977). In addition, children are often unwilling to try unfamiliar foods. This fear of new food experiences, referred to as neophobia has been identified as a factor in children's low consumption of fruits and vegetables (Cooke et al., 2004; Wardle, Carnell, & Cooke, 2005).

In an effort to counteract these barriers to healthy eating in children, government agencies and community groups have begun to develop strategies that encourage healthy eating in children (CDC, 2007). Because children spend a large amount of time in educational environments, schools are key venues for the nutrition intervention programs (Mullen & Shield, 2004). While 70% of all states require nutrition and dietary education (Kann, Telljohann, & Wooley, 2007), the median number of hours devoted to this topic is limited (i.e., <5 h per year; Story, Nanney, & Schwartz, 2009). Moreover, while some programs are effective at increasing attitudes towards healthy eating, many programs do not successfully change children's eating behaviors (Jan, Bellman, Barone, Jessen, & Arnold, 2009; McCullough, Yoo, & Ainsworth, 2004; Seaman & Kirk, 1995). Such findings suggest that more work is needed to understand mechanisms underlying the development of food preferences in order to create effective evidence-based nutrition programs for children.

Recently, Reverdy, Chesnel, Schlich, Koster, and Lange (2008) found that nutrition education that focused on the sensory experiences of tasting unfamiliar foods decreased neophobia and enhanced 8–10 year old children's willingness to try healthful foods compared to those not exposed to this program. This approach is consistent with experimental findings that have shown that repeated exposures to foods increases children's preferences for these foods (e.g., Birch, McPhee, Shoba, Pirok, & Steinberg, 1987; Gerrish & Mennella, 2002; Sullivan & Birch, 1990). The research proposed herein aimed to expand upon these findings to determine whether food exposures

* Corresponding author at: Psychology Department, The College of William & Mary, P.O. Box 8795, Williamsburg, VA 23187-8795, United States. Tel.: +1 757 221 3892; fax: +1 757 221 3896.
E-mail address: caforestell@wm.edu (C.A. Forestell).

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presented as part of a nutrition education program increased children's ability to identify fruit and vegetables and their willingness to try them relative to those who did not receive such exposure.

The children examined in the current study participated in a School Health Initiative Program (hereafter referred to as SHIP), which uses multiple programmatic strategies to create and maintain healthy physical and social environments for children in all schools throughout the school district. For kindergarten students, this includes activities provided by the OrganWise Guys® Program, 2010 (OWG, Duluth, GA), such as music, books, games, and activities that encourage healthy eating, and physical activity through daily stretches, and activity enhanced lessons. Over the course of the 2009–10 academic year children in one school additionally received exposure to a variety of fruit and vegetables provided by the USDA Fresh Fruit and Vegetable Program. This program is provided to select low-income elementary schools throughout the United States. Although $3 million is allocated to this program annually, there has been relatively little evaluation of its impact on children's food preferences (Story et al., 2009). In the school that received this program, 57 different fruits and 23 vegetables were presented in the afternoon three times a week.

We hypothesized that kindergarten children who received fruit and vegetable exposures in addition to regular SHIP activities would be better at identifying and more willing to try a fruit and vegetables compared to those at another school who were exposed to SHIP only.

2. Method and procedure

2.1. Participants

The study consisted of a convenience sample drawn from two schools, both of which served children from Pre-Kindergarten to Grade 5 in the rural fringe of the county. One school employed the standard SHIP program, which consisted of OWG activities, and did not provide additional fruit and vegetable exposure (FV-UNEXP). Children at the other school received exposure to fruits and vegetables on a weekly basis (FV-EXP) in addition to the SHIP program.

At the beginning of the fall semester a letter and consent form were sent home to all parents of kindergarten students at both schools to solicit participation. All procedures were approved by the School Board and the William & Mary Institutional Review Boards.

2.2. Procedure

Children's willingness to try fruits and vegetables was assessed by presenting four vegetables (acorn squash, baby spinach, cucumber slices, and sugar snap peas) and four fruits (pears, pink grapefruit, papaya, and kiwi) in 4 oz plastic containers in random order. All foods were presented raw, except for acorn squash (which was cooked) and prepared for consumption (e.g., chopped or sliced). For each food item, children were asked if they could identify the food, and if they would like to try it. Children could eat as much or as little of the food as they wished. Each container was sealed and put to the side after the child had an opportunity to try the food. Students' were tested once in the fall, at the beginning of the SHIP program, and again after 5 months of the program. Demographic information about the racial background, age, and lunch status (i.e., income level) of the children was obtained from school records.

2.3. Data analyses

The percentage of fruits and vegetables correctly identified and tried for each of the children during each of the tests was calculated and subjected to a mixed analyses of variance (ANOVA) with school (FV-UNEXP, FV-EXP) as the between subjects variable and test (baseline, post-test) as the repeated-measures variable. To determine whether income level interacted with test session, similar mixed analyses which compared children's performance on these measures as a function of their lunch status (free and reduced, regular price) and test (baseline, post-test). A level of $P<.05$ was selected to indicate statistical significance.

Additionally the percentage of children who correctly identified and tried each fruit and vegetable was calculated for the baseline and post-test. A series of Chi-square analyses were conducted separately for each school to determine whether the number of children who identified or tried any of the individual foods increased after the program.

3. Results

3.1. Participant characteristics

A total of 59 parents; 30 from FV-UNEXP and 29 from FV-EXP, provided consent for their children to participate and 58 students (i.e., 31 girls) completed both test sessions. Participants were 5.4 years of age (range 5–6 years) at the beginning of the study. The racial background of these children was as follows: Caucasian, 67.2%; African American, 15.5%; Hispanic, 10.3%; Asian, 5.2%; and admixed–other, 1.7%. Approximately 61% of children at FV-EXP and 10% children at FV-UNEXP received free and reduced lunches ($\chi^2(1)=12.8$, $P<0.001$), which are provided to those whose parents' annual salary was less than $40,793 for a family of four (hereafter referred to as low-income families).

3.2. Test performance

As shown in Fig. 1, children identified more of the fruits; $F(1, 56)=25.7$, $P<0.001$, $\eta^2=0.31$ at the end of the program regardless of the school they attended. As shown in Table 1, this increase was not due to a change in the identification of any single fruit (all P values >0.3). In contrast to the fruits, identification of vegetables did not improve at either school ($P>0.15$).

With respect to the number of foods tried, there was a general trend for more children to try each of the individual foods after the program (Table 1), however these differences failed to reach significance (all P values >0.1). Analyses of the percentage of foods tried by the children at each school revealed a significant school x test interaction for the number of fruits tried; $F(1, 54)=4.8$, $P<0.05$, $\eta^2=0.082$. As shown in Fig. 1, while participants at FV-EXP tried significantly more fruits after the SHIP program ($t(27)=2.4$, $P<0.03$), those at FV-UNEXP did not. No differences were observed for their willingness to try vegetables at either school.

Finally, to determine whether the children in the free and reduced lunch group differed in their willingness to try the foods from the regular lunch group, we compared them on the number of foods they tried. Because of the small number of students at FV-UNEXP in the reduced lunch group ($n=3$) we were unable to determine whether income

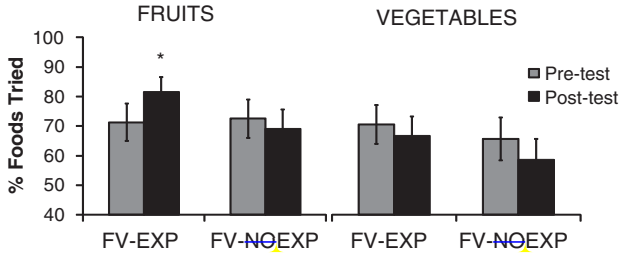

Fig. 1. Fruit and vegetable intake as a result of healthy food exposure. Students with FV-EXP who received exposure to fruits and vegetables as part of their nutrition program tried a greater percentage of fruits in the post-test compared to pre-test, whereas children with FV-NOEXP who did not receive food exposure as part of the SHIP program, tried a similar number of fruits in the pre- and post-tests. Children did not increase their vegetable intake at either school. *Indicates significant difference at $P<.05$.

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Table 1
Percentage of children who identified and tried each food.

	FV-EXP		FV-UNEXP	
	Baseline	Post-test	Baseline	Post-test
Fruit				
Pears				
% Correct ID	3.7	29.6	13.3	26.6
% Tried	29.6	96.3	13.3	79.3
Grapefruit				
% Correct ID	3.6	7.1	3.3	6.6
% Tried	28.5	71.4	36.6	53.3
Papaya				
% Correct ID	0	0	0	0
% Tried	21.4	78.6	36.6	66.6
Kiwi				
% Correct ID	17.8	28.6	20.6	51.7
% Tried	39.3	78.6	23.3	76.6
Vegetables				
Acorn squash				
% Correct ID	3.6	3.6	0	0
% Tried	28.5	35.7	56.6	40.0
Spinach				
% Correct ID	7.1	10.7	3.3	10.0
% Tried	35.7	67.9	26.6	56.7
Sugar snap-peas				
% Correct ID	3.6	0	3.3	3.33
% Tried	42.9	71.4	30.0	63.3
Cucumbers				
% Correct ID	57.1	67.9	43.3	50
% Tried	17.9	85.7	33.3	70

group interacted with the manipulation. However, a comparison of the income groups' responses revealed that those in the reduced lunch group tried more fruits ($t(56) = 2.7$, $P < 0.04$) and vegetables ($t(56) = 28.8$, $P < 0.01$) in both tests compared to those in the regular lunch group. Additionally, comparisons of children from each of the income groups at FV-EXP revealed that the change in the number of foods tried between the baseline and post-test was similar for both income groups at this school ($P > 0.9$).

4. Discussion

The present study demonstrated that whereas all children identified more foods, those who were exposed to fruits and vegetables in addition to SHIP tried more healthful foods compared to children without such exposure after 5 months of nutrition education. These findings support previous research demonstrating that while nutrition education may increase children's knowledge about healthful foods, it is not necessarily successful at changing children's willingness to try healthful foods (Reverdy et al., 2008). Rather, additional exposure to a variety of healthful foods may be an effective method for reducing neophobia (Birch et al., 1987; Gerrish & Mennella, 2002; Pliner, 1982; Wardle, Herrara, Cooke, & Gibson, 2003).

Although children with FV-EXP tried more fruit, they did not try more vegetables after the exposure period. Thus, as has been observed previously (Hendy, Williams, & Camise, 2005, Mennella, Nicklaus, Jagolino, & Yourshaw, 2008), children's liking for fruit did not generalize to vegetables, which differ substantially from fruits in their flavor profiles (i.e. taste, odor, and texture). Because vegetables are rich in phytonutrients that contribute to their bitter taste (Drewnowski & Gomez-Carneros, 2000), and are lower in energy density, children tend to like fruits better than vegetables (Domel & Thompson, 2002; Edwards & Hartwell, 2002; Gibson, Wardle, & Watts, 1998). It is worth noting that in the current study, less than half of the foods presented to the children as part of the USDA program were fruits. Given that shifts in preferences do not readily occur for unpalatable foods (Forestell & LoLordo, 2004; Zeinstra, Koelen, Kok, & de Graaf, 2008) children may have had insufficient opportunity to learn to like the flavor of the vegetables.

Children from low-income families were more willing to try the healthful foods than the high-income children during the baseline and post-tests. Although, there was no evidence that the USDA program increased low-income children's willingness to try the foods more than the high-income children, further research with larger samples of children from a range of socioeconomic backgrounds is warranted to further address this question.

This study supports previous findings demonstrating that although children are generally aware of healthful food options, their eating behaviors do not necessarily coincide with this knowledge (Pelchat & Pliner, 1995; Wardle & Huon, 2000). The evidence that early and repeated taste exposure can reduce neophobia and increase acceptance of foods should inform children's nutrition programs. Because mere exposure to the flavor of healthful foods is the key to increasing children's liking and consumption of these nutrient-rich foods (Birch et al., 1987), getting children to try foods is the first step in increasing their consumption. Future research is warranted to determine whether programs that provide fruit and vegetable exposure increase consumption of these foods over the long-term, and whether the effects reported here generalize to different forms or preparations of healthful foods.

These findings suggest that emphasis needs to be placed on exposing children to a variety of vegetables in addition to fruit to increase their acceptance of these healthful foods. Because the best predictor of children's fruit and vegetable intake is whether they like the taste of these foods (Resnicow et al., 1998) understanding the mechanisms that underlie the development of food preferences is necessary to create effective evidence-based programs for improving children's eating habits.

5. Uncited references

Forestell and Mennella, 2007
Lee et al., 2006
Mokdad et al., 2004
Ogden et al., 2010
Van Duyn and Pivonka, 2000

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Contributors
Forestell and Corbett designed the study and Forestell and Schindler wrote the protocol. Schindler and Forestell conducted literature searches, tested the children, and Schindler completed the statistical analysis. Forestell wrote the first draft of the manuscript, which was based on a senior thesis prepared by Schindler and all authors contributed to and have approved the final manuscript.

Conflict of interest
Denise Corbett, the second author of the manuscript, is the Coordinator of the School Health Initiative Program at the Williamsburg James City County Schools, in which all of the students in this study participated. However, she is not affiliated in any way with the USDA Fresh Fruit and Vegetable Program, the effects of which were evaluated in this study.

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