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Children's Sensitivity to External Food Cues: How Distance to Serving Bowl Influences Children's Consumption

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Abstract

Overweight is increasing in children, leading to negative health consequences. Children also lack appropriate levels of important vitamins and nutrients in their diets. Environmental cues, such as food proximity, have been shown to influence consumption rates in adults. The present study has tested whether proximity to either a nutrient-dense or caloric-dense food would influence children's snack consumption in a day care setting. Children (N = 46, age range 3.4-11) consumed more of both nutrient- and energy-dense foods when they are sitting closer to the food than if they are sitting farther away from the food, above and beyond the effects of age. The data indicate that it may be possible to increase the consumption of nutrient-dense foods or decrease the consumption of energy-dense foods, respectively, by modifying the proximity of such foods within a child's environment.

Keywords

children; food intake; environmental cues; portion size; obesity

Obesity has become a pressing concern in the United States, with two thirds of adults either overweight or obese (Ogden et al., 2006). In children and adolescents, rates of overweight are increasing as well, with almost 34% of American children and adolescents being overweight (body mass index [BMI] for age at 95th percentile or higher) or at risk of overweight (BMI for age at 85th percentile or higher; Ogden et al., 2006). Negative health consequences of overweight and obesity can be found in children, with 60% of overweight children having at least one cardiovascular disease risk factor (Dietz, 2002). *The Dietary Guidelines for Americans* (U.S. Department of Health and Human Services & U.S. Department of Agriculture, 2005) report that children generally lack appropriate intake levels of various vitamins and nutrients, including calcium, potassium, fiber, magnesium, and vitamin E, and stress the importance of increasing the consumption of *nutrient*-dense foods (foods with high nutritional content but low to moderate energy content) and limiting the consumption of *energy*-dense foods (foods with high energy content but low nutritional content). Thus, it is important to understand factors that contribute to increased consumption of nutrient-dense foods and decreased consumption of energy-dense foods.

Environmental cues play an important role in food decision making and consumption. In adults, environmental cues that have been found to influence food consumption include perceived variety (Kahn & Wansink, 2004), portion size (Wansink, 1996; Wansink & Kim,

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2005), serving container size (Wansink & Cheney, 2005), serving utensil size (Wansink, van Ittersum, & Painter, 2006), and social context (Salvy, Jarrin, Paluch, Irfan, & Pliner, 2007). Environmental cues have been shown to influence food consumption in children as well. For example, Rolls, Engell, and Birch (2000) found that 5-year-old children consumed more food at lunch when they were served a larger portion of food than a smaller portion of the same food (macaroni and cheese), although 3-year-old children's consumption was not influenced by portion size. Social context has been found to influence overweight, but not normal-weight, children's consumption of energy-dense snacks (Salvy, Kieffer, & Epstein, 2008), such that overweight children consume more of energy-dense (e.g., chips, cookies) foods when they are alone than when they are with an unfamiliar peer. Salvy et al. also found that both overweight and normal-weight children were more likely to choose and consume a nutrient-dense (e.g., grapes, carrots) snack in the presence of a peer than when alone.

The availability (presence) and accessibility (availability in a form, place, or time that facilitates consumption) of food has been found to influence the intake of fruits and vegetables in children (Cullen et al., 2003). In a study using food diary data, Cullen and colleagues found that for children with higher preference for fruits and vegetables, availability alone was sufficient for increasing fruit and vegetable consumption. For children with a lower preference for fruits and vegetables, however, both availability and accessibility of fruits and vegetables were needed to increase fruit and vegetable consumption. Similarly, a school-based intervention designed to increase the availability and accessibility of fruits and vegetables led to an increase in the consumption of these foods (Perry et al., 2004).

Proximity is one form of accessibility that has been shown to influence food consumption in adults, although this has not been tested in children. In a study by Wansink, Painter, and Lee (2006), adults were provided chocolate candies at work that were placed either on their desks or 2 meters away from their desks. Adults ate fewer candies when the candies were 2 meters away than when they were on their desks. Although the visibility of the candies (in clear versus opaque containers) also influenced consumption, the proximity of food was the stronger influence on how much candy people ate.

Although this research indicates that the proximity of a high-calorie-dense food influences consumption, the relationship between proximity and food consumption in children has not been explored. Therefore, the present study examined the influence of proximity on food consumption in children. First, the relation between proximity and the consumption of a more energy-dense food (i.e., animal crackers) was tested. Given previous research on proximity with adults (Wansink et al., 2006), it was hypothesized that children who sat closer to the animal crackers would consume more crackers than children who sat farther from the crackers. Second, the relationship between proximity and consumption of a more nutrient-dense food (i.e., carrot slices) was examined. Given previous research on the impact of accessibility on the intake of fruit and vegetable consumption in children (Cullen et al., 2003), it was hypothesized that children who sat closer to the carrots would consume more carrots than children who sat farther from the carrots.

Method

Participants

Parents of all preschool and school-age children at a local child care center ($N = 46$) were informed about this study and asked to give written consent for their child to participate. All parents (100%) consented. Children indicated their assent by participating in the snack time activity, by agreeing to answer questions from the researchers, and by agreeing to be

weighed and measured. Because of absences on the days of testing, data were collected from 31 children on each of the two testing occasions. Four children did not follow the parameters of the protocol as they independently decided to engage in a competition of who could eat the most. Data from these children were not included in the analyses. The mean age of the participating children was 6.3 years (*SD* = 2.3 years, range 3.4-11) and 42% of the children were girls. The children were racially diverse, with 75% Caucasian, 8% African American, 14% Latino, and 3% Middle Eastern, and were primarily from middle-class families. The average BMI of the children was 16.4 (*SD* = 1.2, range 14-19.6). Because children's BMIs vary widely by age, these scores were converted to BMI percentile for age and gender. BMI percentile of the children ranged from the 8th percentile to the 98th (*M* percentile = 65th), with 25% of the sample meeting the criteria for overweight or at risk for overweight (85th percentile or higher).

Procedure

Afternoon snack time took place in a large gymnasium. Five tables were arranged lengthwise down the room with the snack serving bowl on the first table (the first child at table 1 was 11 inches from the serving bowl) and the last table at the far end of the gym (the first child at table 5 was 33 feet 8 inches from the serving bowl). Children were seated in a random order at the five tables. One portion (Testing Day 1: 4 crackers = 30 calories; Testing Day 2: 4 carrot slices = 8 calories) was given to each child at his or her seat, along with a serving of juice. These snacks were similar to those typically served at the child care center, although these exact varieties of the foods had not previously been served. At the beginning of snack time on each testing date, an experimenter explained the procedure for snack to the children. The children were told that they were allowed to eat as much snack as they wanted that day. If they finished their snack and wanted more, they could come up to the experimenter and ask for more and take it back to their seat to eat. Any time a child asked for more snack, he or she was given one portion (4 crackers or 4 carrot slices). Another experimenter recorded the number of servings requested by each child. The distance of each child's seat from the serving bowl was measured and recorded in inches. The Human Subjects Review Board of Bowling Green State University approved all procedures.

Results

The average numbers of animal crackers and carrot slices consumed at each table are shown in Figure 1 and Figure 2, respectively. The relationship between demographic variables and proximity to animal crackers and to carrot slices was assessed first. Child's age was correlated with the number of animal crackers, $r(25) = .48$, $p < .05$, and carrot slices, $r(25) = .49$, $p < .01$, consumed, but child's BMI percentile was not correlated with the number of animal crackers, $r(20) = .20$, $p = ns$, or carrot slices, $r(22) = .11$, $p = ns$, consumed. Boys and girls consumed the same number of animal crackers—boys $M = 20.9$, $SD = 15.8$; girls $M = 17.3$, $SD = 13.2$; $t(25) = 0.65$, $p = ns$—as well as the same number of carrot slices—boys $M = 5.4$, $SD = 7.0$; girls $M = 4.9$, $SD = 3.3$; $t(25) = 0.20$, $p = ns$.

Separate hierarchical regressions were used to determine whether consumption of animal crackers and/or consumption of carrot slices were related to the child's proximity to the serving bowl. For each hierarchical regression, child's age was entered in Step 1, and distance from the serving bowl was entered in Step 2 (see Table 1 and Table 2 for the hierarchical regression summary for animal crackers and carrot slices, respectively). After controlling for child's age, distance from the serving bowl significantly predicted number of animal crackers consumed ($\Delta R^2 = .17$, $\beta = -.41$), with children sitting farther away eating fewer crackers. Similarly, after controlling for child's age, distance from the serving bowl

significantly predicted number of carrot slices consumed (ΔR^2 = .14, β = −.38), with children sitting farther away eating fewer carrots.

Discussion

In this study, proximity to the serving bowl was associated with intake of both energy-dense (animal crackers) and nutrient-dense (carrots) foods for preschool and school-age children in a child care setting. The findings of this study are consistent with research that has been conducted with adults, which found that proximity to an energy-dense food increased the consumption of that food (Wansink et al., 2006), extending this research for the first time to a sample of children. This study also furthers research on the impact of accessibility on the consumption of a nutrient-dense food (Cullen et al., 2003), examining proximity as a form of accessibility.

These findings highlight the role that external factors may play in determining how much children eat. Research evidence suggests that both infants and young children adjust their food consumption in response to internal cues such as hunger or the amount of energy (calories) already consumed (Birch & Deysher, 1986; Fomon, 1993). However, it is also clear that feeding practices can undermine children's reliance on internal hunger cues, making them more dependent on external cues to determine how much to eat (Birch & Fisher, 1998). Given that eating in response to external cues (typically for energy-dense foods) has been linked to overeating and overweight (Jansen et al., 2003), the current findings are particularly relevant to the current crisis of childhood overweight.

Implications for Practice

The finding that proximity is related to consumption of both energy-dense and nutrient-dense foods has practical implications. Because of growing rates of overweight and obesity, it is clearly important to increase the consumption of nutrient-dense foods and limit the consumption of energy-dense foods.

Although this study did not find that the child's BMI was related to consumption in this setting, other research (e.g., Jansen et al., 2003) has found that overweight children are more susceptible to external food cues than normal-weight children. Thus, these findings might be especially relevant to this subset of children. Given these findings, health care providers working with families on developing healthy living can educate parents and children about the impact of proximity and other environmental cues on consumption rates. Furthermore, parents can discourage the consumption of energy-dense foods by decreasing their children's proximity to these types of foods and encourage the consumption of nutrient-dense foods by increasing the children's proximity to these types of foods, in turn making them more accessible. Increasing the proximity of nutrient-dense foods may be especially important to children who do not have a preference for these foods (Cullen et al., 2003). Finally, in child care settings, teachers might consider serving snacks (especially energy-dense snacks) from a distal serving table rather than placing serving bowls on the table where the children are sitting. This might encourage children to attend more to internal cues of hunger when deciding how much to eat.

Strengths and Limitations

As data for the present study were gathered by observing consumption in a natural environment, rather than relying on self- or parental reports, confidence in the internal validity of the results is high. However, this study has several limitations that should be noted. First, the sample in this study, although ethnically diverse, is small, limiting the generalizability of the findings. Nonetheless, the 100% consent rate lends confidence that

our sample was representative of the children in the child care center, and the consistency of the findings across occasions increases confidence in the results despite the small sample size. Second, data from four of the children were removed as a result of participation in a self-initiated eating "competition." It is unclear how this competition affected the consumption rates of the other children, because social context has been shown to influence consumption rates in children. However, the consumption of the "competitors" was not related to the amount eaten by the children sitting near them. Furthermore, the direction and significance of results obtained in the analyses were maintained even when data from those four children were included, further minimizing the impact of this group. Finally, the children in the study were required to ask the experimenter for another portion of food. It is not known if asking for another serving is another environmental factor that influenced the results. Nonetheless, children may typically be required to request additional portions of food in home and child care settings, rather than being able to help themselves. Thus, this procedure likely has high ecological validity for children's eating behaviors.

Future Research Directions

Future studies could extend this research to other environments in which children often eat, such as in the home. Parental reports indicate that availability and accessibility influence consumption rates of fruits and vegetables (Cullen et al., 2003). It would be beneficial to experimentally determine if proximity and other environmental cues affect children's consumption at home. It could also be important to understand the relations among various environmental cues as well as the strength of each cue's contribution to children's eating behaviors. In sum, it is important to be aware of the environmental cues that influence food consumption in order to be able to promote a healthy eating environment for children.

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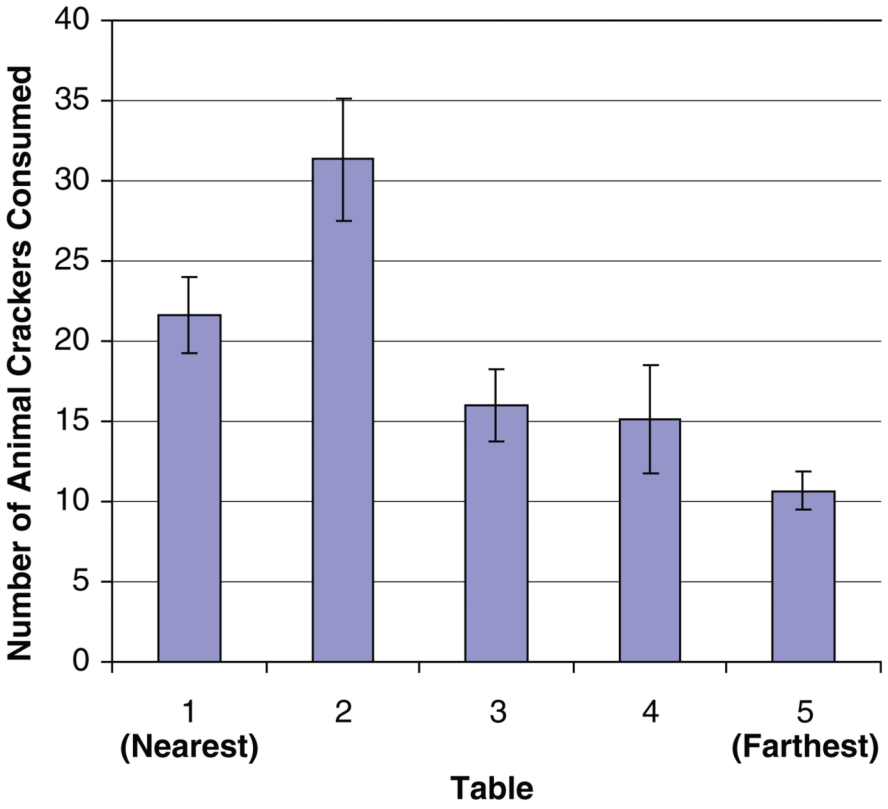

Figure 1.
Average number of animal crackers consumed by each table.

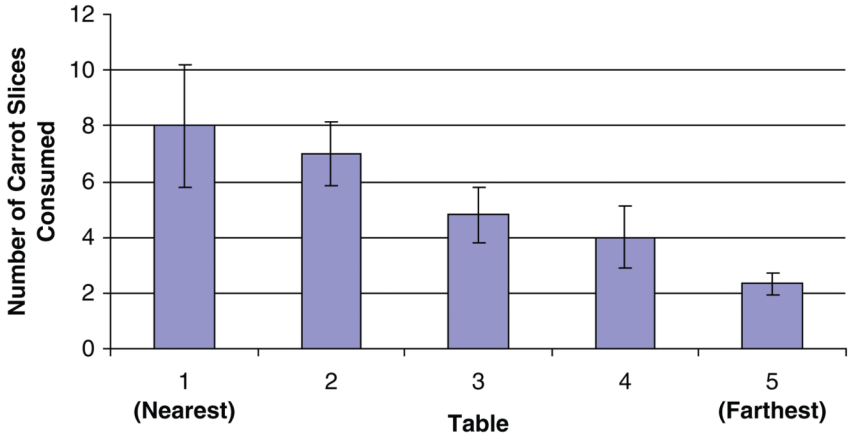

Figure 2.
Average number of carrot slices consumed by each table.

Table 1

Summary of Hierarchical Regression Analysis for Variables Predicting Number of Animal Crackers Consumed

Variable	*B*	*SE B*	β
Step 1			
Child's age	.24	.09	.48*
Step 2			
Child's age	.25	.08	.50*
Distance from animal crackers	−.48	.19	−.41*

Note: R^2 = .23 for Step 1; ΔR^2 = .17 for Step 2; R^2 = .40 for entire model.

*$p < .05$.

Table 2

Summary of Hierarchical Regression Analysis for Variables Predicting Number of Carrot Slices Consumed

Variable	*B*	*SE B*	β
Step 1			
Child's age	.11	.04	.50*
Step 2			
Child's age	.11	.04	.48*
Distance from carrot slices	−.18	.08	−.38*

Note: R^2 = .25 for Step 1; ΔR^2 = .14 for Step 2; R^2 = .39 for entire model.

*$p < .05$.