Restricting access to palatable foods affects children's behavioral response, food selection, and intake[1–3]

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ABSTRACT

Background: Restricting children's access to palatable foods may appeal to parents as a straightforward means of promoting moderate intakes of foods high in fat and sugar; however, restricting access to palatable foods may have unintended effects on children's eating. The efficacy of restricting children's access to palatable foods as a means of promoting patterns of moderate intake of those foods is unknown.

Objective: Two experiments were conducted to test the hypothesis that restricting access to a palatable food enhances children's subsequent behavioral responses to, selection of, and intake of that restricted food.

Design: Both experiments used a within-subjects design to examine the effects of restricting access to a palatable food on children's subsequent behavior, food selection, and food intake. The first experiment examined the effects of restriction within and outside the restricted context and the second experiment focused on the effects within the restricted context.

Results: In both experiments, restricting access to a palatable food increased children's behavioral response to that food. Experiment 2 showed that restricting access increased children's subsequent selection and intake of that food within the restricted context.

Conclusions: Restricting access focuses children's attention on restricted foods, while increasing their desire to obtain and consume those foods. Restricting children's access to palatable foods is not an effective means of promoting moderate intake of palatable foods and may encourage the intake of foods that should be limited in the diet.   *Am J Clin Nutr* 1999;69:1264–72.

KEY WORDS   Palatable food, food selection, food restriction, behavioral response, children

INTRODUCTION

Translating dietary recommendations into child feeding practices that actually promote healthy eating patterns may constitute a formidable challenge for parents, caregivers, and health professionals. Foods high in fat and sugar tend to be palatable and readily accepted by young children (1). Currently, young children's intakes of dietary fat and sugar are high, whereas their intakes of fruit and vegetables are well below recommended amounts (2, 3). In fact, only 1% of children aged 2–19 y meet all the guidelines specified by the food guide pyramid (3). Restricting children's access to foods high in fat and sugar may appeal to parents as one straightforward method of promoting eating patterns consistent with current dietary recommendations. Access to foods may be restricted by limiting portion sizes and limiting how frequently foods are offered.

The effects of restricting access to palatable foods on children's eating behavior are not well characterized. A central feature of child feeding strategies that restrict access to palatable foods is that specific foods, but not total energy in the diet, are restricted. Although the effects of total energy restriction have been studied extensively in human and animal models, Wardle (4) observed that there were "few studies which actually demonstrate that so-called 'forbidden' fruit is more tempting"(p 134). Several studies indicated that restricting access to foods may increase children's preferences for (5, 6) and intake of (7) restricted foods while diminishing self-control in eating (8). Research conducted on the determinants of voluntary alcohol ingestion in rats provided support for this theory in that alcohol consumption increased in response to restricted access to alcohol in the absence of energy restriction (9–17). These findings regarding alcohol ingestion were supported by more recent research in which an optional fat source was used as the restricted entity (18, 19).

The purpose of this research was to examine the effects of restricting children's physical access to a palatable food within their eating environment. Two experiments were conducted to test the hypothesis that restricting access to a palatable food enhances children's responses to and intake of that restricted food. The first experiment used a within-subjects, quasiexperimental design to determine the effects of restricted access on children's behavioral response to and selection and intake of a restricted snack food. These aspects of children's eating were evaluated within and outside the restricted context. The second experiment focused on the effects of restricted access within the restricted context; children's eating behavior was examined in discrete periods during unrestricted and restricted snack ses-

sions. We used an experimental design similar to those used in examining restricted access to alcohol in animal models (9–17). In these studies, rats that were not deprived of food were studied before and during restriction of the number of short (20–30 min) periods of access to alcohol each day (9–11). Similarly, in experiment 2, dependent measures were examined within the restricted context during discrete periods to provide a sensitive measure of children's response to restricted access.

A second aim of experiment 2 was to examine individual differences in parents' use of and children's response to restriction. Parents who restrict children's access to palatable foods tend to impose restricted access on a long-term basis. For example, if parents believe that they need to restrict children's access to candy to control their children's candy intake, restriction is enforced almost continuously with the exception of treats or special occasions. Therefore, a main focus of experiment 2 was to investigate whether parents' reports of restricting their children's access to the experimental foods at home were related to individual children's responses to restriction during the experimental sessions.

In addition, in experiment 2 we evaluated whether parents' restriction of the foods at home differed as a function of either children's adiposity or parents' own weight and eating styles. Costanzo and Woody (20) contend that highly controlling and restrictive child feeding strategies may arise from parents' own eating and weight issues as well as their perceptions of their children's risk for developing similar problems.

SUBJECTS AND METHODS

Experiment 1

Study design

A quasiexperimental design was used to examine children's eating behavior before, during, and after 5 wk of restricted access to a snack food. Children's food selection and intake were measured 3 wk before and 3 wk after the period of restriction. In addition, children's behavioral response was measured both before and during 5 wk of restricted access to a snack food. A within-subject component was used; each child's access to a target food was restricted and each child was also given free access to a control food. The experimental foods were 2 familiar flavors (apple and peach) of fruit bar cookies that were neither highly preferred nor disliked by the children. Two highly similar variants of the same type of food were selected so that children's responses to restriction could be attributed to differences in the schedule of availability. Assignment to receive one or the other type of restricted food was random, with children equally divided between the 2 food types.

Subjects

Participants were 3–5-y-old children attending daycare programs at The Pennsylvania State University Child Development Laboratory and their parents. Written parental consent to participate was obtained for each child. A maximum of 38 children in 2 separate classrooms were screened for inclusion in the study. One child refused to participate, 1 child was too young to complete the procedures, and 5 children were absent for most of the experimental assessments and trials. Data on 31 children (21 boys and 10 girls) were retained for analysis. The children's

mean age was 5 ± 0.12 y (range: 4–6 y) and their weight-for-height percentiles indicated a normal-weight sample ($\bar{x} \pm$ SD: 59.5 ± 4.3; range: 10.5–110.0) (21). All procedures were reviewed and approved by The Pennsylvania State University Institutional Review Board.

Measures

Rank-order preference assessment. Experimental foods were selected by using a procedure that has been shown to provide reliable and valid information about children's food preferences (22–24). Children were interviewed individually by a trained staff member during a regularly scheduled snack. Children sampled small tastes of foods and assigned them to 1 of 3 categories illustrated with cartoon faces depicting "yummy," "yucky," and "just okay." Rank-order scores were then assigned as foods in each category were sequentially identified as being the "yummiest" and were then removed from the selection. The set of foods used in this procedure consisted of cheese crackers, chive crackers, peanut butter crackers, peanut butter granola bars, chocolate chip granola bars, apple bar cookies, peach bar cookies, and strawberry bar cookies. Possible scores ranged from 1 to 8, with lower scores indicating higher preference for the foods. Two neutrally liked foods, apple bar cookies and peach bar cookies, were selected to be used as the target and control foods. Before the period of restriction, there was no initial difference in preference score by type of fruit bar cookies (apple, 4.9 ± 0.41; peach, 4.9 ± 0.40) or by group assignment (control, 5.2 ± 0.4; target, 4.6 ± 0.4).

Dependent measures outside the restricted context: forced-choice selection. A forced-choice test was used to measure children's selection of the control and target foods before and after restriction. Each child was interviewed by a familiar interviewer during a regularly scheduled activity time. Equal portions of the target and control foods were presented to the child in 2 separate but identical containers. The child was then asked which food he or she would choose for a snack. A score of 1 was assigned when the target food was chosen and a score of 0 was assigned when the control food was chosen.

Dependent measures outside the restricted context: 2-choice consumption. The 2-choice consumption test was used to measure children's consumption of the target and control foods before and after a period of restriction. Children were observed as a class during a regularly scheduled afternoon snack, 2 times before and 2 times after 5 wk of restriction. During each 20-min test, each child received a 170-g portion (6 bars) of the control food and the same amount of the target food at the same time in containers of identical shape and size. Pre- and postconsumption weights (in g) were used to calculate children's consumption of the target and control foods. Both types of fruit bar cookies contained 2.1 J/g. Before the period of restriction, there were no significant differences in consumption across type of fruit bar cookies (apple, 51.3 ± 6.1 g; peach, 49.6 ± 5.7 g) or by group assignment (target food, 49.4 ± 6.0 g; control food, 51.5 ± 5.8 g).

Dependent measures within the restricted context: behavioral observations. Behavioral observations were recorded to measure children's spontaneous response to restriction. The observations were recorded at the initial 2-choice consumption tests and at each snack session during 5 wk of experimental restricted access. The frequency of vocalizations and behaviors in each of 4 categories was coded. The categories were as follows: positive comments or behaviors about the restricted food, requests for food or attempts

to gain access to food, positive comments or behaviors about restriction, and negative comments or behaviors about restriction. Each table seating 3–4 children was observed by one coder. Each event that occurred during the 20-min period was coded in a single category. Any questionable behaviors or vocalizations were noted and categorized at the end of the 20-min trial. Coders were trained by giving them verbal and written instructions with examples and by having them complete a practice session with feedback. All coders were given explicit instructions to refrain from participating in any discussion regarding the experimental foods or responding to any child behaviors or comments involving those foods. Scores indicating children's behavioral response to restriction were determined by summing the numbers of vocalizations and behaviors that occurred during each 20-min trial. Interrater agreement calculated from 3 separate snack sessions was 76%.

Restricted access procedure

Children were familiarized with staff members and experimental procedures during the week before the beginning of data collection. Children were seen as a group twice per week (on separate days) during 5 wk of restricted access. Children were seated in small groups of 3–4 per table. Each child received a generous portion of the control food in an open container. Children had free access to the control food throughout the 20-min procedure. Additional portions were frequently offered to the children and they were also given water on an unlimited basis. The target food was kept in a large transparent jar in the center of each table. After 10 min, a bell signaled the beginning of a 2-min period when the children had access to the target food; they took turns reaching into the jar to take the fruit bar cookies. At the end of the 2-min period, uneaten target food was removed and access was restricted for the duration of the experimental trial.

Statistical analysis

Descriptive statistics including means with SDs or SEMs, skewness, and kurtosis were used. A 2-way repeated-measures analysis of variance (ANOVA) (time × food type) was used to evaluate food intake before and after restriction as well as behavior before and during restriction. The SAS program (version 6.12; SAS Institute, Cary, NC) was used to perform the statistical analyses.

Experiment 2

Study design

A within-subjects design was used to examine children's selection of, intake of, and behavioral response to a palatable snack food. Children participated in 4 unrestricted snack sessions in which the restricted food was freely available throughout the snack session, followed by 4 restricted snack sessions in which access to the restricted food was limited. An additional food of acceptable but relatively lower preference was provided ad libitum throughout the experiment.

Subjects

Participants were 40 apparently healthy, 3–6-y-old children (19 boys and 21 girls) attending daycare programs at The Pennsylvania State University Child Development Laboratory and their parents. The sample consisted of 80% white, 15% Asian, 4% black, and 1% other children. Written parental consent to participate was obtained for each child. Of the 40 children, 3 were

excluded from data analysis (2 because of absence from more than one-third of all trials and 1 because of failure to comply with experimental procedures). Thirty-two mothers (mean age: 39 ± 1 y) and 27 fathers (mean age: 42 ± 2 y) chose to participate in data collection. Most parents were well-educated (fathers' earned degrees: 18% high school, 30% bachelor's, 52% postgraduate; mothers' earned degrees: 10% high school, 33% bachelor's, 57% postgraduate) and employed (26 of 27 fathers; 30 of 32 mothers). All procedures were reviewed and approved by The Pennsylvania State University Institutional Review Board.

Measures

Rank-order preference assessment. Experimental foods were selected before the experimental sessions by using a rank-order preference assessment (22) as described for experiment 1. Two types of restricted foods were used between subjects to determine whether an effect of restricted access on children's eating behavior could be generalized. Six foods were initially rank-ordered: unsalted wheat crackers, unsalted pretzel pieces, wheat and peanut butter crackers, wheat and cheese crackers, pretzel fish-shaped crackers, and cheese fish-shaped crackers. Rank-order preference scores ranged from 1 to 6, with lower scores indicating a higher relative preference for the food. These preference scores were used to select cheese fish-shaped crackers and pretzel fish-shaped crackers as the restricted foods ($\bar{x} \pm$ SEM: 2.0 ± 0.2). Each child was assigned to receive 1 of the 2 restricted foods based on his or her initial high preference for that food, with matching of the 2 groups for child sex. Initially, preference rankings did not differ significantly between the 2 restricted-food groups. Lower preference rankings ($\bar{x} \pm$ SEM: 4.3 ± 0.2) were used to identify unsalted wheat crackers as a food that was neither preferred nor disliked and these crackers were provided ad libitum.

Food selection and intake and behavioral response to restriction. Children's food selection and intake and their behavioral response regarding the restricted food and wheat crackers were measured in 3 consecutive 5-min periods during each 15-min snack session. Each table of 3–4 children was observed by one staff member who coded selection and intake and one staff member who coded behavior. Staff members received uniform instruction on coding, including written and verbal examples and a practice session with feedback.

For each 5-min period, selection of the restricted food was coded in number of measuring scoops of crackers (≈ 7 g/scoop) and selection of wheat crackers was coded in number of crackers. Intake of the restricted food and wheat crackers (in g) was calculated by using observational and weighed food intake data as follows:

$$\text{Intake} = (\text{BFW}_b + S) - \text{BFW}_e \qquad (1)$$

where BFW_b is the weight in g of the bowl and food at the beginning of the 5-min period, S is the amount of food selected in g (based on a estimate of g per coded unit of selection), and BFW_e is the weight in g of the bowl and food at the end of the 5-min period.

Children's spontaneous behavioral responses to the restricted food and wheat crackers were recorded by trained staff members as described for experiment 1. Responses were recorded by tallying the events that occurred during each 5-min period in the appropriate categories. The number of events was summed across all behavioral coding categories to create a behavioral response score for each 5-min period. Interrater agreement calculated from 4 separate snack sessions was 79% for a subset of children ($n = 22$).

Anthropometric measurements. Height and weight measurements of each child were taken in triplicate by using procedures described by Lohman et al (25). Children's weight was measured in light clothing without shoes and was recorded by a trained staff member to the nearest 0.1 kg. Height was measured without shoes by using a stadiometer (Shorr Productions, Olney, MD) and was recorded to the nearest 0.1 cm. Children's height and weight values were converted into age- and sex-specific percentiles (21).

Eating Inventory Questionnaire. The Eating Inventory Questionnaire was used to measure parents' restrained eating and disinhibited eating (26). Dietary restraint refers to the cognitively based restriction of food intake. The restraint scale (21 items) consists of statements such as "When I have my quota of calories, I am usually good about not eating any more" and "I often stop eating when I am not really full as a conscious means of limiting the amount that I eat." Scores on the restraint scale may range from 0 to 21, with higher scores indicating greater restraint. The Eating Inventory Restraint Scale has good criterion validity (27) and high internal consistency, with a Chronbach's α ranging from 0.79 to 0.93 (28). Dietary disinhibition refers to eating in response to external influences. The disinhibition scale (16 items) consists of statements such as "Sometimes things just taste so good that I keep on eating even when I am no longer hungry" and "Being with someone who is eating often makes me hungry enough to eat." Scores on the disinhibition scale may range from 0 to 16, with higher scores indicating a greater degree of disinhibition.

Body mass index. Mothers' and fathers' self-reported height and weight data were used to calculate their body mass indexes (BMIs; in kg/m^2). Logarithmic transformations were used on the positively skewed variables of maternal and paternal BMI to better approximate normal univariate distributions for these variables.

Parental restriction of access to the experimental foods at home. Restriction of children's access to the experimental foods was evaluated by using 6 questions that assessed the extent to which parents typically restricted their child's access to these snack foods. This questionnaire included items such as "Do you try to keep this food out of your child's reach?" and "Do you limit how often your child may have this food?" Mothers' and fathers' scores were combined by using principal components analysis to create a composite of parental restriction of access to the experimental foods. The internal consistency, as measured by Chronbach's α, of this composite was 0.81 for mothers and 0.74 for fathers.

Procedure

Children were observed as a group in sessions that took place during a regularly scheduled afternoon snack time for 4 consecutive days per week during a 2-wk period at The Pennsylvania State Children's Eating Laboratory. Teachers and staff members were instructed to avoid any discussion of food during the sessions. A practice snack session was used before the experimental period to familiarize children with the experimental setting and procedures. Three to 4 children were seated at each table, grouped according to the type of restricted food they were served. To comply with regulations regarding snacks in daycare settings, children were served one glass of milk (≈4 oz) at each snack session.

During each of 4 unrestricted snack sessions, children were provided with the restricted food and wheat crackers ad libitum during all three 5-min periods; thus, they had 15 min of free access to both foods. Children could self-select either food from identical containers that were placed in the middle of the table and held large portions of each food.

During the 4 restricted snack sessions, wheat crackers were served in an open container in the middle of the table while the experimental food was kept in a closed, clear container in the middle of the table. Children were allowed to self-select wheat crackers throughout all three 5-min periods of the 15-min session, but they had free access to the restricted food only during the second 5-min period of the restricted snack session. Thus, during the 15-min restricted snack sessions, children had only one 5-min period of free access to the restricted food.

A bell was used during the unrestricted and restricted snack sessions to signal the beginning of each 5-min period when the restricted food would be available. In addition, a timer buzzer was used to signal the end of every 5-min period, at which time the children's dishes of wheat crackers and experimental foods were removed and weighed.

Statistical analysis

Univariate statistics including means, SEMs, and ranges were generated for all variables. Children's responses on each dependent measure were averaged within the 4 unrestricted snack sessions and within the 4 restricted snack sessions.

ANOVA was also used to evaluate children's 5-min selection, 5-min intake, and 5-min behavioral response to the restricted food. In each model, session type (unrestricted or restricted) was used as the within-subjects factor and the between-subjects factors included type of restricted food assigned, child's age, and child's sex. In each analysis, the first 5-min period of unrestricted sessions was compared with the second 5-min period of restricted sessions. Food intake during the first 5-min segment was examined in unrestricted snack sessions because it was the first opportunity that the children had to obtain the restricted food. The second 5-min period was examined during restricted snack sessions because it was the first and only 5-min period of the 15-min session when children were allowed access to the restricted food. Finally, to adjust for general changes in eating across the experiment, eating responses were also evaluated as a percentage of total 15-min (restricted food + wheat cracker) behavioral response, selection, and intake.

Pearson's product-moment correlation coefficients were used to examine correlates of parents' restriction of the target food at home and correlates of children's changes in selection, intake, and behavioral response to the target food across the experimental study. Changes in selection, intake, and behavioral response were expressed as the difference between restricted snack session and unrestricted snack session responses, with higher scores indicating a greater response to restricted access.

RESULTS

Experiment 1

Indicators within the restricted setting: behavioral observations

No initial differences in responses to the target and control foods were noted when the 2-choice consumption test was used as a baseline observational period. As shown in **Figure 1**, a time × food type interaction occurred in the children's behavioral responses to the target and control foods when the periods before and during restriction were compared. Restricting children's access to the target food resulted in an increased behavioral response to that food relative to the control food. That is, relative
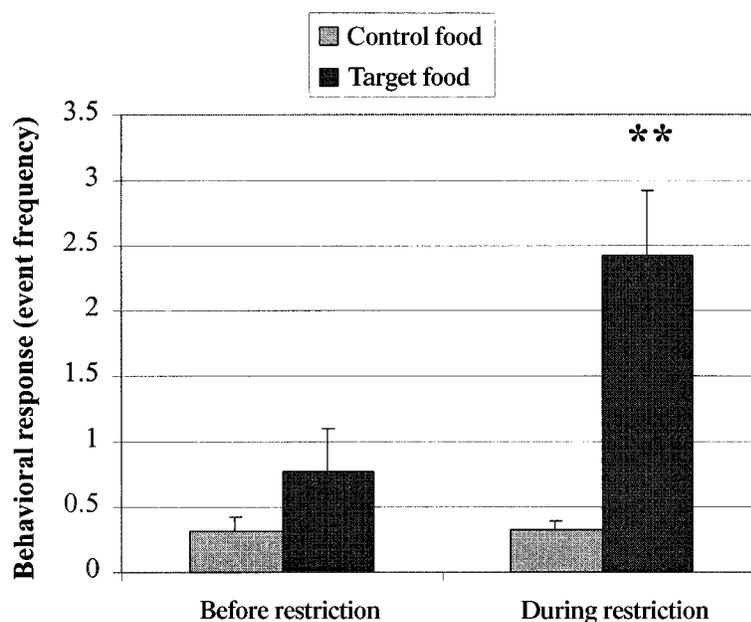
FIGURE 1. Children's mean (±SD) behavioral response (frequency of positive and negative events such as requests for the food, attempts to obtain it, or comments about liking it, per child) during 20-min experimental trials conducted before and during the 5-wk period of restricted access to the target food ($n = 31$). **Significantly different from control food, $P < 0.01$.

to a similar food that was freely available, the restricted food elicited more positive comments about it, more requests for it, and more attempts to obtain it. This increased response relative to the control food was greater for boys than for girls during restriction (time $\times$ food type $\times$ child sex, $P < 0.05$).

Measures outside the restricted setting: pre- and postrestriction food selection and intake

In contrast with the clear effects of restriction observed during the period of restricted access to the target food, measures taken 3 wk before and 3 wk after the experimental trials revealed no significant effect of restriction on children's intake or selection. Additionally, no significant effect of food type on children's intake was observed. A main effect of time was observed in that children's consumption of both the target food (49.4 ± 6.0 compared with 45.0 ± 6.4 g) and control food (51.5 ± 5.8 compared with 38.5 ± 4.7 g) decreased over time ($P < 0.05$). In addition, no significant differences between pre- and postrestriction were observed in the percentage of children selecting the target food as a snack (58% compared with 59%).

Experiment 2

Descriptive statistics are shown in **Table 1**. On average, the sample consisted of normal-weight parents (29) with mean dietary restraint and disinhibition scores in the normal range (28).

Effect of restriction on behavioral response to and selection and intake of the restricted food

The primary objective of this research was to examine the effects of restriction on children's selection and intake of and behavioral response to a palatable food by examining their responses before and during a 5-min period of restricted access. As shown in **Figure 2**, a main effect of restriction on children's behavioral response to the restricted food occurred. Children's

spontaneous behavioral response (frequency of positive and negative comments and behaviors) to a palatable snack food was greater during restricted sessions than during unrestricted sessions. This effect did not differ by child's sex ($P = 0.16$) or age ($P = 0.66$). However, an interaction was noted between the type of restricted food assigned and the session type ($P < 0.001$); increases in children's behavioral responses were observed for both foods, with higher responses for pretzel fish-shaped crackers than for cheese fish-shaped crackers.

In Figure 2, a main effect of restriction on children's selection of the restricted food is also shown, with higher selection during restricted snack periods than during unrestricted periods. This effect did not differ by type of experimental food used ($P = 0.39$) or by child's age ($P = 0.65$) or sex ($P = 0.16$). A main effect of session type on children's intake of the restricted food also occurred; intake

TABLE 1
Descriptive statistics for child and parent variables[1]

	Value
Mother	
Restraint[2] ($n = 32$)	8.2 ± 0.6 (2–15)
Disinhibition[2] ($n = 32$)	5.2 ± 0.7 (0–14)
BMI [log(kg/m²)] ($n = 29$)	23.6 ± 0.9 (18–39)
Father	
Restraint[2] ($n = 27$)	5.5 ± 0.7 (1–13)
Disinhibition[2] ($n = 27$)	4.0 ± 0.4 (1–10)
BMI [log(kg/m²)] ($n = 27$)	25.9 ± 0.8 (21–35)
Child	
Weight for height[3] (%) ($n = 32$)	57 ± 5 (6–99)

[1] $\bar{x}$ ± SEM; range in parentheses.
[2] Score on Three-Factor Eating Questionnaire (26), with high scores indicating high levels of the construct.
[3] Age- and sex-specific percentiles using National Center for Health Statistics reference data (21).
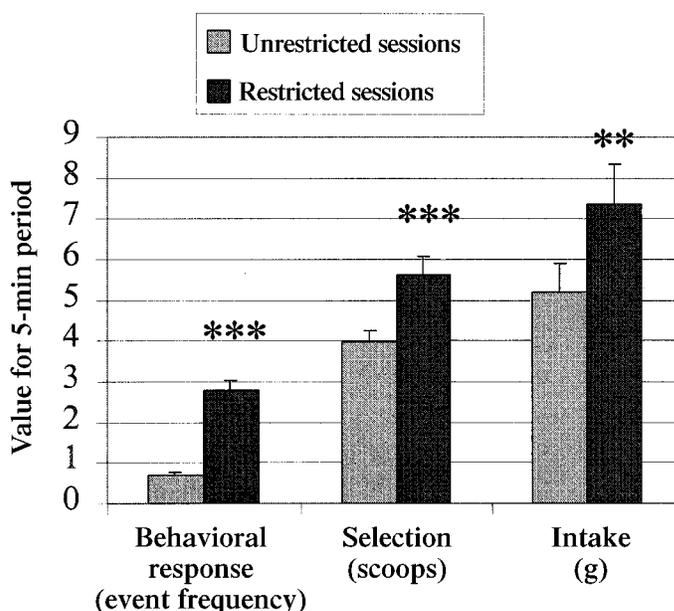
FIGURE 2. Main effects of session type (unrestricted compared with restricted access) on behavioral response (frequency of positive and negative events), selection of restricted food, and intake of restricted food during 5-min periods ($n = 37$). [**,***]Significantly different from unrestricted sessions: [**]$P < 0.01$, [***]$P < 0.001$.

was higher during restricted snack sessions than during unrestricted sessions. This effect did not differ by type of experimental food used ($P = 0.34$) or by child's age ($P = 0.27$) or sex ($P = 0.79$).

Behavioral response to and selection and intake of the restricted food were also each expressed as a percentage of the total (target and control) 15-min value to adjust for overall changes in behavior over time. Children's behavioral response to the restricted food ($37 \pm 3\%$ of total behavioral response to target and control foods during unrestricted sessions compared with $49 \pm 3\%$ in restricted sessions; $P < 0.01$) and intake of the restricted food ($18 \pm 2\%$ of total target and control food intake during unrestricted sessions compared with $37 \pm 4\%$ in restricted sessions; $P < 0.001$) increased during restricted sessions when expressed as a percentage of total activity. There was no significant effect of snack session type on children's adjusted selection of the experimental food ($45 \pm 3\%$ of total target and control food selection during unrestricted sessions compared with $49 \pm 3\%$ in restricted sessions; $P = 0.14$).

Individual differences in parents' use of restriction and children's response to restriction

A secondary objective of the study was to examine individual differences in parents' reported use of restriction at home and children's response to restriction in the laboratory (**Tables 2** and **3**). As shown in Table 2, mothers' and fathers' education (as a categorical variable) was positively related to parental reports of restriction and parental BMI was negatively related to parental reports of restriction. Thus, higher education level and lower BMI were associated with greater restriction of access to the experimental food at home. In addition, mother's dietary disinhibition was negatively related to parents' reports of restricted access to the experimental food at home. Children's weight status was positively related to parental restriction, with higher levels of reported restriction associated with higher child's relative weight (weight for height).

In Table 3 the correlations between children's response to restriction in the laboratory and parental background variables are shown. Greater increases in children's selection of the restricted food were associated with higher levels of maternal restriction of access to the restricted food at home. In addition, greater increases in children's behavioral response to restriction were observed for children whose mothers purchased the experimental food less frequently.

DISCUSSION

The failure of most children's diets to meet current dietary recommendations highlights the need to identify child feeding strategies that encourage healthful patterns of eating (3). Restricting access to palatable, energy-dense foods may appeal to parents as a straightforward means of achieving moderate patterns of intake in children. However, the results of this research suggest that restricting children's access to palatable foods within their eating environment is not an effective means of promoting moderate intake of those foods and may in fact promote the intake of such foods.

In both experiments, restricting access increased children's spontaneous behavioral response to the restricted food. In experiment 1, data collected within the experimental context showed a clear effect of restriction on boys' and girls' comments and behaviors toward the restricted food. Initially, children indicated similar degrees of preference for the control and target foods, which were 2 highly similar variants of the same type of snack food. When restricted access was imposed, however, children's behavior changed to focus on the restricted food. Relative to the highly similar control food, restricting children's access to the target food generated more spontaneous positive comments and behaviors about the target food (eg, saying "I like peach bars" and grabbing the cookie jar), positive comments and behaviors regarding restriction (such as chanting and clapping), and nega-

TABLE 2
Pearson's product-moment correlations (r) between parents' reports of restricting access to the experimental food at home and background variables[1]

Background variables	Parents' reports of restriction in the home
Mother	
Restraint[2]	0.26
Disinhibition[2]	−0.41[3]
BMI [log(kg/m^2)]	−0.48[3]
Education	0.53[4]
Father	
Restraint[2]	0.09
Disinhibition[2]	−0.03
BMI [log(kg/m^2)]	−0.38[3]
Education	0.36
Child	
Weight for height	0.42[3]

[1] Parents' reports of restricting access were based on standardized composite of mothers' and fathers' scores for the 6-item indicator, with high scores indicating high levels of restriction at home.

[2] Score on Three-Factor Eating Questionnaire (26), with high scores indicating high levels of the construct.

[3] $P < 0.05$.

[4] $P < 0.01$.

tive comments and behaviors regarding restriction, particularly the fairness of the procedure. This effect was observed despite the fact that both the target and control foods were initially neither liked nor disliked and that children's access to a similar control food was not restricted. Increases in comments and behaviors directed toward the restricted food were greater in boys than in girls, suggesting that boys may exhibit more verbally and physically reactive behavior when restriction is imposed. Similar results were obtained in experiment 2: restricting children's access to a snack food resulted in increased behavioral response to the food compared with similar periods in which the snack food was freely available.

These observations reveal that young children are acutely aware of and respond to feeding practices that restrict their access to palatable foods in their eating environment. These findings are consistent with research on children's use of cognitive strategies in maintaining self-control; in such studies, responsiveness to a palatable, preferred food was enhanced by focusing children's attention on the inaccessibility of the food (6, 30). Because foods high in sugar and fat are the likely targets of parental restriction,

this practice may draw children's attention to and focus their behavior on foods that should be consumed in moderation (31, 32). Thus, this research provides evidence that restricting children's access to a snack food that is visible, but not physically accessible, directs children's behavior toward that food.

This research also provides evidence that children's enhanced behavioral response to restriction is accompanied by a heightened desire to obtain and consume restricted foods. In the second experiment, restricting access to a palatable snack food increased children's selection and intake of that food relative to similar periods when it was freely available. These findings closely parallel results obtained in similarly designed research using animal models; in such studies, restricting access produced elevated intakes of restricted substances when they became available (9–19). In contrast, however, those assessments performed outside the restricted context in experiment 1 failed to show any effect of restricting access on children's selection and intake of the restricted food. One interpretation of these contradictory findings is that the strength of the experimental manipulation in experiment 1 was insufficient to produce an effect of restricted access on children's selection and intake outside the restricted context. For instance, the high degree of similarity between the target and control foods may have decreased the effect of the contrasting schedules of availability for the 2 foods. As a result, the foods may have been difficult to differentiate outside the experimentally restricted context. Measurement of children's selection and intake during the period of restriction in experiment 1 might have provided a relatively more sensitive measure of the effects of restriction on these outcomes. Similarly, a greater degree of differentiation between restricted and unrestricted foods in experiment 1 might have increased the children's response to differences in availability between the foods.

The effects of restricting access on children's response to and consumption of palatable foods have implications for the composition and amount of children's dietary intake. Children snack 2–3 times a day, and their snack choices constitute as much as 25% of their energy intake (33, 34). These findings suggest that children who experience restriction on a long-term basis will preferentially select and consume palatable, restricted foods when given the opportunity to make their own choices. Consistent with this idea, Klesges et al (35) observed that preschool children's food choices contained higher amounts of sugar when they were allowed to select foods in the absence of their mothers. Because foods high in sugar and fat are the likely targets of

TABLE 3
Pearson's product-moment correlations (r) between child's response to experimental restriction and parental background variables

	Child's response to restriction[1]		
	Selection	Intake	Behavioral response
Mother			
Restriction of experimental food at home[2]	0.41[3]	−0.05	0.15
How often experimental food purchased[4]	−0.03	−0.03	−0.51[5]
Fathers			
Restriction of experimental food at home[2]	0.21	−0.02	0.02
How often experimental food purchased[4]	0.14	0.22	0.12

[1] Higher values represent a greater response to restriction.

[2] Standardized scores for a 6-item composite; higher values indicate greater restriction.

[3] $P < 0.05$.

[4] 0 = never, 1 = once a month, 2 = twice a month, 3 = weekly.

[5] $P < 0.01$.

parental restriction, restricting access may promote children's selection and excessive intakes of energy-dense foods. Recent work provides support for this view; maternal reports of restricting access to palatable snack foods were positively related to young girls' intakes of those foods in a context in which maternal restriction was not in effect (7).

In discussing a model of obesity proneness, Costanzo and Woody (20) argued that highly controlling approaches to child feeding undermine children's ability to develop and exercise self-control over eating. Parental control in child feeding is negatively associated with preschool children's ability to self-regulate energy intake (36). Similarly, research on children's ability to delay gratification has shown that children show less self-control when they can see, but cannot physically access, a preferred food relative to when that food is out of sight (6). Thus, restricting children's access may interfere with their ability to exercise self-control by stimulating eating of palatable, restricted foods simply because they are present.

Associative conditioning processes have been proposed in describing mechanisms by which eating may be conditioned by contextual cues, such as the presence of palatable foods (37–40). In the case of restricted access to foods, the repeated pairing of cues regarding the availability of a palatable food with the desire to eat might eventually stimulate eating simply by the presence of a previously restricted food. In this sense, restricting access to palatable foods may help to promote the development of "obesigenic" environments. To the extent that restriction imparts a particular attractiveness to energy-dense, restricted foods, this practice may increase the salience of these types of foods relative to other food or activity choices that children may make.

In this study, we also used exploratory techniques to identify individual differences in parents' use of and children's response to restricted access. We found that children's responsiveness to restriction in the experimental setting was positively related to mothers' reported restriction of access to the experimental food at home and negatively related to the frequency with which mothers purchased the food. These individual differences in children's response to restriction may reflect the effects of more chronic restriction at home. In turn, parents' use of restriction at home was positively related to parents' education level and negatively related to their BMI and mothers' disinhibited eating. Parental reports of greater restriction were also noted for heavier children. This finding is consistent with previous work in preschool children that showed a positive association between maternal restriction and children's adiposity (7). Costanzo and Woody (20) contend that highly controlling parenting practices may be imposed specifically in those domains of child behavior that parents perceive as important or potentially problematic for the child. In this case of restriction, the importance given to weight and eating issues by parents with more education may translate into these parents' restricting their children's access to palatable snack foods. These findings provide a preliminary empirical framework that may be used as a basis for future work on the determinants of parents' use of restriction and individual differences in children's response to restricted access.

In conclusion, restricting children's access to a palatable food within their eating environment does not promote moderate patterns of intake and paradoxically may actually promote the very behavior its use is intended to reduce. This research supports the view that restricting access can sensitize children to external eating cues while increasing their desire to obtain and consume the restricted food. These findings also suggest that the effects of restriction on children's eating will be particularly pronounced in families in which restriction is consistently in effect. Additional research is needed to better understand the facets of restrictive child feeding practices that have an effect on children's eating. In particular, it is unclear whether restricting children's access to palatable foods within their environment has a different effect on children's eating than restricting children's access to foods by keeping them out of the home. Finally, long-term studies are needed to examine whether chronic restriction has lasting effects on children's ability to develop and exercise self-control in eating. ❧

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