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Short communication

Practice does make perfect. A longitudinal look at repeated taste exposure

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ABSTRACT

Previous research has found that 10–15 exposures to a novel food found can increase liking and consumption. This research has been, however, largely limited cross-sectional studies in which participants are offered only one or a few novel foods. The goal of the current study uses a small clinical sample to demonstrate the number of exposures required for consumption of novel foods decreases as a greater number of foods are added to the diet. Evidence that fewer exposures are needed over time may make interventions based upon repeated exposure more acceptable to parents and clinicians.

Introduction

In two early studies of repeated exposure, preferences for novel foods were shown to occur after 10 exposures (Birch & Marlin, 1982; Pliner, 1982). These studies involved groups of preschoolers and undergraduates, respectfully, and involved limited numbers of novel foods. Subsequent research conducted in home and school settings demonstrated that repeated exposure to novel or nonpreferred foods over periods of 10 and 14 days, respectfully, increased acceptance of the particular food presented in each study (Wardle, Cooke, Gibson, Sapochnik, Sheilham, & Lawson 2003; Wardle, Herrera, Cooke, & Gibson, 2003).

Studies that have described neophobia, or the fear of novel foods, among children have consistently mentioned the possible benefits of exposure for increasing variety (Carruth & Skinner, 2000; Cooke, Wardle, & Gibson, 2003; Nicklaus, Boggio, Chabanet, & Issanchou, 2005). Materials designed to help parents address their children's eating problems have drawn on past work involving repeated exposure. One book stated, "believe it or not, studies suggest that it can take 10–15 exposures to a new food before a child accepts, much less, likes it" (Jana & Shu, 2008, p. 93), while another stated, "children learn to eat new foods through the developmental sensory stages as described in Jessica's story: acceptance, touch, smell, taste, and eating. . .researchers have reported that it may take up to 10–15 exposures of a new food before a resistant eater is ready to move on to the next sensory stage" (Ernsperger & Stegen-Hanson, 2004, p. 172). While both of these works incorrectly interpreted the literature, they do reflect the notion that children need to do *something* 10–15 times in order to increase acceptance of a particular food.

What has not been demonstrated by the current literature is whether 10–15 taste exposures are needed to develop consistent acceptance or a preference for each novel food or, as a greater number of novel foods are added to a person's diet, does the number of exposures needed decrease? Thus far, most research has focused on cross-sectional studies involving groups of persons exposed to limited numbers of novel foods. One recent study demonstrated the effectiveness of repeated taste exposure as part of a behavioral treatment for extreme food selectivity for two children with autism (Paul, Williams, & Riegel, 2007).

Although previous studies suggested the effects of repeated exposure differs with the type of food offered, to date, these studies have utilized small groups of participants to examine the effects of exposure on either one or a limited number of foods. Two studies revealed exposure produced strong effects with fruit (Birch & Marlin, 1982), while another study showed exposure produced smaller effects with tripe (Peryam, 1963). One study that did compare the effect of exposure on different foods showed preferences for sour drinks did not increase with exposure whereas preferences for sweetened drinks did (Liem and de Graaf, 2004).

The current study examines the pattern of acceptance in six children in which repeated exposure was used as part of a treatment package for extreme selectivity. We hypothesized that the number of exposures required for acceptance of new foods would decrease as the number of foods previously accepted increased. We also examined the differences in the number of exposures required for acceptance by food group.

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Method

Participants and setting

All six children were referred to a pediatric feeding clinic for treatment of extreme selectivity and/or food refusal. Two of the children (Cases 1 and 2) were described in a previous study concerning the effectiveness of treatment procedure (Paul et al., 2007). This same treatment was used with the other four children as well.

Case 1 was a 3.5-year-old boy diagnosed with autism, who, prior to treatment, received the majority of his calories from drinking milk and eating grilled cheese sandwiches and hot dogs. His parents reported that he displayed aggression and other disruptive behaviors during meal times including crying, tantrums, and food refusal.

Case 2 was a 5-year-old girl diagnosed with autism, who, prior to treatment was totally dependent on her gastronomy tube for her nutritional intake. She had eaten a diet limited to hot dogs, bacon, peanut butter, eggs, toast and chocolate before she stopped eating completely after an acute illness. This child also engaged in undesirable mealtime behaviors such as crying, tantrums, and throwing food.

Case 3 was an 11-year-old boy with developmental disabilities and malnutrition. Both his weight and height were below the 3rd percentile. His diet was limited to water, mashed potatoes, French fries, corn, potato chips, and cheerios. He gagged and vomited when presented with novel foods.

Case 4 was a 5-year-old boy diagnosed with autism whose diet was limited to milk with instant breakfast, hot dogs, chicken nuggets, and a few snack foods. He cried, screamed, and pushed away all novel foods.

Case 5 was a 4-year-old boy with a history of gastroesophageal reflux and delayed gastric emptying whose diet was limited to milk with instant breakfast, Swedish fish candy, French fries, and one brand of nacho chips. He would scream, tantrum, and vomit when novel foods were presented.

Case 6 was an 8-year-old boy diagnosed with autism and allergies to milk, egg, and wheat, whose diet was limited to juice, French fries, cheerios, waffles, and crackers. He would cry, tantrum, and exhibit aggression when presented with novel foods.

The children's interventions were conducted in a pediatric feeding center in treatment rooms equipped with table, chairs, kitchen timer, and video camera. This study used the same dependent measures and procedures described previously (Paul et al., 2007). The procedures and measures used for the current study are described.

Procedure

Foods were presented to participants in either probe meals or taste sessions. During probe meals, the participant was presented with three tablespoons each of three to four novel foods on a plate accompanied by regular utensils and a small cup. Across the course of treatment, the children were offered fruits, vegetables, meats, starches, and dairy products. Prior to treatment, parents completed a 139-item food inventory containing commonly eaten foods and indicated which foods were offered in the home setting. These foods as well as foods commonly served in school settings were served in meals. One of the goals of treatment was to have the child's diet more closely match the diet of other family members. One child (Case 6) had several food allergies which significantly the number of foods that could be offered. The length of the probe meals was limited to 10 min and the end of the meal was indicated by the ringing of a kitchen timer. If the child took a bite of any food, he/she was praised. The feeder instructed the child to take a bite, otherwise no other prompts were given, and all inappropriate behaviors were ignored. Probe meals were conducted to determine if the children would eat novel foods with social praise as the only consequence and whether the pattern of consumption in probe meals changed over the course of treatment.

Generalization meals were conducted by the children's parents outside of the clinical setting. The parents were given foods that were presented during treatment and asked to offer them to their children. Parents set a timer for 10 min and instructed their children to "take your bite." Parents recorded the number of bites of each food the child took. The generalization meals were used to demonstrate acceptance of foods in environments outside of the clinic.

Taste sessions were conducted as a method of introducing new foods to the participants. In a taste session, each child was presented with a pea-sized bite of a food not eaten in a probe meal. The child was told, "When you take your bite, you can go play". The child was allowed to leave his or her seat as soon as the bite was eaten. In this treatment, the ability to leave the room could be interpreted as reinforcement for eating the bite presented. If the bite was expelled, a new bite of the same food was presented. Each of the foods not eaten during probe meals was presented in a rotating basis in the taste sessions. Each taste session was timed and when the child accepted a bite of the same food within 30 s for three out of four sessions, the bite size was increased to half spoonful. When the child was eating half spoonfuls of the same food within 30 s for three out of four sessions, the food was again presented in probe meals (for Cases 1 and 2, bite size was increased to a full spoonful before the foods were presented in probe meals). If the child ate the entire portion of a food, that food was not presented during taste sessions.

Cases 1, 3, and 4 had demonstrated the ability to self-feed and were given 30 min to accept the bite on their own. The procedure was modified for Case 1 and he was given 30 min before being placed in a high chair and fed the bite. He was also placed in the highchair if his disruptive behavior made not possible for him to sit in his chair. As soon as the bite was finished, the child was praised and given 5 min of playtime until the next session. Cases 2, 5, and 6 did not consistently use utensils so the therapist immediately presented the bite. If one of these children refused, the therapist held the spoon to the child's mouth until the bite was accepted. If the spoon was pushed away, the therapist blocked the child's hands. When the bite was finished, the child was praised and given 5 min of playtime until the next session.

Measures

For this study, data was collected on the consumption of novel foods. Unlike some past studies of repeated exposure that measured "liking" or another measure of preference, we based our measure on consistent consumption. Mastery of a novel food was defined as either: (1) 3 full size spoonfuls of the food were eaten in a single probe or generalization meal, or (2) 1/2 spoonful of the food was eaten in less than 30 s in three of four consecutive taste sessions.

We also calculated the average number of presentations required for mastery for each food group. Each food offered was included in one of the following food groups; fruit, vegetable, starch, dairy product, meat and protein, or other. Examples of food in the other group would be stew and pot pie.

Results

For each child, the number of presentations to reach one of the mastery criterion decreased across the number of novel foods

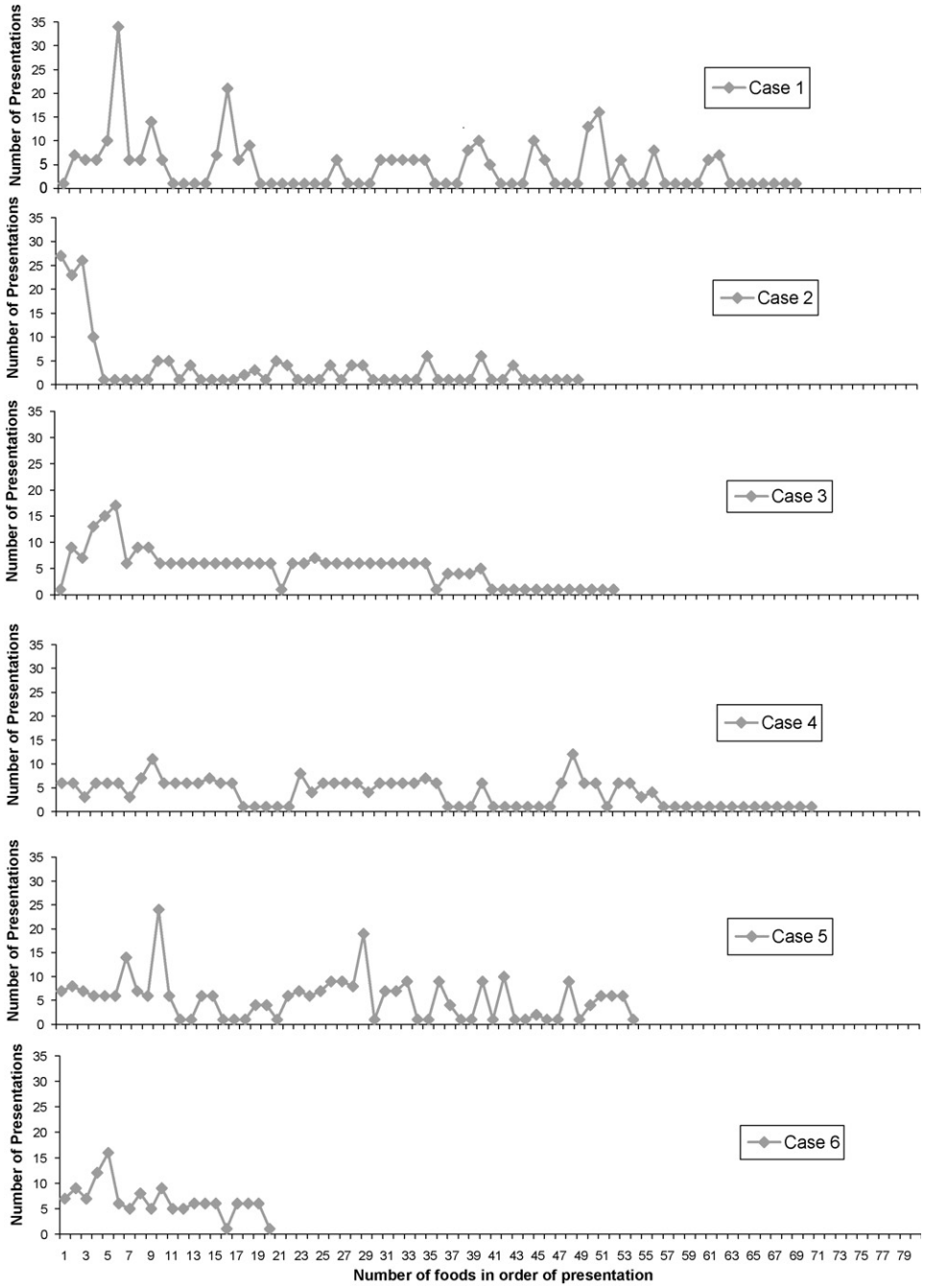

Fig. 1. Presentations to mastery criterion.

presented. For these six children, the range in the number of presentations required for mastery of the first food introduced was 1–27. The mean number of presentations for mastery for the initial ten foods ranged from 6 to 10 for the six children, but for the final ten food introduced in treatment (final nine foods for Case 6) this mean ranged from 1 to 7 presentations. The number of presentations required to meet mastery for each food presented for each of the six children is shown in Fig. 1.

The average number of presentations to mastery by food group was calculated and is shown in Table 1. There was not a consistent pattern for all of the children.

At 3-month follow-up, parents were asked to complete the same 139-item food inventory used prior to treatment. The parents of Case 1 reported their child to be eating 53 foods, while the parents of Case 2 reported their child to be eating 47 foods. The parents of Case 3 did not complete the 139-item food inventory, but during their appointment reported their child continued to eat a variety of foods and was continuing to gain weight, but had largely stopped eating vegetables because they were not served in the home. The parents of Case 4 reported their child to be eating 50 foods and the parents of Case 5 reported their child to be eating 39 foods. The parents of Case 6 reported their child to be eating 24 foods.

Although some of the children were not eating as many foods at the time of follow-up as they were at the conclusion of treatment, all were eating a wider variety than prior to the beginning of

Table 1
Average number of trials to mastery by food group per case

Food type	Case 1		Case 2		Case 3		Case 4		Case 5		Case 6	
	No. of foods presented	Average no. of trials	No. of foods presented	Average no. of trials	No. of foods presented	Average no. of trials	No. of foods presented	Average no. of trials	No. of foods presented	Average no. of trials	No. of foods presented	Average no. of trials
Vegetable	9	11.4	5	1.4	5	5	8	3	7	6	1	9
Fruit	17	5.5	9	9	14	4.7	12	4.9	10	7.2	8	5.8
Starch	23	3.7	19	1.9	20	4.7	24	3.8	22	5.1	5	5.2
Dairy	5	3.2	3	11.3	3	10.3	7	5.3	7	6.3	4	10.3
Meat and protein	13	1.4	12	1.7	9	6.2	15	3.1	6	3.8	2	5
Other	1	6	1	1	0	0	1	1	2	1	0	0

intervention. Anecdotally, the parents of two children reported that the foods their children were no longer eating were those either not served at all at home or not served frequently.

Discussion

It has been hypothesized that the unwillingness to eat novel foods is a phobia and that exposure to novel foods in the absence of aversive consequences could be an effective treatment (Pliner, Pelchat, & Grabski, 1993). The results of this intervention provide some support for this hypothesis. Consistent with past research, each of the children in this study required 10–15 presentations (sometimes more) to meet a mastery criterion for at least some foods, but more importantly, there were numerous foods that required less than 10 presentations, including many novel foods which were eaten during probe meals. One possible explanation for this finding could be that across the course of treatment they were exposed to foods they found to be "good tasting" and ate other foods in anticipation they would taste good as well (Loewen & Pliner, 1999). We would also hypothesize that, secondary to the intervention, hunger was a motivating factor in the consumption of novel foods as the children were exposed to a wide range of foods and the children were prohibited from consuming mostly formula, fortified milk, or only the few foods previously in their diets.

When we examined the number of presentations required to meet criteria by food group, we did not find any consistent pattern across this group of children. Given that the children received different foods and these foods were not introduced in a specific order, the absence of a pattern is not unexpected.

Although there are many possible reasons why these six children did not require 10–15 presentations for each novel food, the fact that the consumption of novel foods became easier for these children, all of whom had severe feeding problems, is important information for parents, clinicians, and healthcare providers.

References

Birch, L. L., & Marlin, D. W. (1982). I don't like it; never tried it: effects of exposure on two-year-old children's food preferences. *Appetite, 3*, 353–360.

Birch, L. L., McPhee, L., Shoba, B. C., Pirok, E., & Steinberg, L. (1987). What kind of exposure reduces children's food neophobia? Looking vs. tasting. *Appetite, 9*, 171–178.

Carruth, B. R., & Skinner, J. D. (2000). Revisiting the picky eater phenomenon: Neophobic behaviors of young children. *Journal of the American College of Nutrition, 19*, 771–780.

Cooke, L., Wardle, J., & Gibson, E. L. (2003). Relationship between parental report of food neophobia and everyday food consumption in 2–6-year-old children. *Appetite, 41*, 205–206.

Ernsperger, L., & Stegen-Hanson, T. (2004). *Just take a bite: Easy, effective answerers to aversions and eating challenges!*. Arlington, TX: Future Horizons Inc.

Jana, L. A., & Shu, J. (2008). *Food fights: Winning the nutritional challenges of parenthood with insight, humor, and a bottle of ketchup*. American Academy of Pediatrics.

Liem, D. G., & de Graaf, C. (2004). Sweet and sour preferences in young children and adults: role of repeated exposure. *Physiology and Behavior, 83*(3), 421–429.

Loewen, R., & Pliner, P. (1999). Effects of prior exposure to palatable and unpalatable novel foods on children's willingness to taste other novel foods. *Appetite, 32*, 351–366.

Nicklaus, S., Boggio, V., Chabanet, C., & Issanchou, S. (2005). A prospective study of food variety seeking in childhood, adolescence, and early adult life. *Appetite, 44*, 289–297.

Paul, C., Williams, K. E., & Riegel, K. (2007). Combining repeated taste exposure and escape prevention: An intervention for the treatment of extreme food selectivity. *Appetite, 49*, 708–711.

Peryam, D. R. (1963). The acceptance of novel foods. *Food Technology, 17*, 33–39.

Pliner, P. (1982). The effects of mere exposure on liking for edible substances. *Appetite, 3*, 283–290.

Pliner, P., Pelchat, M., & Grabski, M. (1993). Reduction of neophobia in humans by exposure to novel foods. *Appetite, 20*, 111–123.

Wardle, J., Cooke, L., Gibson, E. L., Sapochnik, M., Sheilham, A., & Lawson, M. (2003). Increasing children's acceptance of vegetables: A randomized trial of guidance to parents. *Appetite, 40*, 155–162.

Wardle, J., Herrera, M.-L., Cooke, L., & Gibson, E. L. (2003). Modifying children's food preferences: The effects of exposure and reward on acceptance of an unfamiliar vegetable. *European Journal of Clinical Nutrition, 57*, 341–348.