

*AN EVALUATION OF SIMULTANEOUS AND SEQUENTIAL
PRESENTATION OF PREFERRED AND NONPREFERRED
FOOD TO TREAT FOOD SELECTIVITY*

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In the current investigation, we compared two methods of food presentation (simultaneous vs. sequential) to increase consumption of nonpreferred food for 3 children with food selectivity. In the simultaneous condition, preferred foods were presented at the same time as nonpreferred food (e.g., a piece of broccoli was presented on a chip). In the sequential condition, acceptance of the nonpreferred food resulted in presentation of the preferred food. Increases in consumption occurred immediately during the simultaneous condition for 2 of the 3 participants. For 1 participant, increases in consumption occurred in the simultaneous condition relative to the sequential condition, but only after physical guidance and re-presentation were added to treatment. Finally, consumption increased for 1 participant in the sequential condition, but only after several sessions. These results are discussed in terms of possible mechanisms that may alter preferences for food (i.e., establishing operations, flavor-flavor conditioning).

DESCRIPTORS: developmental disabilities, establishing operations, food selectivity, negative reinforcement

Food selectivity is a commonly reported problem in children (Wilson, 1994). Palmer and Horn (1978) noted that “bizarre feeding habits” were reported in 23.4% of the 500 patients seen in a nutrition division over a 4-year period. In that study, only individuals

who had been referred for feeding problems were evaluated. These figures may be underestimates of the prevalence of food selectivity, because they tend to reflect families who seek professional help for this problem. Children may demonstrate strong preferences for particular types or textures of foods and may eat only a limited variety of foods for prolonged periods (Davis, 1939). Pediatricians and other professionals typically recommend a “wait and see” approach with the idea that the child will “outgrow” the problem. However, persistent food selectivity

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may present a more serious health risk if the child fails to eat a sufficient variety of foods to maintain his or her nutritional status or grow.

Methods that have been used to increase consumption of a variety of food have included both simultaneous (Kern & Marder, 1996) and sequential (e.g., Riordan, Iwata, Wohl, & Finney, 1980) presentation of non-preferred and preferred foods. According to Capaldi (1996), simultaneous presentation of a more preferred food with a less preferred food should be a more effective method of increasing food preferences relative to following a less preferred food with a more preferred food (i.e., sequential presentation) as a result of flavor-flavor learning. For example, Holman (1975) evaluated flavor-flavor learning by exposing rats to two different saccharine solutions. In one condition, one flavor was mixed with a highly preferred saccharin concentration; in the other condition, another flavor was mixed with a less preferred saccharin concentration. When the two flavors were presented subsequently in the absence of the saccharine solutions, the rats demonstrated a preference for the flavor that was associated with the highly preferred saccharin concentration. By contrast, Lyn and Capaldi (1994) found that flavor-flavor learning did not occur if there was a large delay when two foods were consumed sequentially (e.g., consumption of coffee was followed by presentation of a sweetener). Studies on treatment of food selectivity have used both simultaneous and sequential presentation of food to increase consumption of nonpreferred foods.

Riordan *et al.* (1980) used sequential presentation of preferred foods to increase the oral intake of 2 participants with developmental disabilities who had highly selective diets. When access to preferred foods followed consumption of nonpreferred foods, rates of consumption for the nonpreferred foods increased. Riordan, Iwata, Finney,

Wohl, and Stanley (1984) used preferred foods to increase consumption for 3 participants. Preferred and nonpreferred foods were presented simultaneously in the first few sessions for 2 of the participants. Subsequently, preferred and nonpreferred foods were presented sequentially by introducing a 2- to 3-s delay between the presentation of the preferred and nonpreferred foods. For the 3rd participant, presentation of preferred foods always followed presentation of non-preferred foods. Food consumption increased for all participants independent of whether the preferred food was presented simultaneously or sequentially.

Kern and Marder (1996) evaluated the differential effects of simultaneous versus sequential presentation of preferred food to treat the food selectivity of a 7-year-old boy with pervasive developmental disorder (PDD). In the simultaneous condition, the preferred (chip) and nonpreferred (fruit) foods were presented at the same time. During the sequential condition, the chip was presented after the nonpreferred food (vegetable) was accepted. In both conditions, an escape extinction procedure was implemented in which the spoon was held at the child's lips until he accepted the presentation. Levels of acceptance were higher in the simultaneous condition than in the sequential condition initially. However, levels of acceptance in the two conditions became similar after nine sessions.

Even though Capaldi (1996) suggests that simultaneous presentation of foods should be a superior method of increasing food preference, it is not clear whether this applies to treatment of children with food selectivity. First, studies on conditioned food preferences (flavor-flavor learning) involve conditioning phases in which preferred foods are presented either simultaneously or sequentially with a flavor; then a test phase is conducted, in which the flavor is presented alone to determine if preferences for the fla-

vor have developed. By contrast, the goal of treatment for children with feeding problems is to increase consumption of food, independent of whether preferences for the foods develop. Thus, it is theoretically possible to increase consumption using sequential presentation as long as the preferred food functions as a reinforcer for consumption and the positive (food) reinforcer competes with other ongoing contingencies (e.g., negative reinforcement in the form of escape from eating).

Second, there are several limitations of the applied literature on simultaneous and sequential presentation of foods that make it difficult to determine if one method is more effective than another in treating food selectivity. Riordan et al. (1980) showed that sequential presentation of preferred and nonpreferred foods was effective in increasing intake for 2 participants. Simultaneous presentation of preferred and nonpreferred foods was used initially for 2 participants by Riordan et al. (1984). However, the contribution of simultaneous presentation to the treatment is unknown because a delay was introduced between the preferred and nonpreferred foods after a few sessions.

Even though Kern and Marder (1996) directly compared simultaneous and sequential presentation of preferred and nonpreferred foods, the study is limited in several ways. First, simultaneous presentation of preferred foods appeared to be associated with a more rapid increase in acceptance; however, this effect was not maintained over time. Second, both treatments were combined with escape extinction; therefore, it is not clear if the increases in acceptance were attributable to the presentation method (i.e., simultaneous vs. sequential) or escape extinction. Third, the simultaneous and sequential presentation methods were paired with specific food groups. Fruits were associated with the simultaneous condition, and vegetables were associated with the sequential condition.

Thus, it is possible that the more rapid acquisition in the simultaneous condition was a function of the type of food (fruit) rather than the procedure used. That is, humans have an innate preference for sweet foods (Capaldi, 1996); therefore, preference for fruits (which usually are sweet) may be conditioned more rapidly than vegetables. Finally, an AB design was employed; therefore, functional control was not demonstrated for the treatment.

In the current investigation we attempted to extend the literature on simultaneous and sequential presentation of preferred and nonpreferred foods (Kern & Marder, 1996) in several ways. First, we directly compared the two procedures with 3 participants to test relative effectiveness. Second, we paired the procedures with foods from all food groups, dividing fruits, starches, vegetables, and meats equally across the two treatment methods to control for the problem of more rapid conditioning with some foods relative to others for 2 of the participants. Finally, in the case in which the presentation procedures alone were ineffective in increasing consumption, we implemented treatment components sequentially to evaluate the relative contribution of the procedures to treatment. Finally, we demonstrated functional control for the presentation method using a multielement design.

METHOD

Participants and Setting

Three children with feeding problems participated. Alex was a 10-year-old boy who had been diagnosed with autism. He had been admitted to an outpatient feeding program for food selectivity and food refusal. Alex was independent in self-help skills. He had an extensive vocabulary, but he used words mainly to express wants and needs. Alex ate a variety of foods until the age of 3 years, when he began eliminating foods from

his diet. By the age of 5 years, he ate only crunchy foods. At the time of admission, he had lost approximately 12 pounds, and his diet was limited to chicken nuggets, apples, and several other crunchy foods (e.g., popcorn). Alex was taking Prozac® throughout the duration of the study.

Vonda was an 11-year-old girl who had been diagnosed with PDD, severe to profound mental retardation, and a seizure disorder. Vonda was ambulatory and could follow simple instructions. Her communication was limited to a few words. Vonda had been admitted to an inpatient unit for the assessment and treatment of aggression, self-injury, property destruction, and food selectivity. Vonda's mother reported that she ate lettuce with salad dressing or ketchup and certain creamy foods such as yogurt. She refused all other foods. When she was presented with nonpreferred food, she would engage in disruptive behaviors. Vonda was taking Risperadol®, Depakote®, and Prozac® throughout the duration of the study.

Brad was an 8-year-old boy who had been diagnosed with attention deficit hyperactivity disorder, severe mental retardation, and PDD. Brad was ambulatory and could follow simple instructions (e.g., "stand up"). His communication was limited to a few signs (e.g., eat, bathroom). Brad had been admitted to an inpatient unit for the assessment and treatment of saliva play, aggression, disruption, self-injury, and food selectivity. Brad's mother reported that he ate only chips and chicken skins and refused all other foods. Thus, his diet was completely devoid of protein, fruits, and vegetables. When he was presented with nonpreferred food, he would scream, cry, and engage in self-injurious behavior. Brad was not taking any medication during the study.

Meal sessions were conducted in rooms (3 m by 3 m) that were adjacent to observation rooms equipped with one-way mirrors and sound. Each child used age-appropriate seat-

ing arrangements (e.g., booster seat, regular chair) and eating utensils. Sessions for Alex were conducted only once per week for an hour during his regularly scheduled outpatient visit, which was at 2:00 p.m., the closest available appointment time to his normal lunch time. On these days, his lunch, which was given normally at 12:00 p.m., was delayed until the outpatient visit and was served during the session. Vonda was presented with a tray of food from the hospital food service at 8:00 a.m., 12:00 p.m., 6:00 p.m., and 7:00 p.m. Trays consisted typically of a fruit, starch, meat, and vegetable. Hospital staff selected menu items for each participant for all meals at the beginning of each week. The participants had access to the tray of food for 30 min. After 30 min, the trays were removed, and no other food was served until either session time or the next scheduled meal. Sessions were conducted twice per day at 10:00 a.m. and 2:30 p.m. The participants were not allowed to have access to their preferred foods for 2 hr before and after the feeding sessions.

Data Collection and Interrater Agreement

The dependent variable for Alex, Vonda, and Brad was percentage of bites consumed, which was derived by dividing the number of clean mouths by the total number of bites and multiplying by 100%. Clean mouth was defined as no visible food in the child's mouth following acceptance. The therapist prompted the child to open his or her mouth every 30 s to determine if the bite had been swallowed. Acceptance was scored when the entire bolus of food entered the child's mouth. Data on clean mouth and acceptance were collected on laptop computers using an event-recording procedure. Percentage of bites consumed was used as the major dependent variable because this measure reflected the bites that actually were swallowed (i.e., as opposed to measuring bites that were accepted but then expelled or

packed in the mouth). Expulsions (Brad only) were defined as emitting food or liquid larger than the size of a pea past the plane of the lips.

A second observer independently coded 16%, 38%, and 28% of sessions for Alex, Vonda, and Brad, respectively. Interobserver agreement was calculated by dividing the number of agreements by the total number of agreements plus disagreements and multiplying by 100%. The mean total interobserver agreement for acceptance was 100%, 99% (range, 99% to 100%), and 97% (range, 72% to 100%) for Alex, Vonda, and Brad, respectively. The mean total interobserver agreement for clean mouth was 100%, 91% (range, 56% to 100%), and 89% (range, 97% to 100%) for Alex, Vonda, and Brad, respectively. The mean total interobserver agreement for expulsion was 98% (range, 74% to 100%) for Brad.

General Procedure

Only one nonpreferred food was evaluated for Alex due to time constraints in the outpatient program. The simultaneous versus sequential analysis included only broccoli (nonpreferred) and apples (preferred).

A different comparison was conducted for Vonda and Brad. Foods were divided into two arbitrary groups (A and B). Each arbitrary group contained two foods from each of the four food groups (i.e., protein, starch, fruit, vegetable), resulting in a total of eight foods in Group A and eight foods in Group B. Each arbitrary group was paired with one of the two treatments (i.e., either simultaneous or sequential presentation). This preparation was consistent with those used in basic studies on conditioned food preferences in which one type of food or one flavor is associated with one stimulus condition and another type of food or flavor is associated with a different stimulus condition (e.g., Holman, 1975). We divided the foods into these groups to control for preexisting dif-

ferences in the rate at which preferences may be conditioned for certain foods. However, we demonstrated that the participants did not have any preexisting preferences for the foods because food consumption was zero or low in baseline.

Group A included bread and mashed potatoes (starches), ham and bologna (proteins), orange and banana (fruits), green beans and carrots (vegetables). Group B included french fries and macaroni (starches), turkey and hot dogs (proteins), apples and grapes (fruits), corn and broccoli (vegetables). All foods were presented as bite-sized pieces (2.5 cm by 2.5 cm). The preferred food for Brad was chips. The preferred food for Vonda was salad dressing.

Experimental Design

A multielement design was used to evaluate the effects of simultaneous versus sequential presentation of foods. The phases for Alex were baseline (broccoli presented alone) and simultaneous versus sequential presentation. The phases for Vonda were baseline (comparison of Group A and Group B foods), simultaneous versus sequential presentation, and simultaneous presentation for all food items. The phases for Brad were baseline (comparison of Group A and Group B foods), simultaneous versus sequential presentation, simultaneous versus sequential presentation plus physical guidance, simultaneous versus sequential presentation plus physical guidance plus re-presentation, and simultaneous presentation plus physical guidance plus re-presentation for all food items. The conditions (simultaneous or sequential presentation) were selected randomly for each session for each participant.

Specific Procedure

Baseline. Alex was presented with three bite-sized pieces of broccoli on a plate and was prompted to take a bite once every 30 s. If Alex accepted the bite, the therapist pro-

vided brief verbal praise (e.g., “good job taking your bite”) and gave Alex a penny. All inappropriate behaviors (e.g., expulsion, emesis, disruptions) were ignored. The meal ended after 5 min. At the end of the meal, if Alex earned 3 pennies, he could trade them for access to preferred toys (e.g., microjammer, key chain).

Vonda and Brad were presented with bites of Group A foods in some sessions and Group B foods in other sessions. Bite-sized pieces of food were placed on a spoon on a plate in front of the child every 30 s and the child was verbally prompted to take a bite. If the child failed to place the bite in his or her mouth within 30 s, the bite was removed and a bite of a different food was presented. The order of presentation for the fruits, starches, proteins, and vegetables was randomized for each session, but remained the same within the session. If the child accepted the bite, the therapist provided brief verbal praise (e.g., “good job taking your bite”). All inappropriate behaviors (e.g., expulsion, emesis, disruptions) were ignored. The meal ended after 20 min.

Simultaneous versus sequential presentation. The same food (broccoli) was presented in both conditions for Alex. The broccoli was embedded in the apple in the simultaneous condition. We embedded the broccoli in the apple by cutting a small hole in the apple and inserting the broccoli piece in the hole. The apple slices were placed on the plate such that Alex could not see the broccoli unless he turned the apple slice over. Three apple slices with three embedded pieces of broccoli were presented in the simultaneous condition. In the sequential condition, one apple slice was presented following consumption of each bite of broccoli. The bites of apple were on a plate next to the plate with the bites of broccoli. When Alex consumed the bite of broccoli in the sequential condition, the therapist placed the bite of apple at midline approximately 5 to 8 cm

from Alex’s mouth. Alex then took the apple piece in his hand and ate it. Three bites of broccoli were presented in the sequential condition. The therapist explained the contingencies to Alex prior to each session. All other procedures were identical to baseline.

During this phase for Vonda and Brad, Group A foods were paired with simultaneous presentation and Group B foods were paired with sequential presentation. In the simultaneous condition, two bites (preferred and nonpreferred) of food were presented together on the same spoon. The preferred food (5 cc of salad dressing) was placed on top of the nonpreferred foods for Vonda. The nonpreferred foods were placed on top of a bite-sized piece of chip (preferred food) for Brad. In the sequential condition, the preferred food (5 cc of salad dressing for Vonda and a bite-sized piece of chip for Brad) was presented immediately (within 1 or 2 s) after acceptance of the nonpreferred food. The preferred food was placed on a spoon, which was directly behind the bite of nonpreferred food. The therapist fed the bite of the preferred food following acceptance of the nonpreferred food. Both children always accepted the preferred food when it was presented during the sequential condition. The therapist explained the contingencies to the child prior to each session.

Physical guidance (Brad). Additional treatment components were evaluated for Brad because consumption did not increase in the simultaneous versus sequential phase. First, physical guidance (Ahearn, Kerwin, Eicher, Shantz, & Swearingin, 1996) was added to the simultaneous and sequential presentations. When Brad failed to take the bite within 30 s of presentation, the therapist placed gentle pressure to the mandibular joint and the bite of food was placed in Brad’s mouth. Physical guidance was terminated once the bite was placed in Brad’s mouth. (Bites that were accepted with physical guidance were not included on the con-

sumption graph.) No consequences were in place for expulsion (i.e., expelled bites were not re-presented). If Brad consumed the bite within 30 s, the next bite was presented at the start of the next 30-s interval. If Brad did not accept and consume his bite within 30 s, the next bite was presented immediately after the bite was either expelled or swallowed. Sessions were extended past 20 min (up to a maximum of 1 hr) until Brad accepted and swallowed the last bite presented. Brad always accepted his bites prior to the 1-hr mark. However, he continued to expel accepted bites, and all sessions during this phase extended to the 1-hr time limit. Inappropriate behavior was blocked and ignored. All other procedures were identical to those described in the simultaneous versus sequential conditions.

Physical guidance plus re-presentation (Brad). Percentage of bites consumed remained at zero for Brad during the simultaneous versus sequential presentation plus physical guidance phase; therefore, re-presentation (placing the expelled bite back into the child's mouth) was added to the treatment. All procedures were identical to the previous phase; however, if Brad expelled the bite it was immediately (within 1 or 2 s of the expulsion) re-presented. In the simultaneous condition, if he expelled both preferred and nonpreferred food, both were re-presented. If he expelled the nonpreferred food only, only the nonpreferred food was re-presented. In the sequential condition, we attempted to present the preferred food immediately following acceptance of the nonpreferred food (i.e., prior to expulsion). Expelled food items were re-presented until he swallowed or 1 hr elapsed, whichever came first. He continued to expel accepted bites in the sequential condition, and all sessions during this phase extended to the 1-hr time limit. Sessions in the simultaneous condition were terminated at the 1-hr time limit until Session 36 when Brad began consuming

bites. Thereafter, sessions were terminated at the 20-min mark because Brad finished the last bite presented by the time 20 min had elapsed.

Simultaneous presentation only. The last phase was identical to the previous phase for Vonda and Brad; however both food groups (A and B) were presented using simultaneous presentation. The purpose of this phase was to evaluate whether simultaneous presentation would be effective in increasing consumption of foods that had been refused in the previous (sequential) condition. That is, we wanted to demonstrate that the effectiveness of the simultaneous condition was related to the procedure rather than to the foods presented.

RESULTS

Figure 1 shows the percentage of bites consumed for Alex. During the baseline condition, percentage of bites consumed was 0%. However, consumption increased immediately to 100% during the simultaneous condition. By contrast, percentage of bites consumed remained at 0% for the first five sessions of the sequential condition but increased to 100% during the last two sessions. Because Alex was discharged from the outpatient program, no follow-up data were collected.

Figure 1 also depicts the percentage of bites consumed for Vonda. No food was consumed in baseline. Percentage of bites consumed increased in the simultaneous condition. By contrast, no foods were consumed in the sequential condition. Consumption of Group B foods increased immediately and consumption of Group A foods remained high when both food groups were presented simultaneously with the preferred foods in the final phase. Follow-up data were not collected for Vonda.

Figure 1 also depicts the percentage of bites consumed for Brad. Food consumption

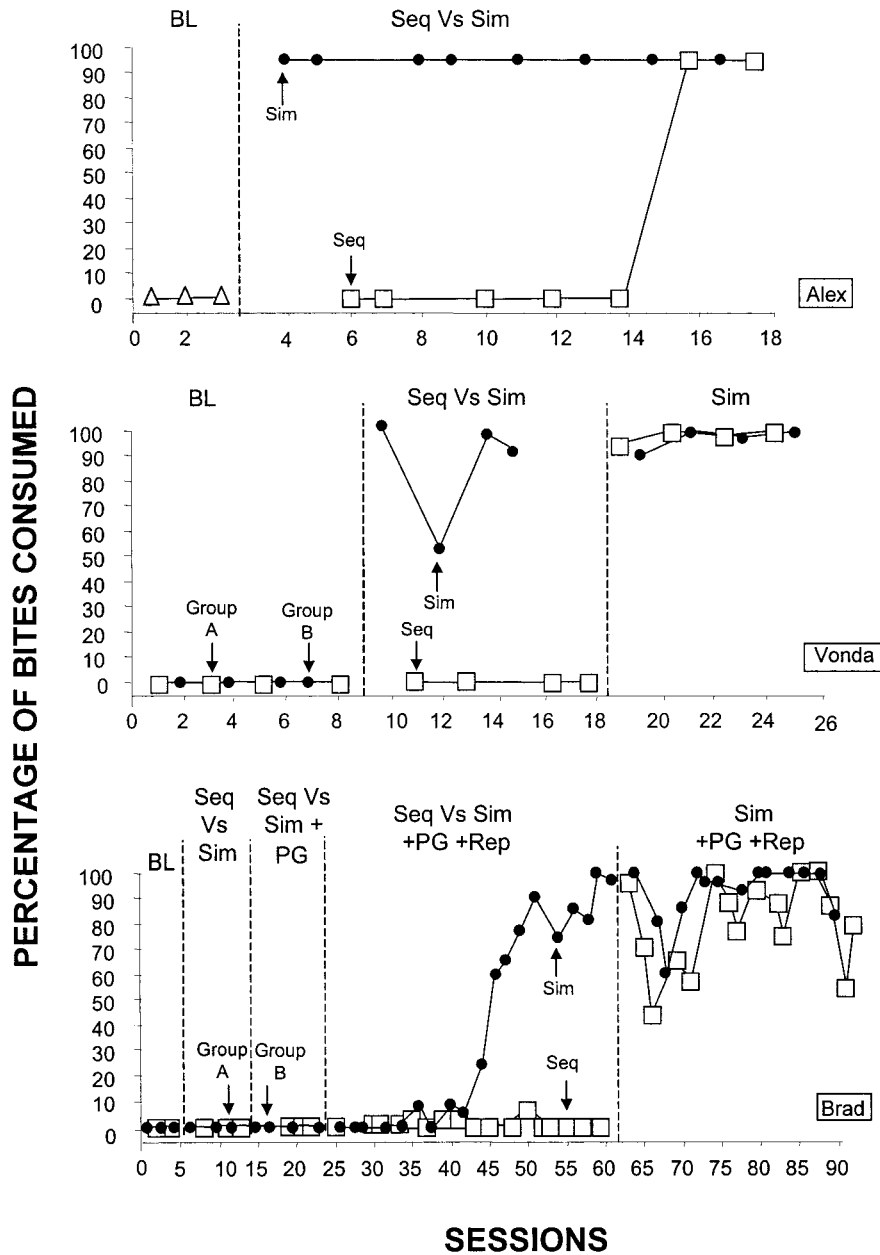


Figure 1. The percentage of bites consumed by Alex, Vonda, and Brad. The *x* axes vary across participants.

was 0% during baseline, the simultaneous versus sequential conditions, and simultaneous versus sequential plus physical guidance conditions. Acceptance of food increased to 100% (data not shown) in both the simultaneous and sequential conditions when physical guidance was added to treat-

ment. However, Brad expelled 100% of the bites accepted (data not shown). When representation was added to treatment, consumption increased gradually over the course of eight sessions (in the simultaneous presentation condition only) and then remained high in the simultaneous condition for the

duration of the phase. However, similar increases in consumption did not occur in the sequential condition. Therefore, we began presenting Group B foods (i.e., foods that had been associated with sequential presentation) with simultaneous presentation in the final phase. Consumption of Group B foods increased immediately and consumption of Group A foods remained high when both food groups were presented simultaneously with the preferred foods. Follow-up data were not collected for Brad.

DISCUSSION

The results from the current investigation showed that simultaneous presentation was more effective than sequential presentation for all participants. The data for Alex are more similar to those of Kern and Marder (1996), in that acceptance did increase in the sequential condition, but only after increases occurred in the simultaneous condition. Increases in consumption occurred for Vonda and Brad only in the simultaneous condition. In addition, simultaneous presentation was effective in the absence of escape extinction for 2 participants (Vonda and Alex). By contrast, the relative contribution of the presentation method (simultaneous vs. sequential) was unclear in the Kern and Marder study, because escape extinction was implemented immediately in both conditions.

There are several reasons why simultaneous presentation of preferred and nonpreferred food may be effective in increasing consumption. Presumably, feeding problems are maintained by negative reinforcement in the form of escape from eating (e.g., Ahearn et al., 1996; Cooper et al., 1995; Hoch, Babbitt, Coe, Krell, & Hackbert, 1994; Kahng, Tarbox, & Wilke, 2001; Patel, Piazza, Kelly, Ochsner, & Santana, 2001; Sevin, Gulotta, Sierp, Rosica, & Miller, 2002). In the case of food selectivity, the putative aversive stimulus is the nonpreferred food. If so, simultaneous

presentation of the preferred food may act as an establishing operation by reducing the aversiveness of the nonpreferred food. Therefore, the presence of the preferred food in combination with the nonpreferred food may alter the effectiveness of escape as reinforcement. Even though specific inappropriate behaviors such as batting at the spoon or head turning were ignored, the participants could avoid eating the nonpreferred food via refusal (e.g., keeping their mouths closed), which they did in baseline. When preferred and nonpreferred foods were presented simultaneously, Vonda and Alex began to eat, even though they could continue to avoid eating nonpreferred foods.

The presentation method for Vonda and Alex was similar in that the preferred and nonpreferred foods were combined or melded into one food (i.e., dressing on food for Vonda and broccoli inserted into an apple for Alex). Thus, the blending of the preferred and nonpreferred food may have altered the flavor to a greater extent (i.e., reduced the aversiveness of the nonpreferred food more) than placing the nonpreferred food on top of the preferred food, as was done for Brad. Brad did not begin to eat until physical guidance and re-presentation were added to simultaneous presentation. Even though simultaneous presentation did not alter the probability of escape for Brad, it did alter the extent to which the escape extinction treatment package was effective, but sequential presentation did not.

It is not clear why the escape extinction procedure was ineffective for Brad during the sequential condition, because the results of several studies have demonstrated the effectiveness of escape extinction in the treatment of feeding problems (e.g., Cooper et al., 1995; Hoch et al., 1994). Flaherty and Checke (1982) have shown that following a test flavor with a preferred flavor may sometimes result in decreases in consumption of the test flavor. Thus, it is possible that for

Brad, following a nonpreferred flavor by a preferred flavor decreased the probability of consumption of the nonpreferred flavor despite the presence of the escape extinction procedure.

A second potential explanation of these findings is that increases in consumption occurred during the simultaneous relative to the sequential condition as a result of flavor–flavor learning (Capaldi, 1996). Studies with both animals and humans have demonstrated that increased preferences for tastes may develop when novel foods are paired with preferred flavors (e.g., Holman, 1975; Zellner, Rozin, Aron, & Kulish, 1983). In experiments on flavor–flavor learning, one flavor is presented simultaneously (mixed) with a preferred flavor and another flavor is presented alone. For example, Zellner *et al.* presented different flavors of sweetened and unsweetened teas to college students. When the teas were presented subsequently, the students preferred the teas that had been mixed previously with the sweetener, even when the sweetener was no longer presented with the tea. Similarly, in the current investigation, we assigned food items to groups for Brad and Vonda, such that one group of foods was associated with the simultaneous condition and a different group of foods was associated with the sequential condition. Even though we showed that Brad and Vonda consumed the nonpreferred foods in the simultaneous condition and not the sequential condition, we did not demonstrate that flavor–flavor learning occurred, because the nonpreferred foods used in the simultaneous condition were never presented in the absence of the preferred foods. That is, we showed only that the participants would eat the nonpreferred foods in the presence of the preferred foods, but we did not test consumption or preference in the absence of the preferred foods. Future investigations should include subsequent tests of the nonpreferred flavors alone to determine if flavor–flavor learning occurs for children

with food selectivity following simultaneous presentation of preferred foods.

Consumption of the nonpreferred food occurred more rapidly for Alex in the simultaneous condition relative to the sequential condition when the same food was presented in both conditions. However, he began eating the nonpreferred food in the sequential condition following seven and five sessions of simultaneous and sequential presentations, respectively. It is possible that the increases in consumption in the sequential condition were the result of flavor–flavor learning. That is, we speculate that Alex may have developed an increased preference for the nonpreferred food as a result of its repeated pairing with the preferred food. These results are speculative, however, because only one food was presented to Alex.

These results are important in that sequential presentation alone may not always be effective in increasing consumption of food for several reasons. One possibility is that participants may not have the opportunity to contact the reinforcement contingency if levels of acceptance are low or near zero in baseline (Hoch *et al.*, 1994). Second, sequential presentation may be ineffective if systematic procedures are not used to identify the reinforcers (e.g., Amari, Grace, & Fisher, 1995). Third, providing access to sequentially presented preferred food may not have competed with the motivation to escape from the nonpreferred foods. Finally, as mentioned previously, sequential presentation of nonpreferred and preferred foods may result in decreases in consumption (Capaldi, Scheffer, & Pulley, 1989; Flaherty & Checke, 1982).

A limitation of the simultaneous presentation method is that taste aversion may occur when nonpreferred foods are paired with neutral or preferred foods (Fanselow & Birk, 1982; Lavin, 1976). Thus, it is possible that rather than increasing preference for the nonpreferred food, the procedure may decrease preference for the preferred food. This

is a serious health risk in a child like Brad, because chips and chicken skins were his only source of nutrition and calories. Anecdotally, all of the children continued to consume their preferred foods in the absence of the nonpreferred foods. Thus, it does not appear that taste aversion for the preferred foods developed for any participant. However, future studies should examine the conditions under which taste aversion may occur during simultaneous presentation of preferred and nonpreferred foods.

Additional limitations of the study were that no follow-up data were collected, and all of the participants had been diagnosed with developmental disabilities. Therefore, the extent to which these results may be generalized to other populations is unclear.

REFERENCES

- Ahearn, W. H., Kerwin, M. E., Eicher, P. S., Shantz, J., & Swearingin, W. (1996). An alternating treatments comparison of two intensive interventions for food refusal. *Journal of Applied Behavior Analysis, 29*, 321–332.
- Amari, A., Grace, N. C., & Fisher, W. W. (1995). Achieving and maintaining compliance with the ketogenic diet. *Journal of Applied Behavior Analysis, 28*, 341–342.
- Capaldi, E. D. (1996). Conditioned food preferences. In E. D. Capaldi (Ed.), *Why we eat what we eat: The psychology of eating* (pp. 53–80). Washington, DC: American Psychological Association.
- Capaldi, E. D., Sheffer, J. D., & Pulley, R. J. (1989). Contrast effects in flavour preference learning. *The Quarterly Journal of Experimental Psychology, 41*, 307–323.
- Cooper, L. J., Wacker, D. P., McComas, J., Brown, K., Peck, S. M., Richman, D., Drew, J., et al. (1995). Use of component analysis to identify active variables in treatment packages for children with feeding disorders. *Journal of Applied Behavior Analysis, 28*, 139–153.
- Davis, C. M. (1939). Results of the self-selection of diets by young children. *Canadian Medical Association Journal, 41*, 651–679.
- Fanselow, M., & Birk, J. (1982). Flavor-flavor associations induce hedonic shifts in taste preferences. *Animal Learning & Behavior, 10*, 223–228.
- Flaherty, C. F., & Checke, S. (1982). Anticipation of incentive gain. *Animal Learning & Behavior, 10*, 177–182.
- Hoch, T. A., Babbitt, R. L., Coe, D. A., Krell, D. M., & Hackbert, L. (1994). Contingency contacting: Combining positive reinforcement and escape extinction procedures to treat persistent food refusal. *Behavior Modification, 18*, 106–128.
- Holman, E. W. (1975). Immediate and delayed reinforcers for flavor preferences in rats. *Animal Learning & Behavior, 6*, 91–100.
- Kahng, S., Tarbox, J., & Wilke, A. E. (2001). Use of a multicomponent treatment for food refusal. *Journal of Applied Behavior Analysis, 34*, 93–96.
- Kern, L., & Marder, T. J. (1996). A comparison of simultaneous and delayed reinforcement as treatments for food selectivity. *Journal of Applied Behavior Analysis, 29*, 243–246.
- Lavin, M. J. (1976). The establishment of flavor-flavor associations using sensory preconditioning training procedure. *Learning and Motivation, 7*, 173–183.
- Lyn, S. A., & Capaldi, E. D. (1994). Robust conditioned flavor preferences with a sensory preconditioning procedure. *Psychonomic Bulletin and Review, 1*, 491–493.
- Palmer, S., & Horn, S. (1978). Feeding problems in children. In S. Palmer & S. Ekvell (Eds.), *Pediatric nutrition in developmental disorders* (pp. 107–129). Springfield, IL: Charles C Thomas.
- Patel, M. R., Piazza, C. C., Kelly, M. L., Ochsner, C. A., & Santana, C. M. (2001). Using a fading procedure to increase fluid consumption in a child with feeding problems. *Journal of Applied Behavior Analysis, 34*, 357–360.
- Riordan, M. M., Iwata, B. A., Finney, J. W., Wohl, M. K., & Stanley, A. E. (1984). Behavioral assessment and treatment of chronic food refusal in handicapped children. *Journal of Applied Behavior Analysis, 17*, 327–341.
- Riordan, M. M., Iwata, B. A., Wohl, M. K., & Finney, J. W. (1980). Behavioral treatment of food refusal and selectivity in developmentally disabled children. *Applied Research in Mental Retardation, 1*, 95–112.
- Sevin, B. M., Gulotta, C. S., Sierp, B. J., Rosica, L. A., & Miller, L. J. (2002). Analysis of response covariation among multiple topographies of food refusal. *Journal of Applied Behavior Analysis, 35*, 65–68.
- Wilson, M. H. (1994). Feeding the healthy child. In F. A. Oski (Ed.), *Principles and practice of pediatrics* (pp. 590–612). Philadelphia: Lippincott.
- Zellner, D. A., Rozin, P., Aron, M., & Kulish, D. (1983). Conditioned enhancement of humans' liking for flavors paired with sweetness. *Learning and Motivation, 14*, 338–350.

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STUDY QUESTIONS

1. What was the dependent variable of interest, and how was it calculated? What additional data on feeding behavior may have been informative?
2. How did the authors select Vonda's and Brad's foods for Groups A and B?
3. What were the similarities and differences between the simultaneous and sequential presentation procedures?
4. What contingencies were in effect for acceptance and inappropriate behaviors during the baseline, simultaneous, and sequential conditions?
5. Briefly describe the additional treatments implemented with Brad.
6. Summarize the results of the comparison between simultaneous and sequential food presentation.
7. How might the effects of the simultaneous procedure be explained in terms of establishing operations?
8. What is a potential limitation of the simultaneous procedure?

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