

*THE EFFECTS OF REINFORCER PAIRING AND FADING ON
PRESCHOOLERS' SNACK SELECTIONS*

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The effects of reinforcement pairing and fading on preschoolers' snack selections were evaluated in a multiple baseline design. Baseline preferences for snack options were assessed via repeated paired-item preference assessments. Edible, social, and activity-based reinforcers were then exclusively paired with a less preferred snack option. Once the snack paired with reinforcement was selected most frequently, the three types of reinforcement were systematically faded. Frequent selections of the previously less preferred snack option were produced with paired reinforcement, but were disrupted for all children as the paired reinforcement was reduced to low levels. These data showed that paired reinforcement was initially effective in increasing preference for the originally less preferred snack options, but more permanent changes in the value of the snack options were not achieved. Conditions for producing persistent changes in children's snack choices are discussed.

DESCRIPTORS: conditioning, preschoolers, preference, reinforcement pairing and fading

Although reinforcement contingencies have proven to be effective in increasing food consumption in preschool children (e.g., Ireton & Guthrie, 1972), the use of a reinforcement contingency to promote consumption of non-preferred foods may not alter the value of the nonpreferred food; therefore, programmed contingencies may be required to maintain consumption. It may be possible to alter the value of a nonpreferred food and maintain consumption of that food in the absence of the initial intervention using conditioning procedures. Capaldi (1996) suggested that some food preferences may develop as a result of flavor-flavor conditioning, which occurs when one flavor is paired with another flavor. The association of one flavor with another is said to result in the appetitive or aversive properties of one flavor transferring to the other (Capaldi).

Holman (1975) found that pairing a less preferred flavor with a more preferred flavor can increase preference for the originally less preferred flavor in rats; similar findings have been observed with humans (Bayens, Eelen, Van den Bergh, & Crombez, 1990; Zellner, Rozin, Aron, & Kulish, 1983).

Past studies concerned with increasing consumption of less preferred foods via pairing have primarily involved two pairing procedures: (a) simultaneous presentation, which involves pairing a highly preferred food with a less preferred food so that the two foods are consumed simultaneously, and (b) sequential presentation, which involves making the availability of a highly preferred food contingent on consumption of the less preferred food (i.e., the two foods are consumed separately). Kern and Marder (1996) showed that simultaneous presentation resulted in a greater number of bites of fruit accepted as compared to the number of bites of vegetables accepted using sequential presentation, but because they associated fruit with one presentation method and vegetables with the other, it is not possible to determine if the presentation style was exclusively responsible for the observed differences.

The research presented in this article was completed in partial fulfillment of thesis requirements for the MA degree by the first author.

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doi: 10.1901/jaba.2007.633-644

Piazza *et al.* (2002) directly compared sequential and simultaneous presentation across all food groups. Increased food consumption occurred for 2 of 3 participants in the simultaneous condition, in which a rarely consumed food was placed in or underneath a preferred food, but not in the sequential condition. Piazza *et al.* suggested that increased consumption of nonpreferred (rarely consumed) foods following intervention may be a result of flavor–flavor conditioning. This assertion was based on the fact that simultaneous food presentation was more effective than sequential food presentation for increasing consumption of nonpreferred foods in studies by Kern and Marder (1996) and Piazza *et al.* However, as Ahearn (2003) pointed out, the nonpreferred foods were never presented alone after the simultaneous presentation procedure, so it is uncertain whether conditioning was responsible for the observed effects. Ahearn extended this research by conducting a postpairing condition after simultaneous food presentation for increasing vegetable consumption by a 14-year-old boy with autism. Results showed that simultaneous presentation increased consumption of vegetables. However, when the highly preferred condiment was completely removed, consumption of all three vegetables returned to baseline levels. These results suggest that it is unlikely that flavor–flavor conditioning was responsible for initial increases in consumption of vegetables, and that increased consumption was more likely a direct effect of the reinforcing features of the condiments. It is possible that there were not enough pairings for flavor–flavor conditioning to occur. However, there were more stimulus–stimulus pairings than in previous studies (Piazza *et al.*).

Pairing procedures also have been used to alter preferences for nonfood items (Hanley, Iwata, & Roscoe, 2006; Hanley, Iwata, Roscoe, Thompson, & Lindberg, 2003). In these studies, a less preferred activity was paired with reinforcement, and preference for the originally

less preferred activities emerged during pairing. Most important was that this shift in preference was maintained during evaluative probes for days (Hanley *et al.*, 2006) or weeks (Hanley *et al.*, 2003) after pairing was terminated, suggesting that conditioning did indeed occur. Hanley *et al.* (2003) provided intermittent pairings before terminating the pairing procedures; this aspect may have promoted a conditioning effect. By contrast, paired reinforcement was simply terminated in a single step by Ahearn (2003). Taken together, these data suggest that pairing may be more likely to condition a preference if the paired reinforcement is more gradually eliminated.

Stimulus fading has been used in combination with other procedures to increase amount and type of food and fluid consumption (Freeman & Piazza, 1998; Patel, Piazza, Kelly, Ochsner, & Santana, 2001; Riordan, Iwata, Wohl, & Finney, 1980) and may be an effective means for eliminating paired foods in conditioning procedures. In these studies, each time the highly preferred food or drink was presented, a small amount of a nonpreferred food or drink was added in gradually increasing amounts, until the nonpreferred item was presented alone. Mueller, Piazza, Patel, Kelley, and Pruett (2004) showed that consumption of nonpreferred foods increased and was maintained after being paired with a preferred food when preferred foods were gradually eliminated. However, because the nonpreferred foods were presented in a single-stimulus format, it is not possible to determine if these procedures would result in the child choosing a nonpreferred food in the presence of more preferred foods. This may be important for less dependent children (e.g., typically developing school-aged children), who are typically faced with choosing between multiple foods, especially when choosing healthy over less healthy foods on the majority of occasions is the ideal outcome. However, before attempting to shift preferences for foods that may be highly discrepant in terms

of form and preference, such as chocolate cake to broccoli, it is important to apply preference-shifting procedures to foods that are formally similar, such as various cereal snacks. If inducing shifts in preferences between formally similar foods is difficult, it would very likely be even more so if foods were formally discrepant.

Thus, the goal of the present study was to combine and extend methods for increasing consumption of less preferred foods demonstrated to be effective in different contexts with clinical populations to typically developing preschool children. More specifically, we evaluated the efficacy of pairing less preferred foods with reinforcement (e.g., social interaction and children's videos) to increase the selection and consumption of less preferred snacks. Stimulus fading was then used to gradually eliminate the superimposed reinforcers until the target snack was once again presented alone. For 2 participants, we assessed formally similar foods (i.e., breakfast cereals), and we included more formally discrepant foods ranging from vegetables to candy for the 3rd participant.

METHOD

Participants and Setting

Three typically developing preschoolers, who were 4 years 5 months (Jessica), 4 years 1 month (Tim), and 3 years 8 months (Susan) old at the beginning of the study, participated. All sessions took place in research rooms containing child-sized chairs and a table, and were conducted at roughly the same time each day (after breakfast but before lunch) no sooner than 30 min after breakfast.

Measurement and Interobserver Agreement

The primary dependent variable measured in this study was snack selections, and data were collected using paper and pencil. Multiple-stimulus without replacement (MSWO) preference assessments as described by DeLeon and Iwata (1996) and paired-stimulus preference assessments as described by Fisher et al. (1992)

were conducted to evaluate preferences among snacks, condiments, and activities. Selection was scored during every preference assessment and consumption was scored during each assessment involving foods. Selection was defined as the child removing a snack item or activity from the pair or array of items. Consumption was defined as the child placing the entire bit of snack in his or her mouth and having a clean mouth (no visible snack in the child's mouth) within 30 s of the selection. Consumption was recorded at the end of 30 s or after the child said that he or she was done and showed a clean mouth. If 30 s had expired, the experimenter checked for a clean mouth by giving the child a verbal prompt (e.g., "show me"). If the child did not comply after two prompts, the experimenter moved to the next trial; however, all participants readily complied with this request. Consumption of selected items ranged from 90% to 100% for all children; therefore, the percentage of selections is the measure reported.

Selection was scored by circling a number that corresponded to the item that was selected. Agreements for selection were scored when both observers circled the same number for the same trial. The number of agreements was divided by the total number of trials in the assessment. Consumption was scored at the end of each trial in all of the preference assessments involving snacks by circling "yes" or "no" next to the corresponding trial number. Agreements for consumption were scored when both observers circled the same word. The number of agreements was divided by the total number of trials in the assessment. Interobserver agreement was collected during 69% of all sessions and averaged 99% (range, 87% to 100%) for selection and consumption combined.

Procedure

Overview. First, MWSO assessments were conducted with 15 snack foods. These large preference assessments served not only as a method for identifying a range of preferred

items but also as pre- and posttest measures of preference. To evaluate preference shifts in a smaller context, five snack foods were selected based on the results from the 15-item MWSO assessment (pretests). Foods that represented different preference values (e.g., high, medium, low) were selected. Paired-choice preference assessments were then conducted with the five snack foods to establish a baseline for the pairing and fading assessment. Paired-choice assessments began either the same day as the 15-item MSWO assessments or the following school day. Next, potential reinforcers (activities and condiments) were selected based on the results of MSWO assessments. Once these items were identified, the pairing and fading intervention was implemented within the context of repeated paired-choice assessments. Finally, when the pairing and fading assessment was complete, the initial 15 snacks were reevaluated in MSWO assessments to determine the effects of our procedures in a broader context. These measures were taken either the same day as the pairing and fading assessment or the following school day.

15-item MSWO assessments (pre- and posttest measures of preference). We selected 15 cereals as the formally similar foods to be included in the initial preference assessments for Tim and Susan. Cereals were reported to be a common snack for these children. For Jessica, a survey was given to parents to identify more discrepant preferred and nonpreferred snacks. Her mother was instructed to circle the snacks that Jessica liked and disliked. Snack items consisting of different cereals, crackers, chips, candy, fruits, and vegetables were included in the survey. The results were used to select 15 snacks of differing nutritional values to be included in her initial preference assessments. For Jessica and Tim, five pre- and posttests were conducted. Five pretests but only two posttests were conducted with Susan because she left the preschool just prior to completion of this study.

Prior to the beginning of the initial MSWO assessment, children were allowed to sample

each item. A small, consistent portion of each snack (e.g., one slice of a carrot or one flake of cereal) was placed on 15 small plates. The plates were arranged in a semicircle on a table in front of the child in an arbitrary order. The experimenter named each snack in the array prior to the first trial. The child was instructed to select a snack by removing it from the table and consuming it. The selected snack was absent from the array in the subsequent trials. Before the next trial began, the position of the remaining snacks was rotated by taking the snack on the far left, placing it on the far right, and adjusting the other snacks so that they were equally spaced. This process continued until all of the snacks had been chosen.

The results of these assessments provided a hierarchy of preferences. The snacks were ranked 1 through 15, with 1 being the most preferred and 15 being the least preferred. A mean rank for each snack was derived from the five MSWO assessments. From this hierarchy, the snacks were partitioned into five groups with three snacks in each group. The top three (mean rank of 1 to 3) were in the first group, the following three (mean rank of 4 to 6) were in the second group, and so on. One snack from each group was selected to provide a smaller context from which to evaluate the effects of paired reinforcement and fading.

Condiment and activity preference assessments. Additional MSWO assessments were conducted to identify a preferred condiment and activity to pair with the target snack. These assessments were conducted after baseline but before implementation of the intervention. Preference assessments were conducted with the target low-preference snack paired with multiple condiments. For example, Jessica's least preferred target snack was green peppers; therefore, a preference assessment was conducted with a variety of condiments (e.g., salad dressings, Easy Cheese[®], ketchup, peanut butter, etc.) on the green peppers. A variety of condiments were

also assessed for Tim's and Susan's target snacks (cereals) such as honey, applesauce, sugar, peanut butter, jelly, and chocolate. The target snack without a condiment was also included in the array to ensure that having a condiment on the snack was more preferred than the snack alone. During this assessment, condiments were placed on top of the snacks. The condiment amounts were selected so that the condiment covered the snack. Condiment preference assessments were conducted with each child until preferences were relatively stable; four condiment assessments were conducted with Tim, three with Susan, and two with Jessica. The most preferred condiment was used in the pairing and fading assessment.

MSWO assessments conducted with activities involved activities that could eventually be systematically faded (i.e., audio stimulation could be systematically dialed down). Activities included in the assessment included a variety of movies, music, and toys such as Play-doh[®] and Legos[®]. Assessments were conducted until preferences were relatively stable; three, five, and two activity preference assessments were conducted for Tim, Susan, and Jessica, respectively. The three most highly preferred activities were included in the pairing and fading assessment. Three activities were selected so that the children could be given a choice of activities each day.

Reinforcement pairing and fading assessment.

Baseline sessions consisted of paired-stimulus assessments with the five assessment snacks extracted from the MSWO assessment rankings. Pairs of stimuli were presented to the children on spoons that were placed on tiny plates. The pairs were presented in a random order, and the right or left placement of each item was rotated every other session. At the start of each trial, the child was instructed to select one of the two items and consume it. The trial ended after 1 min expired or after the child said that he or she was done and showed a clean mouth. Consumption was then scored and the next trial

began. When the preference hierarchy was stable, the reinforcement pairing phase began.

Paired-choice assessments were used for the evaluation of reinforcement pairing and fading because preliminary data (not included in the study) suggested that the MSWO assessments yielded variable preference patterns over time, and 1 of the children for whom this was the case stated that she liked to "save the best for last." This sort of rule was not likely to affect the results of paired assessments because not choosing a preferred item results in omission of the item, whereas the consumption of the preferred item is simply delayed in the MSWO assessment.

The snack with the lowest mean rank in baseline was selected for pairing. Paired-stimulus assessments were conducted as in baseline, with the exception that social, edible (condiment), and activity reinforcers now accompanied the target snack. Specifically, when the target snack was presented in this condition, it was paired with a specific amount of a preferred condiment placed under the snack item. The condiment was placed under the snack item in this assessment to increase the likelihood that the food item and not the condiment would influence selections towards the close of the fading procedure. Tim's Shredded Wheat[®] was paired with 3.0 ml of maple syrup, Susan's corn flake was paired with 2.8 ml of Marshmallow Creme[®], and 2.8 ml of Easy Cheese[®] was placed under a green pepper for Jessica. These initial amounts were selected based on the approximate amounts that were placed on the snacks during the condiment preference assessment. In addition, after selection of the target snack, the children were provided with continuous attention (for 1 min), and access to 1 min of a preferred movie (after entering the session room each day, the child was given a choice between the three movies that had been identified as preferred in an earlier assessment). If the child selected any snack other than the target snack, the experimenter provided access

Table 1
Fading Schedule for Tim

Fading step	TV placement (degrees)	TV volume	Condiment (ml)	Intervals of attention
Baseline			0.0	0
1	20	11	3.0	20
2	20	11	3.0	19
3	20	10	2.8	18
4	40	10	2.8	17
5	40	9	2.6	16
6	40	9	2.4	15
7	60	8	2.2	14
8	60	8	2.0	13
9	60	7	1.8	12
10	80	7	1.6	11
11	80	6	1.4	10
12	80	6	1.2	9
13	100	5	1.0	8
14	100	5	0.8	7
15	120	4	0.6	6
16	120	4	0.6	5
17	140	3	0.4	4
18	140	3	0.4	3
19	160	2	0.2	2
20	160	2	0.2	1
21	180	0	0.175	0
22	180	0	0.15	0

to the item and did not provide access to any other social or material reinforcers. Each child was provided with 15 to 30 s of attention between trials.

When the target snack moved up to the first rank for two to four consecutive sessions, fading was initiated. The condiment, attention, and activity were simultaneously and gradually eliminated according to a predetermined schedule (for an example of a fading schedule, see Table 1 for that used with Tim). The preferred condiments were eliminated by gradually reducing the amount paired with the target snack until the target snack was once again presented alone (which occurred with Tim and Susan only). The movies were eliminated in two ways. First, the volume on the television was gradually turned down until there was no sound, and second, the television was gradually turned away from the child until the back of the television was facing the child. The 1-min trial was partitioned into 20 3-s intervals, and attention was eliminated by deleting 3 s of attention at each fading step. This was accomplished by randomly eliminating an interval of attention at

each fading step. The fading schedule included 20 fading steps, followed by a return to baseline. Experimenters progressed through fading steps according to the six fading rules included in Table 2. Additional fading steps (e.g., 21 and 22) were added for Tim and Susan. These steps were added when the rank of the target snack dropped after returning to baseline (see Rule 6 in Table 2).

RESULTS

The five assessment snacks selected for the reinforcement pairing and fading assessment (see pretest rankings in Figure 1) for Tim were, in mean rank from the most preferred to the least preferred, Cocoa Puffs[®], Colossal Squares[®], honey graham squares, Bran Flakes[®], and Shredded Wheat[®]. The assessment snacks for Susan were Cocoa Puffs[®], Cinnamon Toast Crunch[®], Frosted Flakes[®], corn flakes, and Corn Crisp[®]. The five assessment snacks selected for Jessica were Gummy Bears[®], Skittles[®], M&Ms[®], potato chips, and green peppers.

Table 2
Fading Rules

Rule	Description
1	If the target snack retains rank 1, move onto the next fading step.
2	If the rank of the target food drops from rank 1 to ranks of 2 or 3 and remains at rank 2 or 3 for two consecutive sessions, progress to the next fading step. If the rank of the target food drops from rank 1 to ranks of 2 or 3 and intermittently occupies two of these ranks for four consecutive sessions, progress to the next fading step.
3	If the target food drops to rank 4 or 5, return to the previous fading step and remain there until the target food is ranked 1, 2, or 3 for three consecutive sessions.
4	If you return to the previous fading step three times, remain at that step until the rankings are stable and end the assessment.
5	During return to baseline, if the target food drops to rank 2 or 3, return to Step 20 and continue following fading rules.
6	During the return to baseline, if the target food drops to rank 4 or lower, return to Step 20 and add additional, more incremental fading steps.

The three most preferred movies used in the reinforcement pairing and fading assessments were *The Lion King*, *A Bug's Life*, and *The Fox and the Hound* for Tim; *Rhythm & Blue*, *A Bug's Life*, and *Arthur* for Susan; and *The Little Mermaid*, *Toy Story*, and *Aristocats* for Jessica. The most preferred condiments were maple syrup (Tim), Marshmallow Creme[®] (Susan), and Easy Cheese[®] (Jessica). Data for the complete activity and condiment preference assessments are available from the second author.

Data for the least preferred snack (target snack) from the reinforcement pairing and fading assessment can be found in Figure 2. (Data from the other four snacks included in the preference assessment are not shown.) The least preferred item for Tim during baseline was Shredded Wheat[®], with ranks ranging from 3 to 5 and a mean of 4.6. Ranks of his other items during baseline were consistent with the initial MSWO assessments; the mean ranks were 1.6 for honey graham squares, 2 for Cocoa Puffs[®], 2.6 for Colossal Squares[®], and 4.2 for Bran Flakes[®]. When Shredded Wheat[®] was paired with reinforcement, this item immediately moved up to a rank of 1 and was selected first for 14 sessions. A slight disruption was observed at Fading Step 13, but Tim continued to select the Shredded Wheat[®] first until the return to baseline, in which no remnants of the paired

reinforcement were present. Selecting Shredded Wheat[®] instead of the other items was clearly influenced by the availability of a small amount of additional reinforcement. Shredded Wheat[®] was ranked first at Step 20 when only 0.2 ml of maple syrup was placed under it, the television screen was no longer visible, the volume on the television was set at 1 (barely audible), and he received 3 s of attention. By contrast, Shredded Wheat[®] ranked much lower during the baseline probes in which these minute amounts of reinforcement were absent. Attempting to fade using more incremental steps was not successful. The assessment ended with Shredded Wheat[®] occupying either rank 4 or 5 over the last eight sessions.

The item most consistently ranked the lowest for Susan was corn flakes, with ranks ranging from 4 to 5 and a mean of 4.7 (Figure 2). During baseline the mean rank of Susan's remaining four items (not shown in Figure 2) were Cocoa Puffs[®] (ranked 1), Cinnamon Toast Crunch[®] (ranked 2), Frosted Flakes[®] (ranked 3.3), and Corn Crisp[®] (ranked 3.8). When reinforcement was paired with corn flakes, this item immediately moved up to a rank of 2 and maintained a rank of 1 or 2 for 28 sessions. Susan continued to select the corn flake at Step 20 when the reinforcers were greatly marginalized. During the return to baseline, corn flakes dropped to a rank of 5.

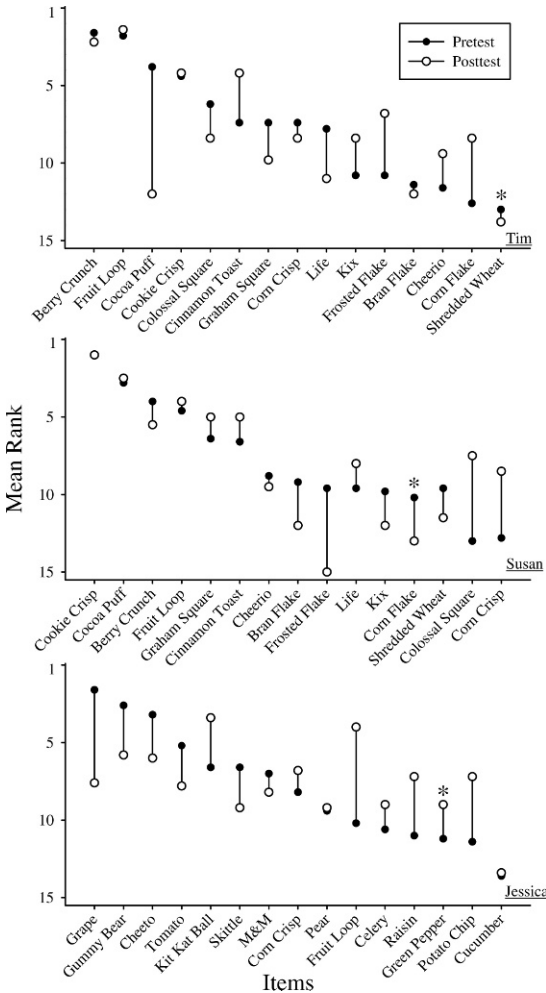


Figure 1. Pre- and post-MSWO preference assessments of 15 snack foods for Tim, Susan, and Jessica. Filled circles represent pretests, and open circles represent posttests. Asterisks above data points represent snacks that were paired with reinforcement.

We returned to Step 20, added additional fading steps, and then returned to an earlier fading step. However, we were unable to recover a rank of 1 or 2 for corn flakes.

The least preferred item during the reinforcement and pairing baseline for Jessica was the green pepper, with ranks ranging from 3 to 5 and a mean of 4.6 (Figure 2). During baseline, the mean ranks of Jessica’s remaining four items (not shown in Figure 2) were Gummy Bears® (ranked 1), Skittles® (ranked

3), M&Ms® (ranked 3.2), and potato chips (ranked 3.4). Green pepper immediately moved up to a rank of 1 when it was paired with reinforcement and maintained the rank of 1 or 2 for 22 sessions. Variability in rankings was observed at Step 14. High rankings were not recovered by returning to a previous step; the assessment ended with highly variable rankings of the green pepper, which were just slightly higher than those observed during baseline.

Figure 1 depicts the results from the pre- and post-MSWO assessments for each child. The 14 snack items not paired with reinforcement moved an average rank of 2.4 in either direction (range, 2.1 to 2.8). Therefore, a shift in rank above 3 units might be noteworthy. The mean rank for Shredded Wheat® was 13.0 in the first assessment and 13.8 in the second assessment for Tim. The mean rank for corn flakes was 10 in the first assessment and 13 in the second assessment for Susan. The mean rank for the green pepper was 11.2 in the first assessment and 9 in the second assessment for Jessica.

DISCUSSION

An immediate and sustained effect for paired reinforcement was observed across children. These results are consistent with the results of Ahearn (2003), Hanley et al. (2003), Mueller et al. (2004), and Piazza et al. (2002) in that preference for an originally less preferred item increased when it was paired with a highly preferred item. If strong preferences for the target snack were maintained in the absence of the paired reinforcement, we would have concluded that preference had been changed via flavor–flavor conditioning (stimulus–stimulus pairings). However, the ranks of the target snacks decreased as reinforcement was eliminated for all children. The pre- and post-MSWO assessments also showed a lack of preference shift in a broader context (14 other snack choices as opposed to the four options during the paired-choice assessments). Although the posttest ranking of one target item (green

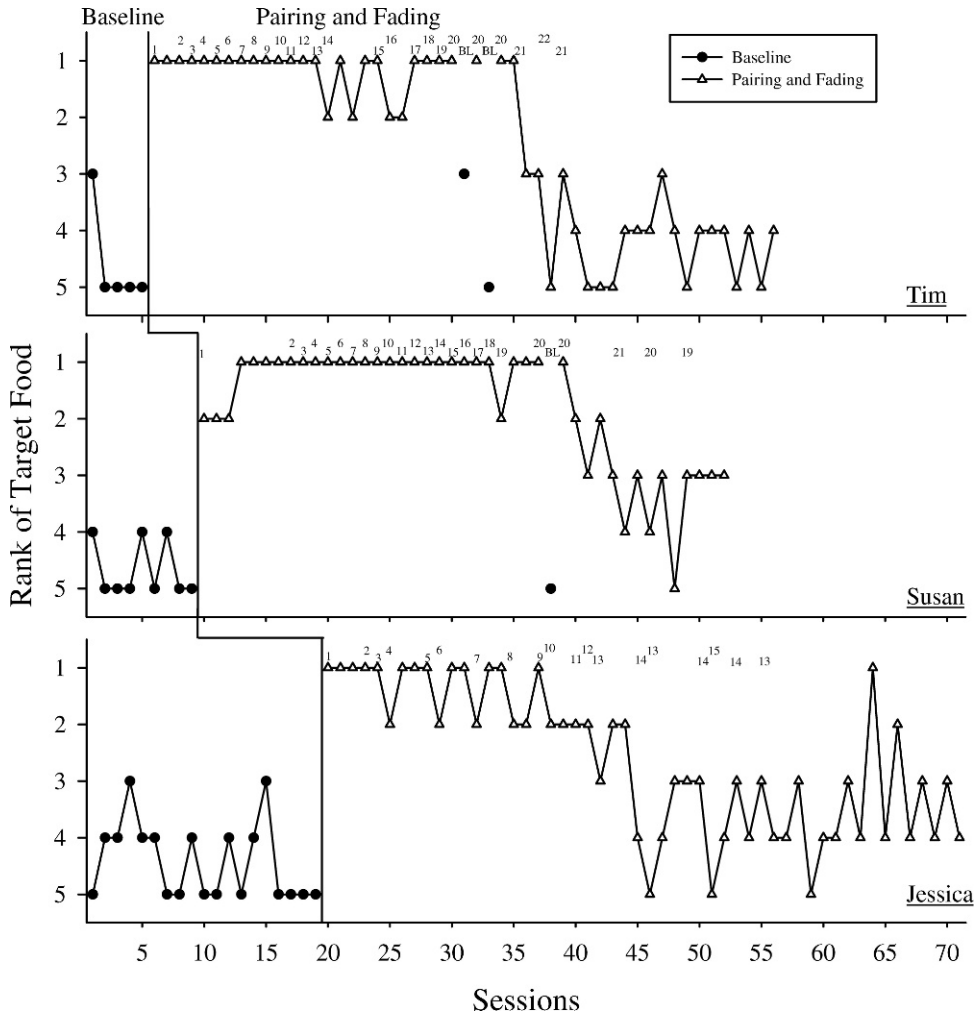


Figure 2. Pairing and fading assessments for Tim, Susan, and Jessica. Circles represent baseline, and triangles indicate pairing and fading sessions. The numbers above the triangles indicate fading steps.

pepper for Jessica) increased compared to the initial MSWO ranking, this change was not greater than the mean change of other items in the assessment. Because strong preferences for the target snacks were not maintained as reinforcement was removed and preference shifts were not observed in subsequent assessments, we can safely conclude that we did not condition a preference via stimulus-stimulus pairings, and the initial shifts in preference were a direct function of the added reinforcers.

It is likely that the initial shifts in preference were a result of differential reinforcement. That is,

the children received highly preferred condiments, movies, and attention only if the target food was selected. The current procedures succeeded in altering the momentary value of the items, as evident by the large shifts in preference following the introduction of the additional reinforcers. However, based on the fact that the target snacks resumed their former status when the added reinforcers were eliminated, it is apparent that our procedures were not successful in altering the permanent value of the items.

Procedural differences between the current study and previous work may account for the

absence of a conditioning effect. For example, Mueller *et al.* (2004) blended the less and highly preferred foods so that the less preferred foods were not readily discernible, at least initially. In the current study, the two foods were not blended, and the children were able to see the less preferred foods at all pairing steps. Strong control of preference by the paired reinforcer may have developed during our assessment but may have been successfully avoided with the procedures described by Mueller *et al.* In addition, previous studies (Kern & Marder, 1996; Mueller *et al.*; Piazza *et al.*, 2002) included the use of escape extinction in the form of representation of the food and nonremoval of the spoon for some of the participants. Trials continued regardless of the child's choices in the current study, and trial time was not increased until the child consumed the target food. If the children did not select and consume the target snack, they were able to consume an alternative snack. Thus, the children could easily avoid consuming the target food in our study; this was not the case in previous studies. Finally, it is plausible that the paired reinforcement may have been more reinforcing for the participants in the Hanley *et al.* (2003, 2006) studies than the paired reinforcement used with the participants in the current study or that the difference in the value of the target activities in the earlier studies was small compared to the difference in the value of the high- and low-preference snacks in the current study.

Our results are similar those of Ahearn (2003), in that preference for an originally less preferred item increased with reinforcement pairing, but the preference shift was not maintained when the paired reinforcement was removed. Our procedures differed from Ahearn's in that we gradually and systematically eliminated the paired reinforcers, but the fading procedure was ultimately not effective in producing a conditioned preference. The results from the current study and Ahearn suggest that

flavor-flavor conditioning (Capaldi, 1996) may be more elusive than previously thought, and may not be the most effective method to alter food preferences for typically developing preschoolers. However, it is possible that our measurement system was insensitive to changes in the value of the target snacks. For instance, Jessica may not have chosen green peppers over other snack options, but she may have consumed more green peppers when presented singly following our intervention than before it (similar to the results reported by Mueller *et al.*, 2004). It is also possible that a more gradual schedule for eliminating the paired reinforcers, with special attention paid to transitioning from small magnitudes of reinforcement to no reinforcement, might have resulted in successful conditioning.

Although paired reinforcement was effective in altering preference with all children, and this effect persisted even under conditions involving minute amounts of the paired reinforcement for 2 children, it is not clear from these data whether the activity, condiment, social interaction, or all of the paired items were responsible for the initial shift in preference. Because we were able to strengthen preference for less preferred snacks with paired reinforcement, it may be reasonable to continue to embed target snacks in these presumably more reinforcing contexts to maintain consumption of these snacks. It would be difficult to justify the continued use of a condiment to increase consumption of healthy snacks, unless a very small amount or intermittent use of high-sugar or high-fat condiments were successful for maintaining consumption of healthy snacks. At this point, it seems important to determine whether intermittent condiment pairings would be successful as opposed to the gradual and complete elimination of the condiment. It would likely be acceptable to continue social interaction and possibly some auditory or visual stimulation during snack periods. Future research should determine whether desirable shifts

in food preferences can be achieved with only social and activity-based reinforcers. Previous work by Birch, Zimmerman, and Hind (1980) has suggested that pairing a food item with adult attention may increase preference for that food item. However, the measure of preference was very different from that of the current study. Birch et al. relied on verbal report of preference from the children as opposed to directly observed preferences. In addition, some studies suggest that using preferred foods as rewards (Birch et al.) as well as peer modeling (Birch, 1980) may be effective alternative methods for developing preferences for typically nonpreferred foods in preschoolers.

Effective intervention for and prevention of obesity are important goals, given the current epidemic with children and adults in the United States and around the world (Gill, King, & Caterson, 2005). Interventions that target increased consumption of healthy foods are relevant. Repeatedly exposing children to healthy snacks and restricting access to less healthy snacks are clearly effective methods for increasing children's intake of healthy snacks. However, restricting access to unhealthy foods may become increasingly difficult as children grow older and more independent. Therefore, helping children to make healthy choices in the presence of less healthy choices may be necessary. These challenging circumstances were arranged in the current study by presenting young children less preferred snack options in the presence of highly preferred snack options. These challenging conditions were likely responsible for the marginal outcomes of these intensive behavioral interventions, which previously have been shown to both alter the absolute value of food (Mueller et al., 2004) and condition preferences for nonfood items (Hanley et al., 2003, 2006).

An additional important implication of our results is that although any stimulus may be conditioned to be a reinforcer (Miltenberger, 1997), the specific conditions have not been

well documented. Questions regarding the amount of pairing required, the relevant time frames for conditioning to occur, and the strategy for removing the small amounts of paired reinforcement while maintaining the conditioned effect remain to be answered. Although researchers continue to evaluate the parameters of effective preference conditioning, additional research should also be directed towards identifying alternative interventions for promoting independent healthy snack selections by typically developing young children.

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Received August 1, 2005

Final acceptance April 9, 2007

Action Editor, Iser DeLeon