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FUNCTIONAL ANALYSIS AND TREATMENT OF MULTIPLY CONTROLLED INAPPROPRIATE MEALTIME BEHAVIOR

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Functional analyses identified children whose inappropriate mealtime behavior was maintained by escape and adult attention. Function-based extinction procedures were tested individually and in combination. Attention extinction alone did not result in decreases in inappropriate mealtime behavior or a significant increase in acceptance. By contrast, escape extinction alone resulted in a decrease in inappropriate mealtime behavior and an increase in acceptance. However, inappropriate mealtime behavior did not decrease to clinically acceptable levels. A combined extinction technique (i.e., escape and attention extinction) resulted in a decrease in inappropriate mealtime behavior to clinically acceptable levels and high and stable acceptance.

DESCRIPTORS: escape extinction, food refusal, food selectivity, negative reinforcement, pediatric feeding disorders

Studies on treatment for feeding disorders have provided support for the hypothesis that negative reinforcement (i.e., meal termination) plays a role in the maintenance of inappropriate mealtime behavior (Cooper et al., 1995; Hoch, Babbitt, Coe, Krell, & Hackbert, 1994; Kerwin, Ahearn, Eicher, & Burd, 1995; Patel, Piazza, Martinez, Volkert, & Santana, 2002; Piazza, Patel, Gulotta, Sevin, & Layer, 2003; Reed et al., 2004). For example, Cooper et al. evaluated multicomponent treatment packages for 4 children with feeding disorders and found that putative escape extinction (i.e., nonremoval of the spoon) was always an active variable in treatment. Similarly, Patel et al. showed that nonremoval of the spoon was necessary to increase acceptance and mouth clean (a product measure of swallowing) for 3 children with feeding disorders.

The previously cited studies provided only indirect evidence regarding the role of negative reinforcement because putative escape extinction procedures (e.g., nonremoval of the spoon, physical guidance) were implemented in the absence of experimental functional analysis data demonstrating that escape functioned as reinforcement. That is, negative reinforcement was assumed to maintain inappropriate mealtime behavior because putative escape extinction procedures were effective as treatment. In addition, therapists ignored inappropriate behavior and delivered preferred items noncontin-

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gently or differentially (i.e., attention and tangible extinction). Thus, data from these studies do not address the potential role of positive reinforcement (e.g., access to adult attention or tangible items) in the maintenance of feeding problems (Cooper et al., 1995; Hoch et al., 1994; Kerwin et al., 1995; Patel et al., 2002; Piazza, Patel, Gulotta, Sevin, & Layer, 2003; Reed et al., 2004).

Studies that combine escape extinction and positive reinforcement suggest that positive reinforcement enhances treatment effects for some children (Piazza, Patel, Gulotta, Sevin, & Layer, 2003; Reed et al., 2004). Reed et al. and Piazza, Patel, Gulotta, Sevin, and Layer showed that when positive reinforcement was combined with escape extinction, inappropriate behavior or negative vocalizations were reduced for some participants relative to escape extinction alone. Although positive reinforcement was beneficial for treatment, it is not clear whether any of the participants' inappropriate mealtime behavior was maintained by positive reinforcement because functional analyses were not conducted.

Piazza, Fisher, et al. (2003) conducted analogue functional analyses of the inappropriate mealtime behavior of 15 children, using a modification of the procedure developed by Iwata, Dorsey, Slifer, Bauman, and Richman (1982/1994). Negative reinforcement (i.e., escape from bites of food) was the most frequently identified maintaining variable, with 90% of children with differentiated functional analyses showing sensitivity to escape as reinforcement. However, multiple functions (i.e., access to adult attention or tangible items) were identified for 80% of the children who showed differential responding. These results suggest that negative reinforcement may play a primary role in the maintenance of feeding problems, but a significant number of children with feeding disorders may be sensitive to other sources of reinforcement.

Identification of all functions and implementation of function-specific treatments are critical to treatment success when behavior is multiply controlled. For example, Smith, Iwata, Vollmer, and Zarcone (1993) illustrated the importance of identifying and treating all functions of problem behavior. In the Smith et al. study, the multiply controlled self-injurious behavior (SIB) of 2 of 3 participants decreased only when treatment that matched both functions was implemented, suggesting that extinction procedures are procedurally different and produce different behavioral effects when the same response topographies are maintained by different reinforcers. These results suggest that multiple treatment components may be necessary when behavior is multiply controlled; however, we know of no published studies that have systematically assessed and treated multiply controlled feeding problems. Therefore, the purpose of the current investigation was to identify children with multiply controlled inappropriate mealtime behavior and to assess the extent to which treatment of all functions (i.e., extinction procedures matched to functions individually and in combination) was necessary.

METHOD

Participants and Setting

Four children who had been admitted to a pediatric feeding disorders program participated in the study because a functional analysis indicated that their inappropriate mealtime behavior was maintained by escape from bites or drinks and adult attention. Prior to admission, each child underwent a comprehensive interdisciplinary evaluation to rule out all medical causes for ongoing feeding problems. Each child was cleared as a safe oral feeder (i.e., no evidence of aspiration or the inability to swallow). All sessions were conducted in rooms (4 m by 4 m) equipped with one-way observation and sound monitoring. Age-appropriate seating (i.e., high chair, chair), food or drinks, and utensils were present during all sessions. Therapists from the feeding program conducted all functional analysis and treatment sessions for

Tyler and Savannah. Matthew's and Ella's mothers conducted all of their sessions after reviewing a written protocol and role playing the procedures with the therapists.

Tyler was a typically developing 5-year-old boy with a medical history of two hernia surgeries. Based on the pediatric growth charts from the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (www.cdc.gov/growthcharts/), his weight and height for his age were between the 10th and 25th percentiles. He consumed a limited variety of solid foods (e.g., oatmeal, yogurt, crackers, cookies, fruit snacks) in specific flavors and brands, and the majority of his intake was liquid (i.e., Pediasure, Danimals drinkable yogurt) at highly variable daily intake amounts. Throughout the study, Tyler received supplemental oral feedings (120 cc liquids) and a single serving of oatmeal or crackers at home (6:45 a.m. and 7:00 p.m.) and in the clinic (11:15 a.m., 1:00 p.m., and 4:30 p.m.) approximately 2.5 hr prior to the first meal in the clinic and following meals in the clinic, with 1 to 3.5 hr between meals.

Savannah was 3 years 6 months old and had been diagnosed with developmental delays. Her medical history included gastrostomy (G-) tube dependence, gastroesophageal reflux disease (GERD), oral motor dysfunction, bronchopulminary dysplasia, hypotonia, and left-sided facial nerve paralysis. Her weight for age was between the 5th and 10th percentiles, and her height for age was below the 3rd percentile. At admission, she was receiving 100% of her total daily caloric requirement via G-tube feedings. During this study, she received tube feedings of Pediasure at home at approximately 8:30 a.m. (140 cc), 6:30 p.m. (140 cc), and 9:30 p.m. (240 cc) and in the clinic at approximately 1:30 p.m. (240 cc) and 4:30 p.m. (140 cc). These two in-clinic feedings were delivered approximately 2 hr before study sessions.

Matthew was a 4-year-old boy who had been diagnosed with developmental delays and a history of GERD. His weight for age was below the 3rd percentile, and height for age was between the 10th and 25th percentiles. At admission, he was consuming Pediasure and a limited variety of solid foods including dry cereal, crackers, french fries, hot dogs, and cheese sandwiches. During this study, Matthew received oral feedings at approximately 6:30 a.m., 12:00 p.m., 3:00 p.m., 6:30 p.m., and 8:30 p.m., consisting of Pediasure and a variety of five different table-texture foods. All supplemental feedings were offered at home, one approximately 2 hr prior to and the remainder following clinic sessions.

Ella was a 4-year-old girl who had been diagnosed with developmental delays and whose medical problems included mild vision impairments due to prenatal exposure to cocaine, syphilis, and gonorrhea. Her weight for age was below the 3rd percentile, and height for age was at the 3rd percentile. At admission, she was consuming Pediasure and approximately 10 table-texture foods (e.g., dry cereal, cookies, pizza, chicken nuggets). During this study, Ella received oral feedings at approximately 6:30 a.m., 12:00 p.m., 2:00 p.m., and 7:00 p.m., consisting of Pediasure and table-texture foods. All of these feedings were offered at home at least 2 hr prior to clinic sessions.

Response Measurement and Data Collection

Therapists used laptop computers to record occurrence or nonoccurrence of acceptance for each bite presentation and frequency of inappropriate mealtime behavior. The number of acceptances was divided by the number of bite presentations and converted to a percentage. Inappropriate mealtime behavior was converted to responses per minute by dividing the number of behaviors in the session by the total length of the time that the behaviors could have occurred (i.e., the spoon or cup was within arm's reach of the participant). The observer activated a timer when the feeder placed the spoon or cup within arm's reach of the participant and deactivated

the timer when the feeder removed the spoon or cup.

Acceptance was defined as deposit of the entire bite into Tyler's or Matthew's mouth within 5 s of presentation and as any liquid passing the plane of Savannah's lips within 5 s of the drink presentation. *Acceptance* was defined as Ella actively leaning forward toward the bite presentation or opening her mouth without crying, whining, or other inappropriate behavior, thus allowing the entire bite to be deposited into her mouth within 5 s of presentation. The definition of acceptance was refined with Ella to ensure that increases in acceptance were due to changes in child behavior (i.e., active acceptance) rather than feeder behavior (i.e., increased efficiency in depositing bites at any opportunity during escape extinction).

Inappropriate mealtime behavior for all participants included *head turning* (moving the head at least 45° from the spoon or cup during presentation) and *disruptions* (each instance of the child's hand contacting the spoon or cup, food, or the feeder from elbow to hand during presentation; throwing food or utensils; blocking access to mouth with hand, bib, or toys).

Interobserver Agreement and Procedural Integrity

Two observers recorded child and feeder behavior simultaneously but independently during 20% (Tyler), 34% (Savannah), 32% (Matthew), and 50% (Ella) of sessions during the functional analysis and during 31% (Tyler), 39% (Savannah), 31% (Matthew), and 31% (Ella) of treatment sessions. Interobserver agreement was calculated by partitioning each session into 10-s intervals. Total agreement coefficients for acceptance were calculated by dividing the number of agreements (occurrence and nonoccurrence) by the total number of agreements (occurrence and nonoccurrence) plus disagreements and converting this ratio to a percentage. Agreement for acceptance was 95% (range, 80% to 100%), 97% (range, 83% to 100%), 96% (range, 76% to 100%), and 93% (range, 77% to 100%) during the treatment evaluation for Tyler, Savannah, Matthew, and Ella, respectively.

Exact agreement coefficients for inappropriate mealtime behavior were calculated by dividing the number of 10-s intervals in which the observers scored exactly the same frequency of inappropriate mealtime behavior by the total number of 10-s intervals and converting this ratio to a percentage. Interobserver agreement for inappropriate mealtime behavior during the functional analysis was 95% (range, 92% to 100%) for Tyler, 92% (range, 78% to 100%) for Savannah, 89% (range, 82% to 95%) for Matthew, and 98% (range, 88% to 100%) for Ella. Agreement for inappropriate mealtime behavior during the treatment evaluation was 97% (range, 90% to 100%) for Tyler, 98% (range, 80% to 100%) for Savannah, 95% (range, 37% to 100%) for Matthew, and 95% (range, 68% to 100%) for Ella.

We evaluated procedural integrity when mothers implemented the assessment and treatment protocols, using the measurement procedures described by Mueller et al. (2003). Observers evaluated procedural integrity by scoring Matthew's and Ella's mothers' implementation of instructions, prompts, and consequences for each bite presented. Mothers were required to deliver every prompt and consequence correctly for each bite presentation for the prompt or consequence to be scored as correct for that bite presentation. Observers scored correct instructions when the mother delivered the verbal instruction "take a bite" and placed the utensil with an accurately sized bite at the child's mouth within 5 s of the time specified in the protocol. Observers scored correct prompts when the mother checked for a mouth clean 30 s after the bite entered the child's mouth and delivered the instruction to "swallow your bite" within 5 s of when specified in the protocol. Observers scored correct consequences when the mother deliv-

ered verbal or physical praise within 5 s of when it was scheduled to be delivered according to the protocol and delivered a reinforcer within 5 s of the behavior being reinforced. The percentage of bites with correct procedural integrity was calculated by dividing the number of correctly implemented bite presentations by the total number of bite presentations. Integrity data were collected for 54% and 100% of sessions for Matthew and Ella, respectively. Mean correct instructions were 100% and 99%, correct prompts were 99% and 96%, and correct consequences were 97% and 95% for Matthew and Ella, respectively. Mothers received postsession feedback regarding any incorrect procedural implementations (Mueller et al., 2003).

General Procedure

The number of sessions per meal varied based on the duration of each session. Meals lasted 30 to 45 min and were conducted approximately 30 min to 2.5 hr apart. Sessions consisted of five bite or drink presentations, but were terminated after 30 min even if the feeder did not present all five bites or drinks (e.g., if the child refused bites or drinks during escape extinction sessions). Feeders conducted approximately five meals each day with three to five sessions per meal for Tyler and Savannah during their day-treatment admission. Approximately eight to 12 sessions were conducted during daily 2-hr outpatient visits for Matthew and Ella.

The feeder presented bites or drinks approximately once every 30 s by holding a spoon or cup 2.5 cm from the child's lips and saying "take a bite." Acceptance resulted in brief praise (e.g., "good job, taking your bite") across all conditions. The feeder presented 2.75 cc of Carnation Instant Breakfast and milk in a Flexi Cut Cup to Savannah, a level bolus of table puree-textured food on a Maroon Spoon to Tyler and Ella, and table-textured food (pieces were approximately 0.6 cm by 0.6 cm) on a Maroon Spoon to Matthew. Food items were selected for Tyler, Matthew, and Ella from the protein, starch, fruit, and vegetable food groups based on direct observation and parental report of nonpreferred food status. For Tyler and Ella, the feeder presented one food item from each of the four food groups during each five-bite session and rotated bite presentations among the four foods, resulting in presentation of three foods once and one food twice. For Matthew, the feeder presented the same food item for each of the five bites in the session. Selection of food texture and bite size was based on the child's oral motor skills, prior experiences with eating, and the recommendations of the occupational therapist or speech language pathologist.

The feeder presented a colored card assigned to the specific condition on the tray or table in front of the child and provided the rules for that condition the first time he or she conducted a condition within a meal. The feeder presented only the colored card when repeating the same condition within a meal. We did not evaluate the children's ability to discriminate between the colored cards or whether the cards exerted discriminative control of their behavior, because this was not a central focus of the study.

Functional Analysis Design and Procedure

The functional analyses used procedures described by Piazza, Fisher, et al. (2003) and included control, escape, and attention conditions for all participants (Table 1). Test conditions were selected based on direct observation of preassessment parent-fed meals and parental report of the consequences provided for inappropriate mealtime behavior in the natural environment.

Control. The feeder presented highly preferred toys identified through paired-stimulus (Fisher et al., 1992) and brief stimulus (Roane, Vollmer, Ringdahl, & Marcus, 1998) preference assessments on the high chair tray or the table and interacted (e.g., chatting or singing) with the child throughout the session. The feeder did not provide a differential consequence for inappropriate mealtime behavior (i.e., continued interaction as if the behavior did

Table 1
Functional Analysis

Condition	Consequence for inappropriate mealtime behavior	Bite presentation
Control	No differential consequence	Remained at child's lips for 30 s
Escape	20 s of escape	Removed for 20 s
Attention	20 s of attention	Remained at child's lips

not occur). The spoon or cup remained approximately 2.5 cm from the child's lips following inappropriate mealtime behavior and for the duration of the 30-s interval. The feeder removed the spoon or cup at the end of the 30-s interval and presented a new bite of food or drink immediately. The purpose of this condition was to observe the frequency of inappropriate mealtime behavior when the child had free access to attention and preferred items while the therapist presented bites or drinks on a fixed-time (FT) schedule.

Escape (ESC). The feeder removed the spoon or cup for 20-s if the child engaged in inappropriate mealtime behavior. The feeder presented the next bite or drink immediately following the 20-s break, which resulted in the feeder presenting some bites before and some bites after the expiration of the FT 30-s schedule, depending on when the inappropriate mealtime behavior occurred in the interval. That is, inappropriate mealtime behavior that occurred early in the interval resulted in the therapist presenting the next bite before the expiration of the FT 30-s interval, and inappropriate mealtime behavior that occurred later in the interval resulted in the therapist presenting the next bite after the expiration of the FT 30-s interval. However, the overall mean bite rate approximated the FT 30-s schedule. The feeder did not provide any other differential consequence following inappropriate mealtime behavior (e.g., the feeder did not reprimand the child), and toys were not available. The purpose of this condition was to assess the effects of escape as reinforcement for inappropriate mealtime behavior.

Attention (ATTN). Inappropriate mealtime behavior resulted in 20 s of attention in the form of coaxing (e.g., "you like peas"), reprimands (e.g., "that's not nice"), and statements of concern (e.g., "it's okay"). The spoon or cup remained 2.5 cm from the child's lips following inappropriate mealtime behavior and for the duration of the 20-s attention interval. The feeder removed the spoon or cup and immediately presented a new bite of food or drink to the child at the end of the 20-s interval, which resulted in the feeder presenting some bites before and some bites after the expiration of the FT 30-s schedule, depending on when the inappropriate mealtime behavior occurred in the interval (as described above for the escape condition). Toys were not available. The purpose of this condition was to assess the effects of attention as reinforcement for inappropriate mealtime behavior.

Treatment Design and Procedure

A combination reversal (ABABCDC for Tyler, ABCBC for Savannah, ABABCBC for Ella) and multielement design was used to evaluate levels of acceptance and inappropriate mealtime behavior in the presence and absence of extinction procedures matched directly to each maintaining variable in isolation and in combination for Tyler, Savannah, and Ella. The A phase was the attention and escape baseline, B was the multielement comparison of escape extinction plus attention versus attention extinction plus escape, C was escape extinction and attention extinction, and D was escape extinction plus attention.

A combination multiple baseline and multielement design was used to evaluate variations of extinction procedures matched directly to each maintaining variable individually and in combination for Matthew. A multiple baseline

Table 2
Treatment Evaluation

Condition	Consequences for inappropriate mealtime behavior	Bite presentation
Attention and escape baseline	20 s of attention, 20 s of escape	Removed for 20 s
Attention extinction plus escape	20 s of escape, no attention	Removed for 20 s
Escape extinction plus attention	20 s of attention, no escape	Remained at child's lips until bite was accepted
Escape extinction and attention extinction	No escape, no attention	Remained at child's lips until bite was accepted

design across three foods was used to evaluate acceptance and inappropriate mealtime behavior in the presence and absence of various extinction procedures (i.e., attention and escape baseline vs. escape extinction plus attention, attention extinction plus escape vs. escape extinction, and attention extinction). A multielement design was used to evaluate responding when extinction was applied to one of the maintaining reinforcement contingencies but not to the other (i.e., escape extinction plus attention vs. attention extinction plus escape).

Attention and escape baseline (ATTN+ESC). Inappropriate mealtime behavior resulted in removal of the spoon or cup and brief attention as described for the functional analysis. The feeder terminated the attention and presented a new bite of food or drink to the child at the end of the 20-s interval, as described above. The bite or drink remained at the child's lips for 30 s if inappropriate mealtime behavior did not occur. The feeder removed the bite or drink and presented a new bite or drink immediately after the 30-s interval (Table 2).

Attention extinction plus escape (AE+ESC). Inappropriate mealtime behavior resulted in removal of the spoon or cup for 20 s. The feeder did not provide any other differential consequence following inappropriate mealtime behavior (e.g., the feeder did not reprimand or coax the child). The feeder presented a new bite of food or drink at the end of the 20-s interval.

Escape extinction plus attention (EE+ATTN). Inappropriate mealtime behavior resulted in 20 s of attention as described above; however, the spoon or cup remained at the child's lips (i.e., nonremoval of the spoon; Hoch et al., 1994). The feeder deposited the bite or drink (Tyler, Savannah, Matthew) at any opportunity. The feeder deposited the bite into Ella's mouth at any opportunity if she did not accept the bite independently within 5 s of initial presentation. The feeder scooped up expelled bites or drinks and re-presented them (placed them back into the child's mouth).

Escape extinction and attention extinction (EE+AE). The escape and attention extinction components of this condition were identical to that described above. That is, the spoon or cup remained at the child's lips, and the therapist provided no differential consequences for inappropriate mealtime behavior.

RESULTS

Figures 1 and 2 show the results of the functional analysis for each participant. Rates of inappropriate mealtime behavior were higher for all 4 children in the escape and attention conditions than in the control condition of the functional analysis. These results suggested that each child's inappropriate mealtime behavior was influenced by both environmental factors (i.e., escape from bite or drink presentations, adult attention).

Figure 3 shows the results of Tyler's treatment across inappropriate mealtime behavior and acceptance. Rates of inappropriate mealtime behavior were high, and levels of acceptance were low during the ATTN+ESC baseline. Rates of inappropriate mealtime behavior remained high ($M = 24$ responses per minute), and levels of acceptance remained low ($M = 3\%$) during both implementations of the

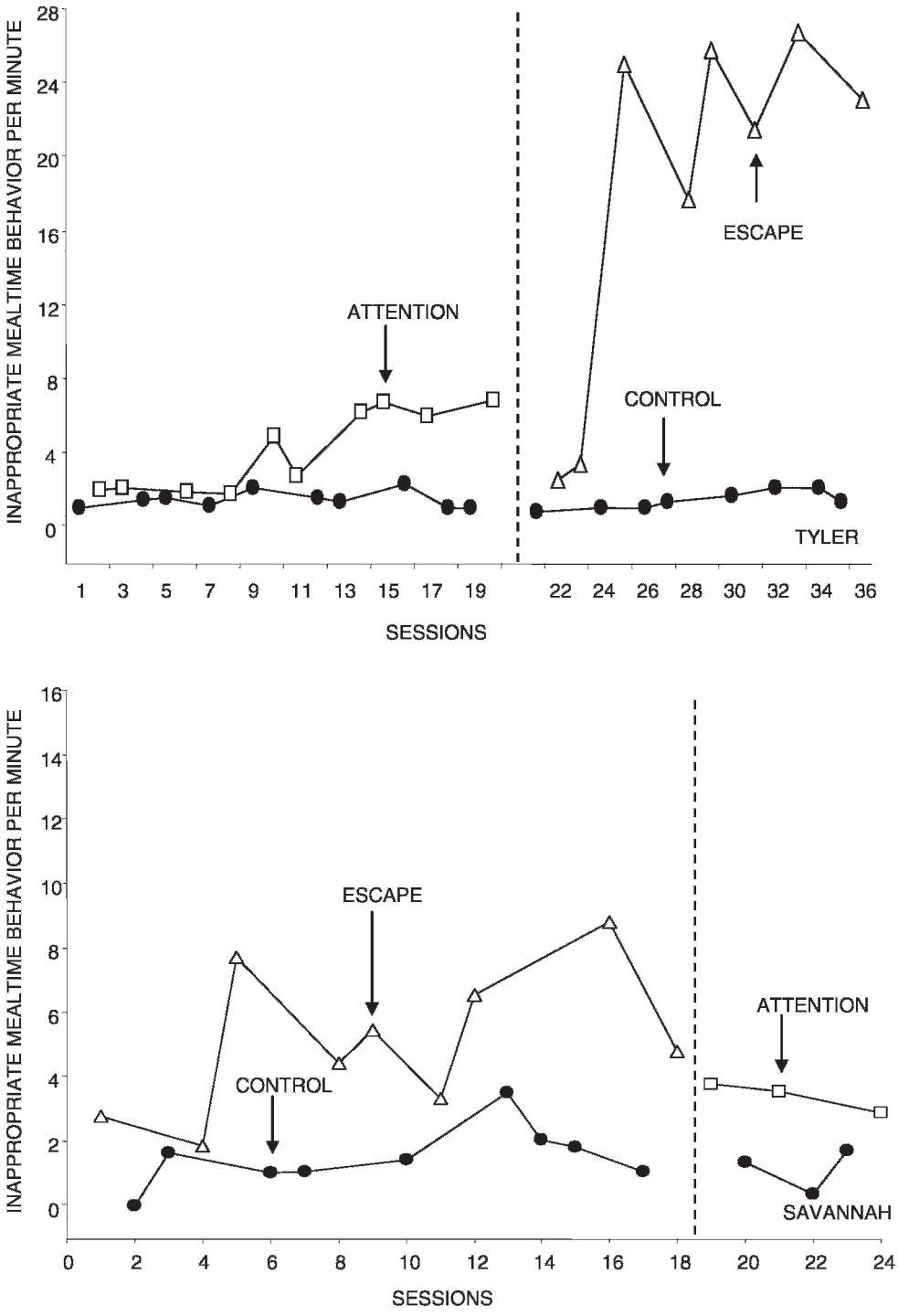

Figure 1. Inappropriate mealtime behavior per minute for Tyler (top) and Savannah (bottom) during the functional analysis.

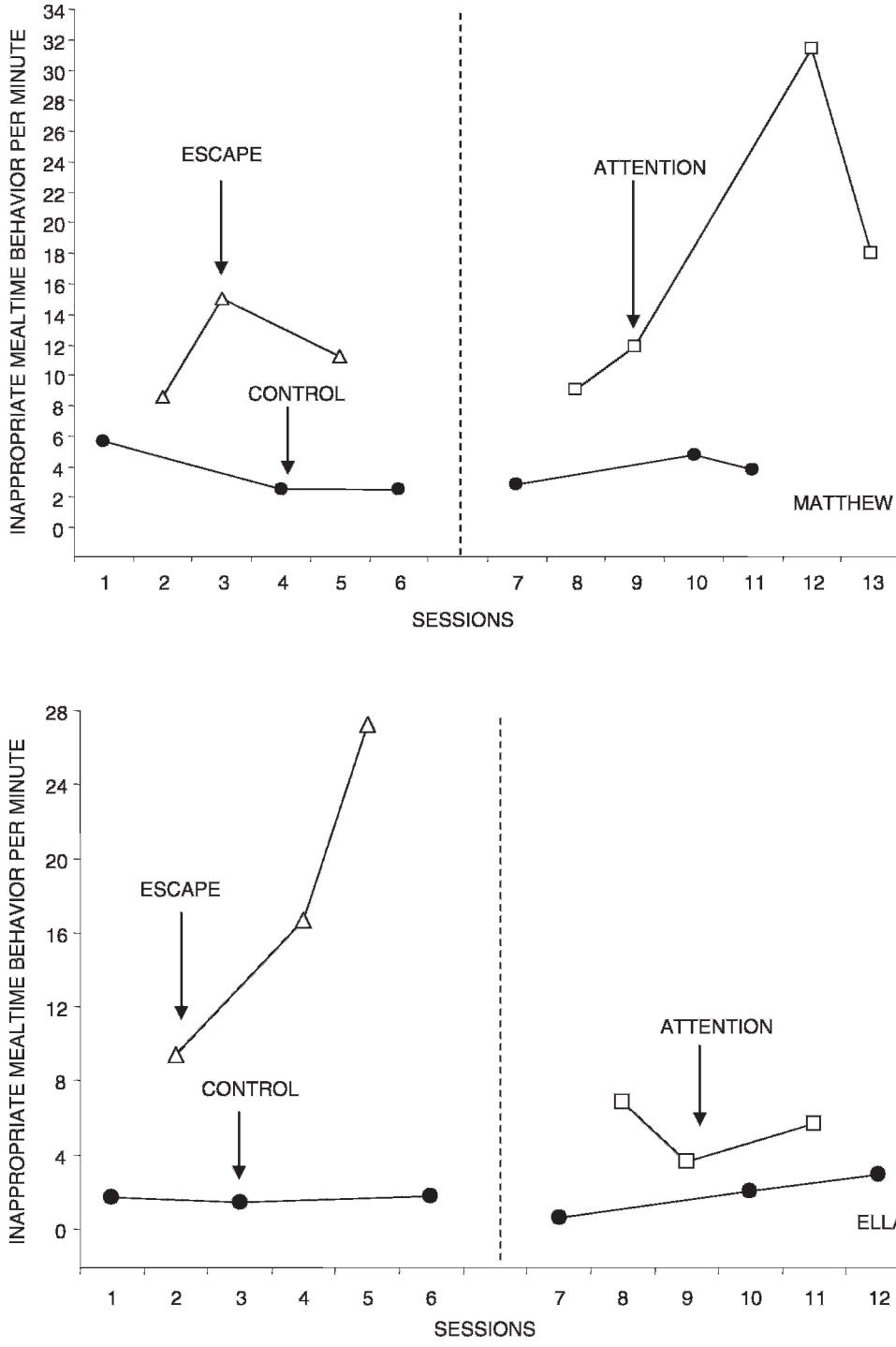

Figure 2. Inappropriate mealtime behavior per minute for Matthew (top) and Ella (bottom) during the functional analysis.

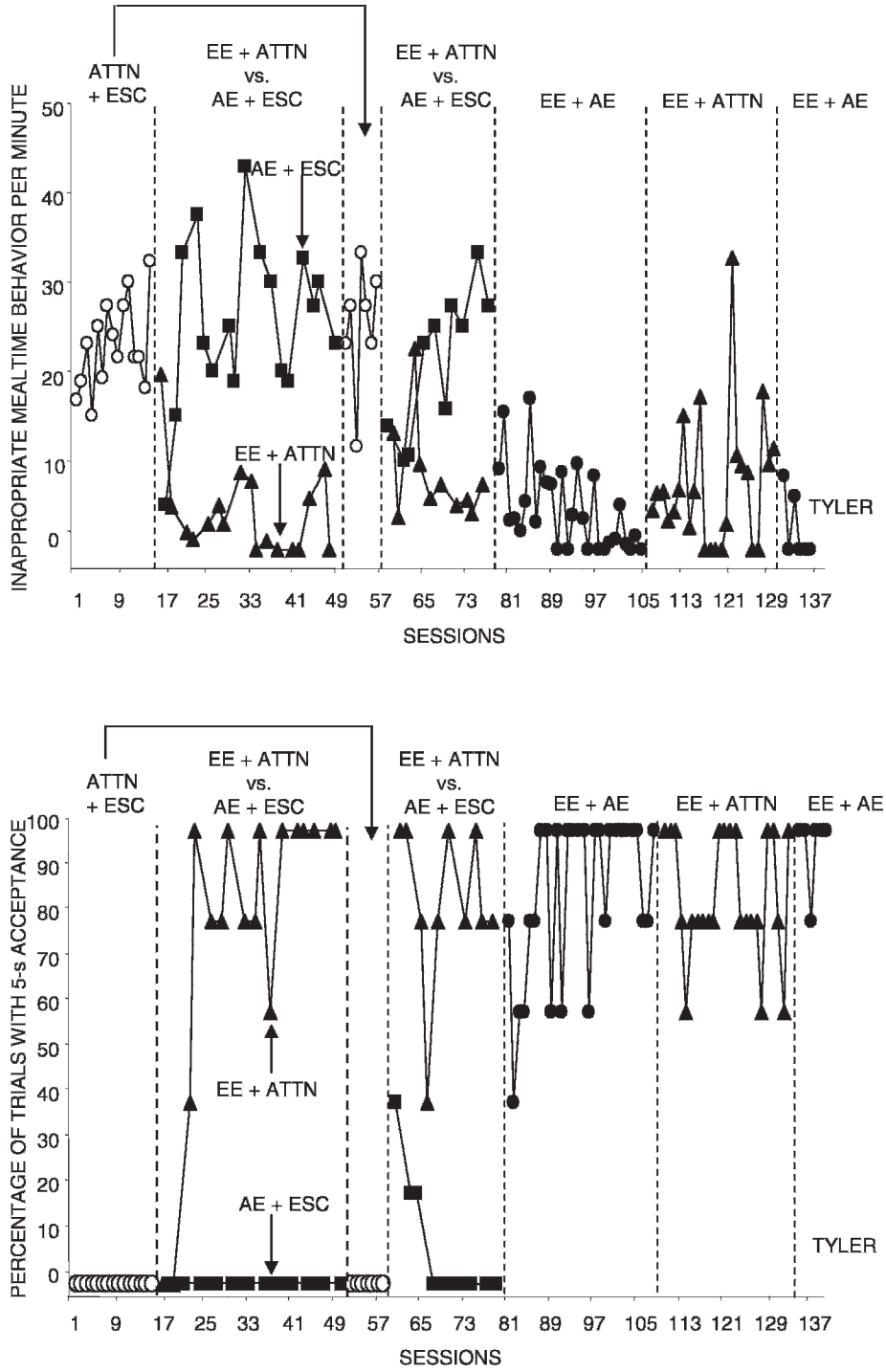

Figure 3. Inappropriate mealtime behavior per minute (top) and percentage of trials with acceptance (bottom) for Tyler during escape and attention baseline, escape extinction plus attention, attention extinction plus escape, and escape and attention extinction.

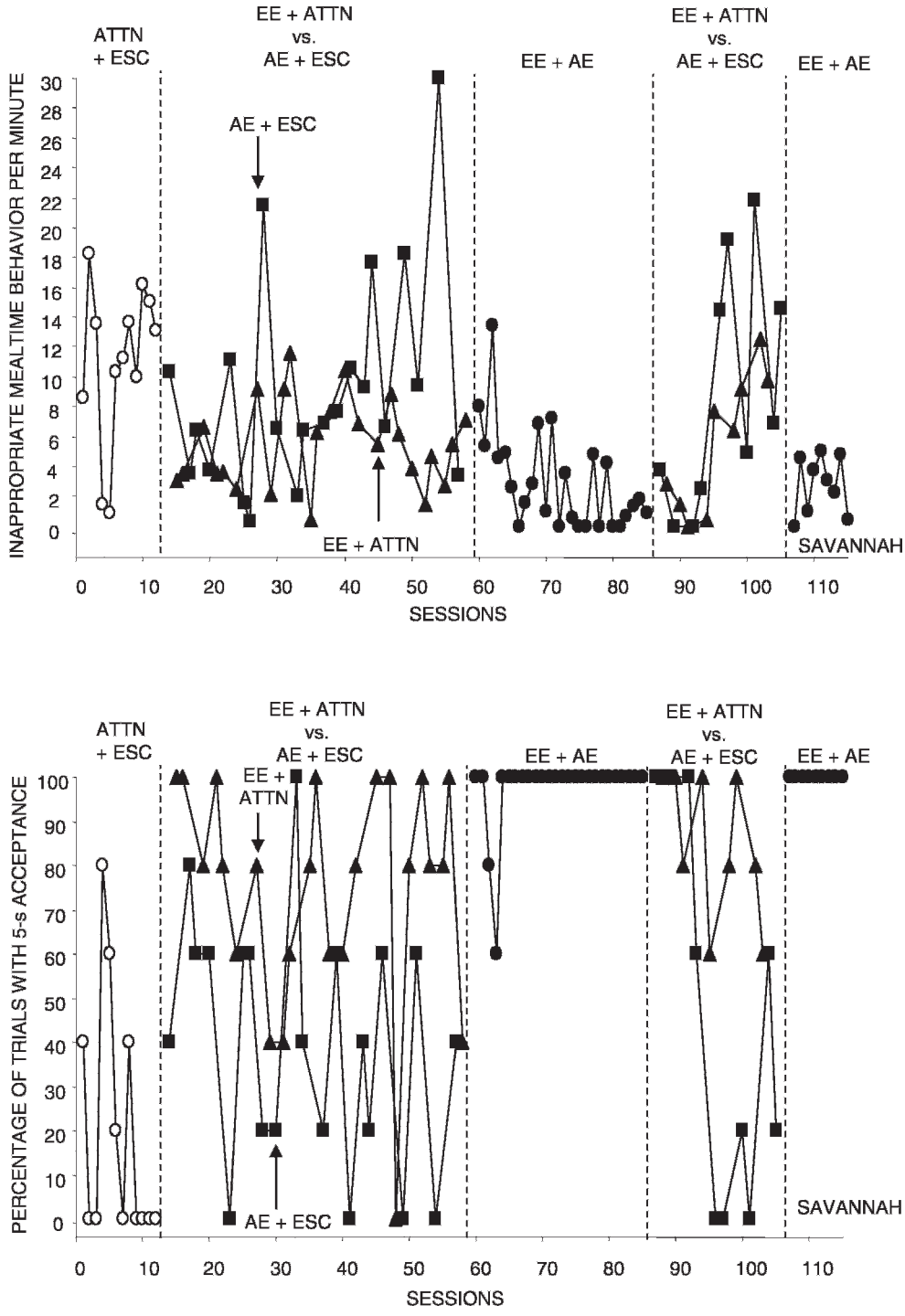

Figure 4. Inappropriate mealtime behavior per minute (top) and percentage of trials with acceptance (bottom) for Savannah during escape and attention baseline, escape extinction plus attention, attention extinction plus escape, and escape and attention extinction.

AE+ESC procedure. Rates of inappropriate mealtime behavior decreased (M = 6.4 responses per minute) and levels of acceptance increased (M = 82.8%) during each implementation of EE+ATTN relative to the ESC+ATTN and AE+ESC conditions. Although rates of inappropriate mealtime behavior decreased during the EE+ATTN condition, inappropriate mealtime behavior remained at or above five responses per minute. Inappropriate behavior decreased to zero or near-zero levels and levels of acceptance stabilized near 100% during the EE+AE condition in both phases in which it was implemented.

Figure 4 shows the results of Savannah's treatment for inappropriate mealtime behavior and acceptance. Rates of inappropriate behavior remained high and levels of acceptance remained low and variable during the ATTN+ESC baseline. Rates of inappropriate mealtime behavior remained high and variable (M = 9.1 responses per minute), and levels of acceptance remained low and variable (M = 42%) during both implementations of the AE+ESC condition. Rates of inappropriate mealtime behavior decreased (M = 5.5 responses per minute) relative to the ATTN+ESC and AE+ESC conditions and acceptance increased and remained variable (M = 78%) during both implementations of the EE+ATTN condition. Although rates of inappropriate mealtime behavior decreased and levels of acceptance increased during the EE+ATTN condition, rates of inappropriate behavior remained above clinically acceptable levels (M = 5.5 responses per minute), and levels of acceptance remained variable. Inappropriate mealtime behavior decreased to near-zero rates and levels of acceptance stabilized near 100% during both implementations of the combined EE+AE condition.

Figure 5 shows the results of Matthew's treatment for inappropriate mealtime behavior and acceptance. Rates of inappropriate mealtime behavior remained high and levels of acceptance remained low during the ATTN+ESC baseline across all three foods. Rates of inappropriate mealtime behavior remained high with Foods 2 and 3 (Ms = 19.2 and 23.2 responses per minute, respectively) and levels of acceptance remained low with Foods 2 and 3 (Ms = 23% and 10%, respectively) during the AE+ESC condition. Rates of inappropriate mealtime behavior decreased with Foods 2 and 3 (Ms = 17.1 and 11.5 responses per minute, respectively), relative to the ATTN+ESC and AE+ESC conditions, and levels of acceptance increased with both Foods 2 and 3 (Ms = 70% and 77%, respectively) during the EE+ATTN condition. Although rates of inappropriate mealtime behavior decreased and levels of acceptance increased during the EE+ATTN condition, rates of inappropriate behavior remained above clinically acceptable levels (Ms = 17.1 and 11.5 responses per minute) and levels of acceptance remained variable. Rates of inappropriate mealtime behavior decreased to zero or near zero, and levels of acceptance stabilized near 100% during the combined EE+AE condition across all three foods.

Figure 6 shows the results of Ella's treatment for inappropriate mealtime behavior and acceptance. Rates of inappropriate mealtime behavior increased and acceptance remained low during the ATTN+ESC baseline. Inappropriate mealtime behavior remained high and variable (M = 20.1 responses per minute) and levels of acceptance remained low and variable (M = 18%) during three implementations of the AE+ESC condition. Rates of inappropriate behavior decreased relative to baseline (M = 7.4 responses per minute), and levels of acceptance increased and remained variable (M = 86%) during the three implementations of EE+ATTN. Although rates of inappropriate behavior decreased and levels of acceptance increased during the EE+ATTN condition, rates of behavior remained above clinically acceptable levels (M = 7.4 responses per

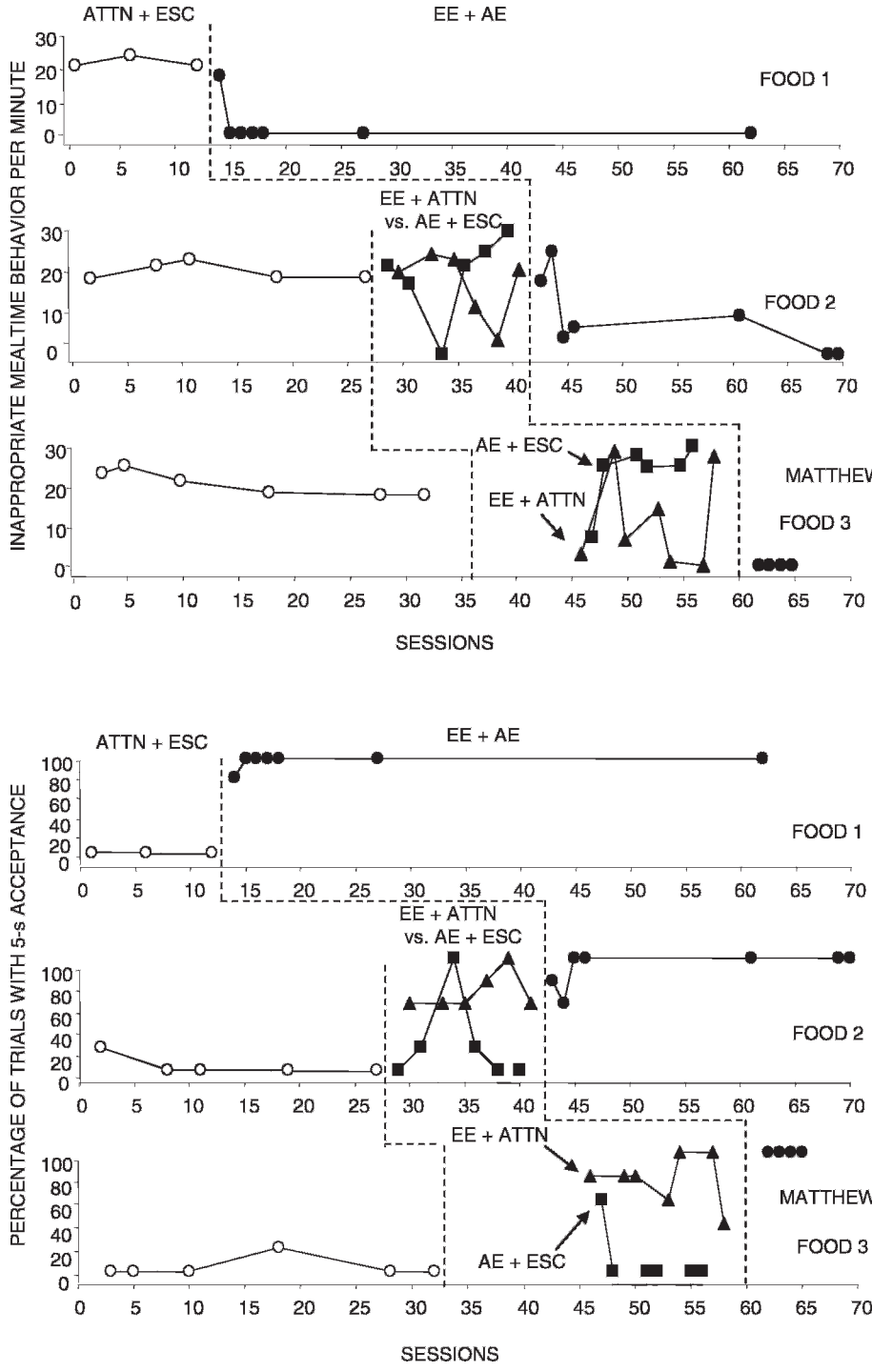

Figure 5. Inappropriate mealtime behavior per minute (top) and percentage of trials with acceptance (bottom) for Matthew during escape and attention baseline, escape extinction plus attention, attention extinction plus escape, and escape and attention extinction across three foods.

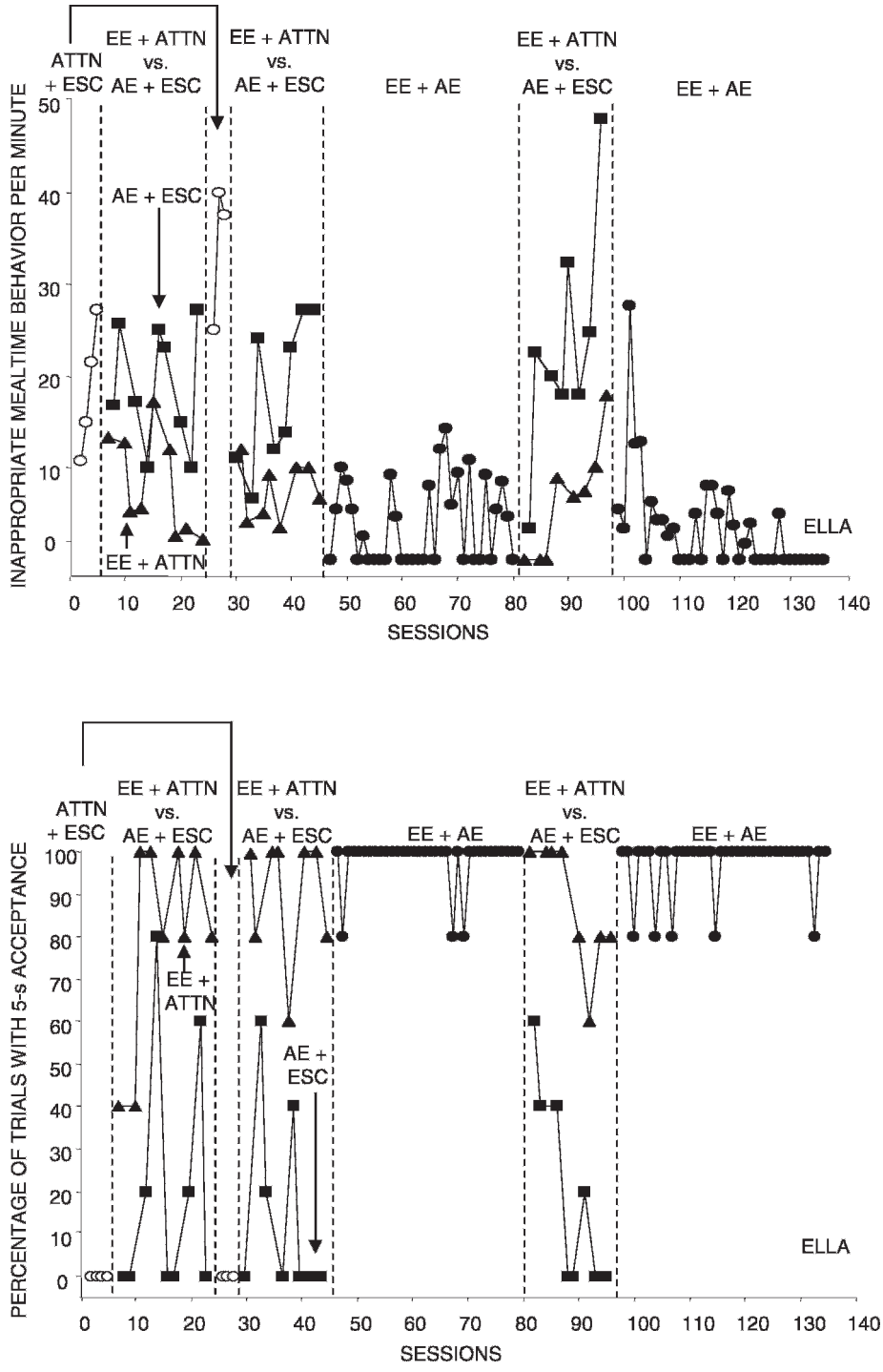

Figure 6. Inappropriate mealtime behavior per minute (top) and percentage of trials with acceptance (bottom) for Ella during escape and attention baseline, escape extinction plus attention, attention extinction plus escape, and escape and attention extinction.

minute) and levels of acceptance remained variable. Rates of inappropriate mealtime behavior decreased to near zero, and levels of acceptance stabilized near 100% during both implementations of the combined EE+AE condition.

DISCUSSION

In the current investigation, analogue functional analyses indicated that the inappropriate mealtime behavior of 4 children diagnosed with a feeding problem was multiply controlled by both escape and attention (Smith et al., 1993). To determine whether both identified functions were accurate or whether the functional analysis produced spurious results (e.g., one accurate function, one false positive), we tested the effects of treatments matched to each putative reinforcer using the method proposed by Smith et al. We evaluated the effects of individual extinction procedures for each potential function in isolation and combination. Attention extinction alone did not result in a decrease in inappropriate mealtime behavior or a consistent increase in acceptance as long as inappropriate mealtime behavior continued to produce escape. By contrast, escape extinction alone resulted in a decrease in inappropriate mealtime behavior and an increase in acceptance, even though inappropriate mealtime behavior continued to produce attention. A combined escape and attention extinction technique produced greater reductions in inappropriate mealtime behavior and was required to achieve clinically acceptable results for both acceptance and inappropriate mealtime behavior for all participants. That is, inappropriate mealtime behavior decreased to near-zero levels, and levels of acceptance stabilized at 100% for all participants when neither escape nor attention was provided for inappropriate mealtime behavior.

These results are consistent with previous findings that illustrate the importance, and perhaps necessity, of escape extinction in the treatment of pediatric feeding problems (Ahearn, Kerwin, Eicher, Shantz, & Swearingin, 1996; Cooper et al., 1995; Hoch et al., 1994; Kerwin et al., 1995; Patel et al., 2002; Piazza, Patel, Gulotta, Sevin, & Layer, 2003; Reed et al., 2004). However, previous studies provided only indirect evidence of the role of negative reinforcement because functional analyses were not conducted. Thus, escape was a putative reinforcer rather than an experimentally documented reinforcer for inappropriate behavior. In the current study, we conducted functional analyses to identify the maintaining variables for inappropriate mealtime behavior and then directly matched extinction procedures to those variables. To our knowledge, the current study is the first systematic function-based study in the treatment of pediatric feeding disorders. Thus, the results of the current investigation, in combination with the previous literature, suggest that escape extinction may be necessary for the treatment of severe pediatric feeding disorders.

Although the results of previous studies have suggested that negative reinforcement plays a role in the maintenance of feeding problems, no studies have evaluated the potential role of positive reinforcement. Thus, one unique contribution of the current investigation is the direct examination of the potential role of positive reinforcement contingencies for inappropriate mealtime behavior. The effectiveness of escape extinction was tested in the context of an explicit positive reinforcement contingency for inappropriate mealtime behavior (i.e., the EE+ATTN condition) as contrasted with previous studies on putative escape extinction procedures which simultaneously eliminated attention and tangible reinforcers (Cooper et al., 1995; Hoch et al., 1994; Patel et al., 2002; Piazza, Patel, Gulotta, Sevin, & Layer, 2003; Reed et al., 2004). In the current study, adult attention was provided for inappropriate mealtime behavior in the attention condition of the functional analysis, in the baseline condition of the treatment analysis, and in the context of escape extinction,

allowing examination of the levels of inappropriate mealtime behavior in the presence and absence of this explicit reinforcement contingency. Escape from presentation of bites or drinks clearly influenced the inappropriate mealtime behavior of our participants; however, adult attention provided in the context of aversive feeding situations also increased the likelihood of inappropriate mealtime behavior, and attention extinction proved beneficial in each case.

Although other researchers have examined multiply controlled destructive behavior, the current investigation is the first experimental examination and treatment of multiply controlled inappropriate mealtime behavior. The findings suggest that extinction of all sources of reinforcement may be necessary to reduce multiply controlled inappropriate mealtime behavior (i.e., escape extinction may be necessary but not sufficient) and are consistent with the findings of Smith et al. (1993) on multiply controlled destructive behavior. Because eating is a multicomponent behavior (e.g., acceptance, chewing, swallowing) that may not have a parallel in the literature on destructive behavior, phenomena such as multiple control should be explicitly examined rather than extrapolated from findings from studies on other behavior problems (e.g., SIB).

Incorporation of a functional analysis of inappropriate mealtime behavior may be helpful in prescribing treatment with greater specificity, efficiency, and effectiveness. A pretreatment functional analysis may provide information about the relative importance of including treatment components such as escape extinction and attention extinction. Treatments that are specific to the results of a functional analysis target all reinforcers that maintain inappropriate behavior and are more efficient because they involve manipulation of only the contingencies needed to change behavior, rather than all contingencies that could possibly affect behavior. Consider a child with inappropriate mealtime behavior maintained only by escape whose mother also happens to provide attention (i.e., irrelevant consequence) for inappropriate behavior. The most specific function-based treatment would be escape extinction, which should be effective based on the results of the functional analysis. Training the mother to implement escape extinction only would be more efficient than training implementation of both escape and attention extinction and may minimize the chances of compromised procedural integrity due to an unnecessarily complex intervention (i.e., inadvertent presentation of escape while remembering to not attend). Alternatively, consider a child whose inappropriate mealtime behavior is maintained by both escape from bites of food and attention. The most effective treatment for this child would be escape extinction and attention extinction, and the current results suggest that both treatment components may be necessary to achieve optimal treatment effects in the natural environment. The functional analysis in each instance provides evidence that allows specification of any and all necessary components and elimination of unnecessary ones.

Although functional analysis of inappropriate mealtime behavior can be helpful in prescribing the necessary and sufficient components for intervention, certain limitations inherent in the design of the experimental conditions may lead to interpretive difficulty. These difficulties may partially account for the paucity of research in this area. Three studies of mealtime behavior have conducted the functional analyses using the same antecedent event (i.e., presentation of food or liquid) for all conditions (Girolami & Scotti, 2001; Piazza, Fisher, et al., 2003; current investigation). The potential interpretive problem when including prompts (i.e., the aversive meal stimuli) in all functional analysis conditions is that the prompts may evoke inappropriate mealtime behavior across all conditions (i.e., high and undifferentiated responding), resulting in inconclusive results. However, most participants in these three studies demonstrated

differentiated responding (i.e., negative reinforcement only, both negative and positive reinforcement) with inappropriate mealtime behavior remaining low or decreasing over time in the control condition despite the aversive prompts that were present.

An alternative functional analysis procedure for inappropriate mealtime behavior is delivery of prompts to eat in the escape condition only (e.g., Nadjowski et al., 2008). The potential major interpretive problem with this procedure is that the relevant discriminative stimuli or motivating operations for inappropriate mealtime behavior may not be present in all conditions of the functional analysis. That is, reinforcement effects may be context specific, such that a stimulus (e.g., attention) functions as reinforcement when prompted to eat during a meal but not in other contexts (e.g., when left alone with food on the table). The data from the current investigation, Piazza, Fisher, et al. (2003), and Girolami and Scotti (2001) suggest that prompts to eat may serve as a motivating operation for attention-maintained inappropriate mealtime behavior. Children commonly seek parental attention (e.g., "I want my mommy.") when presented with painful, fearful, or noxious stimuli (e.g., loud noises, strangers, aversive mealtime situations). Thus, parental attention may function as reinforcement when aversive stimulation is present (i.e., demands to eat), but not in the absence of aversive stimulation (i.e., no demands to eat), suggesting that prompts need to be present across conditions to ensure the identification of this potential functional relation.

A final limitation of the current investigation is that the increase of acceptance in the attention extinction condition may have been a function of multiple treatment interference (Heward, 1987). That is, the participants may not have discriminated which reinforcement (i.e., escape or attention) was produced by the inappropriate mealtime behavior because of the rapid alternation between conditions. Future studies should examine this question when treatments are implemented in isolation (e.g., reversal design).

Future researchers should continue to examine the role of positive and negative reinforcement in the treatment of multiply controlled feeding problems. Specifically, future researchers may want to evaluate the effects of reinforcement procedures matched directly to the maintaining variables of multiply controlled inappropriate mealtime behaviors. Future studies also should examine function-based treatments for other problem behaviors associated with pediatric feeding disorders such as expulsions, packing, gagging, and vomiting.

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