Evaluating the High-Probability Instructional Sequence to Increase the Acceptance of Foods with an Adolescent with Autism

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Abstract This study evaluates the effectiveness of a variation of the high-probability (high-*p*) sequence involving bites of food as high-*p* tasks on the acceptance of low-probability (low-*p*) foods in an adolescent with autism spectrum disorder. After demonstrating the effectiveness of the high-*p* sequence using a reversal design, the participant's mother implemented the intervention. Intervention effects were partially maintained during 7-month maintenance probes. Implications for research and practice are provided.

Keywords Antecedent interventions · Parent implementation · Feeding disorders · Food selectivity

The high-probability (high-*p*) instructional sequence is an antecedent intervention that is studied by behavior analysts in the treatment of non-compliance. The high-*p* sequence is used in various ways and has produced inconsistent outcomes in the feeding disorders literature, however. Dawson et al. (2003) evaluated the high-*p* sequence with a 3-year-old girl who engaged in total food refusal and found that the high-*p* sequence

had no impact when used in isolation and, moreover, that the high-*p* sequence did not add to the effectiveness of escape extinction (EE). Patel et al. (2006) evaluated the effects of the high-*p* sequence on the acceptance of foods and inappropriate behavior with three young children with feeding difficulties. Patel et al. (2006) found that, relative to EE alone, the high-*p* sequence increased acceptance for two out of the three participants when combined with EE and that the addition of the high-*p* sequence further reduced inappropriate mealtime behavior relative to EE alone.¹ Patel et al. (2006) evaluated the high-*p* sequence in isolation with one of the three participants and found it to be ineffective towards increasing acceptance.

Other researchers have found the high-*p* sequence to be effective in the absence of EE. Patel et al. (2007) further evaluated the high-*p* sequence, in the absence of EE, with a 4-year-old boy who engaged in food selectivity and found the high-*p* sequence to be effective at increasing the acceptance of foods. Interestingly, the studies by Patel et al. (2006, 2007) used high-*p* tasks that were topographically similar to the low-probability (low-*p*) tasks (rather than high-*p* tasks that were topographically dissimilar to the low-*p* tasks, e.g., “touch your shoulder”). Specifically, Patel et al. (2006) used bites from an empty Nuk® brush, spoons with liquid, and spoons with a preferred liquid as the high-*p* tasks, and Patel et al. (2007) used bites from an empty spoon as the high-*p* task. Along these lines, Meier et al. (2012) evaluated the effects of the high-*p* sequence in the absence of EE on acceptance of low-*p* foods with a 3-year-old girl with autism spectrum disorder. Meier et al. used bites of high-*p* foods as the high-*p* requests and bites of low-*p* foods for the low-*p* requests. This variation of the high-*p* sequence was effective at increasing the

-Intervention may be considered preventative and used with less severe feeding problems

-Parents may implement this intervention with integrity

-Critical to consider the child's chewing and swallowing skills before implementing

-Systematic fading may be necessary

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¹ Inappropriate mealtime behavior was only measured with two of the participants.

acceptance of three foods and, moreover, was successfully faded for two of the three target foods.

As there are relatively few studies on the high-*p* sequence, especially variations of it that use high-*p* tasks that are topographically similar to low-*p* tasks, the extent to which this variation of the high-*p* sequence is effective in the absence of EE requires further exploration. Alternatives to EE are particularly needed in practice settings, where the implementation of EE may be difficult and possibly involve intermittent reinforcement of challenging behavior (Bachmeyer 2009). Moreover, the existing literature on the high-*p* sequence has not explored the extent to which parents and other caregivers can implement the high-*p* sequence with integrity and has focused on young children with feeding problems. In addition, few of the studies on the topic of feeding problems have been conducted in the context of the child's home with children with less severe feeding problems, primarily focusing on improving the variety of foods in the child's diet.

Thus, the goal of the current study is to (a) further evaluate a variation of the high-*p* sequence in the absence of EE where in high-*p* bites are presented as high-*p* tasks and low-*p* bites are presented as low-*p* tasks, (b) with an adolescent with autism who is a picky eater and does not engage in inappropriate mealtime behavior, (c) in a home-based setting, and (d) examine the extent to which a parent can implement the intervention effectively.

Method

Participants, Settings, and Materials Kenny, a 15-year-old boy with autism spectrum disorder and a history of selective eating participated in this study. Kenny received general behavioral services (unrelated to feeding specifically), and all sessions were conducted at his dining room table. Kenny sat in a regular sized chair, was a self-feeder, and used a regular fork and spoon. Kenny did not have a history of packing or choking nor did he have trouble chewing or swallowing foods. Kenny ate a number of foods but was a selective eater and avoided a number of healthy foods.

Data Collection Observers collected paper-and-pencil data on the acceptance of high-*p* and low-*p* bites and percentage of steps of a task analysis performed correctly by Kenny's mother during the final treatment phase. *Acceptance* was defined as the participant putting the food in his mouth within 5 s of the instruction without subsequent expulsion. During each session, we calculated the percentage of acceptance for both high-*p* and low-*p* bites by dividing the number of presentations with acceptance by the total number of presentations and converting the ratio into a percentage. During parent implementation sessions, we calculated the percentage of steps implemented correctly by dividing the number of steps

implemented correctly by the total number of steps and converting this ratio into a percentage.

Interobserver Agreement (IOA) Interobserver agreement was calculated by dividing the number of agreements for each session by the total number of agreements plus disagreements and converting this ratio into a percentage. Agreement was considered as both observers agreeing on the occurrence/non-occurrence of acceptance of the bites presented. An independent observer collected IOA data during 67 % of the sessions. Mean total IOA for consumption was 96 % (range, 80 to 100 %) across all conditions.

Design and Procedure The effectiveness of the intervention was evaluated using a reversal design. Kenny's mother identified hard-boiled egg and cauliflower as foods she would like Kenny to eat more, and these foods were targeted in the study. Kenny's mother identified ramen noodles as a food that he consumed consistently. We conducted a compliance assessment to verify that the ramen noodles were high-*p* foods prior to intervention. There were no efforts to control consumption of high- or low-*p* foods outside of sessions.

Compliance Assessment During the compliance assessment, the therapist conducted two five-bite sessions with ramen noodles. The noodles were presented on a utensil on a plate (one spoonful=5 ml), and the therapist gave the instruction to "take a bite." If Kenny accepted the food within 5 s, the therapist waited approximately 5 more seconds before presenting the next bite. If Kenny did not accept the food within 5 s of the instruction, the therapist removed the food and waited approximately 5 s before presenting the next bite. Kenny consumed 100 % of the presentations during each compliance assessment session; therefore, we used ramen noodles during intervention.

Baseline Baseline sessions consisted of five presentations of each low-*p* food, in random order, for a total of 10 trials per session. All of the foods were presented in their regular texture, and the bite size was approximately 1 in.². To begin a trial, the therapist placed the low-*p* bite on a utensil on a plate in front of Kenny and gave the instruction "take a bite." If Kenny accepted the low-*p* bite within 5 s of receiving the instruction (i.e., putting the food in his mouth within 5 s of the instruction without subsequent expulsion), the therapist provided neutral praise and waited approximately 5 s before presenting the next bite. If Kenny did not accept the food within 5 s, the therapist removed the food and waited approximately 5 s before beginning the next trial.

High-*p* Sequence During the high-*p* sequence, trials were conducted the same way as they were during baseline with the exception that the therapist presented three high-*p* bites,

one at a time (one spoonful=5 ml), followed by one low-*p* bite. Therefore, each trial consisted of 4 bites, with a total of 40 bites per session. If Kenny accepted the foods within 5 s of the instruction, the therapist provided general praise and waited approximately 5 s before presenting the next bite. If Kenny did not accept the bite within 5 s of the instruction, the therapist removed the food and waited 15 s before presenting the next bite or beginning the next trial (to avoid inadvertently reinforcing non-compliance with high-*p* bites). Mastery criteria were acceptance of the low-*p* bites for 80 % or more of the trials for three consecutive sessions.

Parent Implementation Kenny's mother was trained to implement the intervention. During training, Kenny's mother was given a verbal explanation of the procedure they would be implementing and the task analysis they would be using, the investigator modeled the procedure, then the investigator and family member role-played. When Kenny's mother implemented 80 % or more of the steps on the task analysis correctly for three consecutive role-plays, she began to implement the procedure with Kenny. Kenny's mother was given the task analysis to refer to as needed throughout implementation. Mastery criteria were the same as during the high-*p* sequence phase.

Follow-Up Seven-month follow-up probes were conducted the same as baseline sessions, with both the therapist and mother.

Results and Discussion

Figure 1 depicts Kenny's acceptance of low-*p* bites and implementation of the high-*p* sequence by his mother. During baseline, acceptance was 0 % ($M=0$ %). When the high-*p* sequence was implemented, acceptance of the low-*p* bites increased ($M=96$ %; range, 90 to 100 %). During the reversal

to baseline, acceptance of low-*p* bites decreased ($M=16$ %; range, 0 to 50 %). When the high-*p* sequence was reintroduced, acceptance of low-*p* bites again increased ($M=94$ %; range, 90 to 100 %). The intervention was then implemented by Kenny's mother, and mastery criteria were met after four sessions ($M=80$ %; range, 50 to 100 %). In addition, Kenny's mother implemented the intervention with integrity ($M=96$ %; range, 94 to 98 %). Finally, Kenny accepted 50 % of the bites during the 7-month maintenance probes (50 % therapist, 50 % mother).

The current investigation extends upon the literature on the use of the high-*p* sequence in a number of ways. First, as a relatively small amount of research has examined the use of topographically similar high-*p* tasks in the absence of EE to improve the variety of foods accepted, the current study adds to the external validity of this intervention. Second, an adolescent with autism participated in the study, adding to our understanding of the use of the high-*p* sequence as a feeding intervention with older children with autism. Finally, although the current study was not a parent-training study per se, the parent implementation phase demonstrated that parents can implement the high-*p* sequence with integrity.

While it is difficult to point to the exact mechanisms responsible for these results, it seems possible that operant processes contribute to the success of the intervention. In addition, the specific type of high-*p* task used in high-*p* sequences may influence outcomes. Along these lines, future evaluations might consider comparing variations of the high-*p* sequence, such as high-*p* sequences with and without preferred items involved in the high-*p* tasks or high-*p* tasks that are and are not topographically similar to the low-*p* tasks to better understand the mechanisms responsible for the effective application of the high-*p* sequence.

Moreover, the current study was conducted with a child who did not engage in inappropriate mealtime behavior but, rather, passively avoided non-preferred foods. It is possible that antecedent interventions are more likely to be successful

Fig. 1 Percentage of low-*p* bites accepted by Kenny and the percentage of steps implemented correctly by Kenny's mother

in isolation when they are used with children who do not have more serious feeding difficulties and IMB. That is, when the sole goal of the intervention is to target the stimulus properties of foods, antecedent interventions may be more likely to be successful in isolation. In this sense, antecedent interventions might be used to promote overall health and possibly prevent more serious problems from developing (Bachmeyer 2009; Seubert et al. 2014).

As the high-*p* sequence described in this study involves multiple presentations of bites of food, it is critical that researchers and practitioners consider the client's chewing and swallowing skills when scheduling the timing of bite presentations. For example, children with oral motor deficits may require a slower pacing of bites to avoid choking. Also, while we waited 15 s to initiate high-*p* trials contingent upon non-acceptance to avoid potentially reinforcing non-compliance with high-*p* bites, future evaluations of this intervention should hold inter-trial intervals constant to remove this potential confound. Finally, as the effects of the intervention were only partially maintained at the 7-month follow-up, researchers and practitioners should consider systematically fading the intervention to more successfully transfer stimulus control to the natural environment.

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