Using Graduated Exposure and Differential Reinforcement to Increase Food Repertoire in a Child with Autism

Amy Tanner¹ · Bianca E. Andreone¹

Published online: 5 August 2015

© Association for Behavior Analysis International 2015

Abstract Food selectivity is often seen in children with autism spectrum disorder and can lead to severe nutritional deficiencies. Food selectivity can be specific to food texture, colour, shape, presentation, type, brand or container. Often food selectivity is treated using escape extinction in conjunction with other procedures, which can be challenging to implement for the therapist or caregiver, aversive for the child, and requires adequate supervision from a professional to ensure fidelity of the procedure. A preference assessment, parent interview and food journal determined the child's food repertoire consisted of four different foods in total (pasta, fish crackers, dry cereal and yogurt), and the child was selective by brand, texture, temperature and utensil requirement. A 12-step graduated exposure food hierarchy was constructed, the child was lead through the hierarchy, and parent training was implemented for generalization. After 9 months of treatment, the participant's food repertoire increased from four items to more than 50 items. Additionally, food refusal behaviour decreased to rates of zero during intervention and parents report significant decreases in mealtime behaviour at home. The importance of using an alternative strategy to escape extinction for treating food selectivity in children with autism spectrum disorder will be discussed.

Keywords Food selectivity · Picky eating · Autism · Gradual exposure · Systematic desensitization

Children with autism spectrum disorder (ASD) are more likely to exhibit food selectivity and have more limited food repertoires than their typically developing peers (Ahearn 2001; Bandini et al. 2010; Schreck and Williams 2006). Prevalence of food selectivity is reported between 25 and 40 % of typically developing children and 40 and 85 % of children with ASD (Ahearn 2001; Bandini et al. 2010). The large variance in prevalence for food selectivity in children with ASD can be partially attributed to a lack of a standardized definition across the literature (Bandini et al. 2010). In the past, food selectivity was defined as food refusal behaviours leading to the inability to attain adequate nutritional health and often scored solely from parent report (Dovey et al. 2008; Herndon et al. 2009; Piazza et al. 2003a, b; Williams et al. 2000).

In 2010, Bandini et al. put forth a standard definition for food selectivity which included three domains: food refusal, limited food repertoire and high-frequency single food intake. Food refusal refers to the rejecting of food when it is presented and can often be accompanied by challenging behaviours such as head turning, spitting out food, swiping at food and/or utensils, holding food in mouth, refusing to open mouth or engaging in aggression or self-injurious behaviours when food is offered (Laud et al. 2009). Bandini et al. (2010) used a 3-day food to track the number of unique foods consumed across a 3-day period and compared it to same-age peers in order to determine if the child exhibits a limited food repertoire. Lastly, high-frequency single food intake was defined as any food consumed more than four times per day, not including beverages (Bandini et al. 2010). Children can demonstrate food selectivity based on food texture, temperature, presentation, colour, brand, smell and utensil requirement (Schreck

Electronic supplementary material The online version of this article (doi:10.1007/s40617-015-0077-9) contains supplementary material, which is available to authorized users.

✉ Amy Tanner
atanner@cbi.ca

¹ CBI-Monarch House, Burnaby, BC, Canada

and Williams 2006). Children who exhibit food selectivity often exhibit more challenging behaviours during mealtimes, leading to an aversive mealtime experience for the entire family (Ahearn 2001; Ahearn et al. 2001). Food selectivity can vary greatly in severity from mild to extremely severe, where a feeding tube may be required (Ahearn 2001). In addition, nutrient inadequacies may result in more severe medical complications and therefore are often a main area of concern for parents and the clinical intervention team (Bicer and Alsaffar 2013). Although there is a plethora of case studies and anecdotal reports to support the growing concern for food selectivity, only a few empirical studies have been conducted into the treatment of food selectivity (Cermak et al. 2010). The limited number of empirical studies targeting food selectivity could be partially due to the difficulties and challenges associated with finding an effective treatment. Firstly, various medical conditions such as gastroesophageal reflux or oral motor delay can significantly contribute to the causes and maintaining variables of food selectivity (Laud et al. 2009; Maenner et al. 2011). Secondly, the food repertoire of the child's family can greatly influence the child's food repertoire in that the numbers of different foods eaten by the family have been found to be related to the number of different foods that the child will consume (Schreck and Williams 2006). Another challenge in treating food selectivity is the difficulty, inability or ethical implications involved with physically prompting a child to consume food that they are refusing to ingest. Additionally, an aversive long history of negative interactions with food, paired with a history of reinforcement of inappropriate mealtime behaviours can further contribute to challenges in choosing an effective treatment (Riordan et al. 1982; Bandini et al. 2010; Bicer and Alsaffar 2013).

The majority of the current literature utilizes various forms of escape extinction, commonly referred to as negative reinforcement or non-removal of the spoon to treat food selectivity in children with ASD (Piazza et al. 2003a, b; Bachmeyer et al. 2009; Paul et al. 2007). A meta-analysis on the "Efficacy of interventions to improve feeding difficulties in children with autism spectrum disorder" (Marshall et al. 2014) analyzed data from 2000 to 2013 and reported that, out of 23 different studies, 100 % of the studies used escape extinction. The use of escape extinction for challenging feeding behaviour requires the participant to consume the target food prior to receiving reinforcement and that any challenging behaviours exhibited during feeding are ignored and/or do not function as a means to escape consuming the target food; thus, the session would continue until the target food is consumed (Anderson and McMillan 2001). The effectiveness of escape extinction demonstrates that negative reinforcement greatly contributes to the maintenance of challenging feeding behaviours (Bachmeyer et al. 2009; Patel et al. 2002; Piazza et al. 2003a, b; Reed et al. 2004). Additionally, escape extinction

was found to increase food acceptance, decrease food refusal and decrease inappropriate mealtime behaviours when escape was identified as the maintaining variable of the behaviour (Piazza et al. 2003a, b). Escape extinction is often accompanied with additional procedures. Anderson and McMillan (2001) examined parental implementation of escape extinction used with differential reinforcement and found that parental implementation was successful at increasing food acceptance while decreasing challenging mealtime behaviour. Piazza et al. (2003b) examined the effects of positive reinforcement and escape extinction alone compared to the effects of positive reinforcement and escape extinction when used together and found that positive reinforcement alone did not contribute to increased food acceptance whereas escape extinction alone did increase food acceptance; however, using both together had the greatest effect on increasing food acceptance while decreasing challenging mealtime behaviours. In a study by Seiverling et al. (2012), three sets of parents with children with autism received behavioural skills training for a feeding treatment package, consisting of taste exposure, escape extinction and fading, in which the parents were successful in significantly increasing their child's food acceptance while observing decreases in challenging mealtime behaviour. Valdimarsdottir et al. (2010) used escape extinction in conjunction with differential reinforcement of alternative behaviour and stimulus fading to increase consumption of non-preferred foods for one child with autism and generalized this procedure to different settings and parents. Although escape extinction is vastly replicated and effective, procedural fidelity can be difficult for the caregiver or therapist implementing the procedure for a variety of reasons. Firstly, it is difficult and unethical to physically prompt a correct response (i.e. consumption of the target food) and the caregiver or therapist may not have sufficient time to wait for the target response; therefore, the participant is able to escape the task and their 'waiting out' behaviour may be reinforced. Additionally, the participant may engage in severe problem behaviours such as aggression or self-injurious behaviour that the caregiver or therapist are not properly trained to manage; the participant may then escape the task without completion, in which case, the participant's challenging mealtime behaviours are likely to be reinforced on an intermittent schedule, leading to increased problem behaviour in the future. In order to reduce the likelihood of reinforcing problem behaviours maintained by escape on an intermittent schedule, more supervision time from a trained professional is required, which may result in a greater cost for the intervention.

A less common approach for treating food selectivity is using systematic desensitization or graduated exposure by reinforcing successive approximations of gradually increased exposure to targeted food. Systematic desensitization is a treatment package composed of three steps: relaxation training, the construction of the graded exposure fear hierarchy and

desensitization to the fear-invoking stimulus (Dudley 1973). Systematic desensitization has been effectively used to treat various fears and phobias from dentist procedures (Luscre and Center 1996), needle phobia (Shabani and Fisher 2006), medical procedures (Cavalari et al. 2013) and food intake (Dovey and Martin 2014). Graduated exposure is composed of the latter two components of systematic desensitization; it is composed of the hierarchy construction and the desensitization to the stimulus but does not include a relaxation component (Schmidt et al. 2013). Systematic desensitization and graduated exposure can reduce the likelihood of reinforcing inappropriate mealtime behaviours on a variable ratio schedule, as it reduces the motivation to escape the task as food consumption is not required for a correct response; therefore, it does not require the same amount of supervision for implementation and is likely to be less aversive for the participant and the person implementing the procedure compared to using an escape extinction approach.

The primary goal of the present study was to evaluate the effectiveness of using a graduated exposure hierarchy to decrease food refusal, increase food repertoire and decrease mealtime behaviours during intervention (immediate effects) and posttreatment (generalization) in a young child with ASD. A secondary goal of the present study was to provide training to the parents of the child with ASD, in order to generalize and maximize the effects of intervention in a way that is socially significant for the child and family. A 12-step graduated exposure hierarchy, beginning with tolerating the target food in the same room and concluding with consuming a piece of the target food, was designed to expose the participant to previously refused food items without the use of physical prompting or aversive strategies.

Methods

Participants, Setting and Materials

The present study used a 3.5-year old boy with ASD as the sole participant. Sam was diagnosed with ASD at 2.11 years of age and had been receiving applied behaviour analysis (ABA) therapy since the age of 3 years old. Sam began independently attending a typical play-based preschool at 3.5 years of age for 3 days per week, without the support of an individual educational assistant. Sam was verbal, spoke in three- to five-word utterances, requested to play turn-taking games with particular peers, had a strong imitative repertoire (vocal, motor, social) and generally complied without challenging behaviour to most demands throughout his ABA sessions. Sam's ABA sessions were each 2.5 h in length and occurred 4 days per week. Feeding sessions took place during Sam's regular ABA sessions; feeding sessions ran 20 min in length and took place approximately 20 min before Sam's scheduled

snack time. For the first 6 months, all feeding sessions took place inside Sam's therapy room at an autism centre. Sam's therapy room contained a table, two chairs, a large toy shelf, a few bins of preferred toys, a token board, visual schedule and windows that looked outdoors and into the clinic. Materials included an array of the current target foods, cut into small pieces and presented on a single plate, a five-item token board, a garbage can and various developmentally appropriate and preferred toys. A multiple stimulus without replacement preference assessment was conducted daily at the beginning of each therapy session to determine Sam's most current preferred toys. Often Sam chose social reinforcement such as playing board games with the therapist, leading circle time with peers or participating in show and tell at circle time, in addition to tangible reinforcement such as bubbles, spinning tops, smart phones and puzzles. A parental interview and a 3-day food journal confirmed that Sam consumed exclusively four foods: Honey Nut Cheerios, strawberry yogurt, fish-shaped crackers and beefaroni pasta. In addition, Sam would consume a nutrition supplement drink and three to five cups of apple juice per day. Target foods were originally selected based on family preference; however, after the first six foods, targets were then selected based on similarities with currently accepted foods (i.e. different brands, flavours or colours of currently accepted food). Once target foods were fully accepted (i.e. achieved step 12) across two consecutive intervention sessions, target foods were then generalized to home and preschool environments using generalization probes. After approximately 6 months of conducting feeding sessions in Sam's ABA therapy room, Sam began accepting a variety of premade meals; thus, sessions were moved to the clinic kitchen in order to access the microwave which was needed for preparation and to support generalization across environments.

Dependent Variables

The dependent variables of the present study included (1) independent oral consumption of target foods during treatment measured by bites and (2) independent oral consumption of target foods outside of treatment. Independent oral consumption was defined as eating an entire spoonful or spoonful-sized piece of a previously refused food, without the use of any physical prompting.

Response Measurement and Inter-Observer Agreement

Data was recorded in the moment via paper and pencil. Data was scored directly onto a data sheet recording: (1) the target foods, (2) the 12-step food hierarchy and (3) the number of pieces of each target food and which step of the hierarchy was attained (Table 1). An additional observer collected inter-observer agreement (IOA) data on approximately 30 % of

Table 1 Daily tracking sheet for intervention with 12-step food hierarchy

12-step hierarchy	Target food: carrots	Target food: cheese	Target food: cracker	Target food: grape
1. Tolerate food in therapy room				
2. Tolerate food on therapy table				
3. Tolerate food within 1 ft.				+
4. Touch food and throw away	+			++
5. Smell food and throw away	+	+		+
6. Kiss food and throw away	+	++	+	+
7. Lick food and throw away	++	++	+	
8. Lick food five times and throw away			+	
9. Break food with teeth and throw away			+	
10. Chew food five times and throw away			+	
11. Eat a small piece				
12. Eat an entire piece				
Furthest step attained				

all treatment sessions. The mean IOA across all treatment sessions was above 95 %. No IOA data was collected for generalization probes, as generalization probes relied solely on parent report and a food journal. Each step of the 12-step hierarchy was operationalized and defined as such: (1) to tolerate food in same room; (2) to tolerate food on a shared table; (3) to tolerate food when placed directly in front of participant; (4) to touch food, pick up and throw in the garbage can; (5) to pick up food, smell food and throw away in the garbage can; (6) to pick up food, kiss food and dispose of in the garbage can; (7) to lick food one time, making contact with tongue; (8) to lick food five consecutive times, making contact with tongue each time; (9) to break target food using teeth into at least two pieces; (10) to chew the target food for five consecutive times and then dispose food in the garbage can; (11) to eat one small piece of the food, equivalent to the size of an eraser on the end of a pencil; and (12) to eat one entire/larger piece of target food, equivalent to the size of one tablespoon. Mastery criteria of each target food were that a minimum of one large piece was independently consumed across two consecutive days. Generalization was defined as the target food was independently consumed outside of the therapy room and outside of treatment.

Procedure

Prior to treatment, an Occupational Therapist and Speech and Language Pathologist assessed Sam to rule out any possible structural or motor issues that could be contributing to his limited food repertoire. A functional behaviour assessment was conducted and included a parent interview, a 3-day food journal and the Brief Autism Mealtime Behavior Inventory (BAMBI) questionnaire (Lukens and Linschied 2008), a multiple stimulus without replacement (MSWOR) preference assessment, novel food probes and an observation of Sam eating

snack with peers. The 3-day food journal confirmed information from the parent interview that Sam ate solely four unique foods and consumed two beverages. A list of novel foods was compiled based on similarities in the colour and texture of Sam's four preferred food items.

Baseline Procedures A preintervention baseline probe was conducted 10 min prior to the introduction of each food target. The target foods were placed in small bite-size pieces in an array on a plate on the therapy table while Sam was engaged in other activities. A generalized verbal antecedent “help yourself” or “you can eat it if you would like” was delivered. Sam's level of interaction with the food was recorded as per the 12-step hierarchal sequence.

General Procedure A MSWOR preference assessment was conducted at the start of each session to identify potent reinforcing items and activities for the session. An array of four to six pictures, which represented preferred items and activities, was placed in an array on the table. Sam was instructed to choose an item or activity. Once he selected an item, the item was removed from the array and he was asked to choose again. This process was continued until three potent reinforcers were selected. Subsequently, Sam's four food targets were cut into small bite-size pieces and placed on a plate between the experimenter and Sam. The garbage can was placed directly beside the table to discard of any used food. The experimenter delivered the antecedent “What food would you like to play with first?” If Sam did not select a food, the experimenter would select a food to start. The experimenter led Sam through the 12-step hierarchy by modelling each step and having Sam imitate the experimenter's interaction with food. The experimenter used tokens to differentially reinforce Sam's imitation behaviour. Once Sam earned five tokens, he could have a 3-min break from the table and access to a

preferred toy, and at the completion of each feeding session, Sam could earn a preferred social reinforcement with peers. The experimenter was instructed to keep treatment sessions creative, silly and playful and to use natural language and antecedents throughout session. If Sam refused to complete a step in the hierarchy, the experimenter regressed two levels on the hierarchy and began the hierarchical levels again in attempt to re-establish behaviour momentum and finish the trial with independent completion. After each trial, Sam chose which target food he wanted to interact with next. A minimum of five pieces per target food was ran each session. Challenging feeding behaviour was recorded using antecedent-behaviour-consequence (A-B-C) and frequency data collection across sessions.

Gagging Protocol If Sam engaged in gagging behaviour anytime during the graduated exposure, the experimenter would move back two steps on the exposure hierarchy and have Sam complete that step and provide reinforcement. Any gagging behaviour was recorded on the data sheet, and foods that consistently evoked a gagging response for four consecutive sessions were removed from the current targets.

Generalization Probes Once a food was mastered during the treatment sessions (an entire piece was consumed across two consecutive days), the targets were then put on a generalization list. Once foods were on Sam's generalization list, parents would present food at home to Sam during snack or mealtimes. If food was accepted and a full piece was consumed, it was recorded in Sam's food journal. If Sam consumed a novel food (one that he was not exposed to during treatment), that was also recorded in Sam's generalization food journal and counted towards the generalization totals.

Results

The graduated exposure feeding intervention lasted for 100 sessions that occurred over the span of 9 months, during which time, the participant increased his food acceptance from 4 foods to over 50 foods, with 27 of those foods generalizing to additional settings and people. The cumulative food graph (Fig. 2) depicts the same pattern across the treatment and the generalization data. The rate at which Sam ascended through the exposure hierarchy for the first four food targets was notably slower than the subsequent food targets, taking 28 days for Sam to consume the first target food. The mean average of sessions to consume the first set of four targets was 33 sessions, with one of the first four targets never meeting mastery criteria. The rate of food acceptance began to increase with the second set of food targets, which took an average of 12 sessions per target to reach independent oral consumption. The third set of four targets took only an average of 3.75 sessions

per target to be independently consumed. The rate continued to increase as more foods were mastered (Fig. 1). The generalization probes seemed to mirror the results of the treatment sessions, and food targets were quickly acquired outside of the session (Fig. 2). Foods with wet textures such as banana and green pepper did not generalize outside of treatment. After 30 target foods were mastered, premade frozen meals were introduced as targets and mastered with the same rate. Generalization to family mealtime was seen with ten different frozen premade meals including the following: macaroni and cheese, spaghetti, chicken Alfredo, chicken and rice and beef stroganoff. Sam did not demonstrate the ability to generalize to other brands of mastered target foods that were not trained; however, other brands of mastered target foods were introduced as subsequent targets and Sam did show an increased rate at acquiring these targets (i.e. three different brands and types of crackers). Mild challenging feeding behaviour occurred in the form of verbal protests, negotiating and “accidentally” dropping target food on the floor during the initial first month of the treatment, but no major problem behaviours such as aggression, tantrums or self-injurious behaviours were recorded throughout the entire duration of treatment sessions. Behaviour data was not collected from the home; however, anecdotal reports describe a decrease in challenging mealtime behaviour. During the initial parental interview prior to treatment, it was reported that Sam engaged in high levels of food refusal and protest during meals; in addition, Sam would not remain at the table during mealtimes. In the follow-up interview posttreatment, Sam's mother reported that Sam is able to eat a variety of mealtime foods and remains at the table for the duration of his meal.

Discussion

Graduated exposure using a 12-step food hierarchy was successful at increasing food repertoire, decreasing food refusal and decreasing high-frequency single food intake. A posttreatment 3-day journal revealed that Sam had consumed 15 unique foods, which was a significant increase over the pre-treatment journal, which revealed that Sam had consumed only four unique foods. Foods generalized to three additional people (mother, father and preschool teacher) and to three additional settings (home, preschool and a birthday party). The treatment was discontinued after 100 sessions, as parents reported that food selectivity was no longer a treatment priority for them based on the foods and meals that Sam had acquired. The present study has various limitations. Firstly, a functional analysis was not conducted prior to beginning the treatment; therefore, a conclusive function for food selectivity had not been determined. The discrepancy between the treatment and the generalization results could provide some indication that the food refusal behaviour may be partially

Fig. 1 *Top left*: first four food targets introduced. *Top right*: second set of four food targets introduced. *Bottom left*: third set of four food targets introduced. *Bottom right*: fourth set of four food targets introduced

maintained by escape, as there were no planned consequences for refusing food during the generalization probes and many of the generalization probes were conducted during family mealtimes where escape behaviour was often reinforced. The discrepancy between the treatment and the generalization results could also be attributed to a weaker mastery criteria, such that if the mastery criteria were more stringent (i.e. five consecutive days of consumption or entire portions rather

single bites), then this may have also lead to a higher degree of generalization across mastered targets. Secondly, the present study relied on Sam's parents for providing the food each session. Some sessions did not have all the current targets and would have replacement targets; thus, Sam was often exposed to new targets prior to mastering all current targets. One should use caution when interpreting generalization data as it was provided through parent report, and thus, social

Fig. 2 Cumulative graph of all target foods accepted and target foods generalized to additional settings

desirability bias could have inflated results. Additionally, generalization data was only assessed one time per target after treatment. To provide more comprehensive generalization results, it would be necessary include multiple generalization probes of the same food target posttreatment. Lastly, using a graduated exposure approach can take significant time and effort before seeing results (i.e. Sam took 28 days of exposure to target food before independent consumption). Therefore, if the participant requires urgent intervention due to the severity of food selectivity, an escape extinction procedure may be more effective. Aside from these limitations, the present study remains an important contribution to the literature for providing an alternative to escape extinction procedures in order to treat food selectivity.

References

- Ahearn, W. H. (2001). Why does my son only eat macaroni and cheese? Dealing with feeding problems in children with autism. In C. Maurice, R. Foxx, & G. Green (Eds.), *Making a difference: Behavioral intervention for autism*. Austin: Pro-ed.
- Ahearn, W., Castine, T., Nault, K., & Green, G. (2001). An assessment of food acceptance in children with autism or pervasive developmental disorder-not otherwise specified. *Journal of Autism and Developmental Disorders*, 31(5), 505–511. doi:10.1023/A:1012221026124.
- Anderson, C. M., & McMillan. (2001). Parental use of escape extinction and differential reinforcement to treat food selectivity. *Journal of Applied Behavior Analysis*, 34(4), 511–515. doi:10.1901/jaba.2001.34-511.
- Bachmeyer, M., Piazza, C., Fredrick, L., Reed, G., Rivas, K., Kadey, H., & Zarcone, J. (2009). Functional analysis and treatment of multiply controlled inappropriate mealtime behavior. *Journal of Applied Behavior Analysis*, 42(3), 641–658. doi:10.1901/jaba.2009.42-641.
- Bandini, L., Anderson, S., & Must, A. (2010). Food selectivity in children with autism spectrum disorder and typically developing children. *The Journal of Pediatrics*, 157(2), 259–264. doi:10.1016/j.jpeds.2010.02.013.
- Bicer, A., & Alsaffar, A. (2013). Body mass index, dietary intake and feeding problems of Turkish children with autism spectrum disorder (ASD). *Research in Developmental Disabilities*, 34(11), 3978–3987. doi:10.1016/j.ridd.2013.08.024.
- Cavalari, R. N. S., DuBard, M., Luiselli, J. K., & Birtwell, K. (2013). Teaching an adolescent with autism and intellectual disability to tolerate routine medical examination: effects of a behavioral compliance training package. *Clinical Practice in Pediatric Psychology*, 1(2), 121–128.
- Cermak, S., Curtin, C., & Bandini, L. (2010). Food selectivity and sensory sensitivity in children with Autism Spectrum Disorders. *Journal of the American Dietetic Association*, 110, 238–246. doi:10.1016/j.jada.2009.10.032.
- Dovey, T., & Martin, C. (2014). A parent-led contingent reward desensitization intervention for children with a feeding problem resulting from sensory defensiveness. *ICAN: Infant, Child, & Adolescent Nutrition*, 4(6), 384–393. doi:10.1177/1941406412452132.
- Dovey, T. M., Staples, P. A., Gibson, E. L., & Halford, J. C. (2008). Food neophobia and picky/fussy' eating in children: a review. *Appetite*, 50(2–3), 181–193. doi:10.1016/j.appet.2007.09.009.
- Dudley, M. F. (1973). Graded imagination and relaxation as components of experimental desensitization. *Journal of Nervous & Mental Disease*, 156(6), 377–385. doi:10.1097/00005053-197306000-00002.
- Herndon, A., DiGuseppi, C., Johnson, S., Leiferman, J., & Reynolds, A. (2009). Does nutritional intake differ between children with autism spectrum disorders and children with typical development? *Journal of Autism and Developmental Disorders*, 39, 212–222. doi:10.1007/s10803-008-0606-2.
- Laud, R. B., Girolami, P. A., Boscoe, J. H., & Gulotta, C. S. (2009). Treatment outcomes for severe feeding problems in children with Autism. *Behavior Modifications*, 33(5), 520. doi:10.1177/0145445509346729.
- Lukens, C. T., & Linscheid, T. R. (2008). Development and validation of an inventory to assess mealtime behavior problems in children with autism. *Journal of Autism and Developmental Disorders*, 38(2), 342–352.
- Luscre, D. M., & Center, D. B. (1996). Procedures for reducing dental fear in children with autism. *Journal of Autism and Developmental Disorders*, 5(26), 547–556.
- Maenner, M., Arneson, C., Levy, S., Kirby, R., Nicholas, J., & Durkin, M. (2011). Brief report: association between behavioral features and gastrointestinal problems among children with Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, 42(11), 1520–1525. doi:10.1007/s10803-011-1379-6.
- Marshall, J., Hill, R. J., Ziviani, J., & Doodrill, P. (2014). Features of feeding difficulty in children with autism spectrum disorder. *International Journal of Speech Language Pathology*, 16, 151–158. doi:10.3109/17549507.2013.808700.
- Patel, M. R., Piazza, C. C., Martinez, C. J., Volkert, V. M., & Santana, C. M. (2002). An evaluation of two differential reinforcement procedures with escape extinction to treat food refusal. *Journal of Applied Behavior Analysis*, 35, 363–374. doi:10.1901/jaba.2002.35-363.
- Paul, C., Williams, K., Riegel, K., & Gibbons, B. (2007). Combining repeated taste exposure and escape prevention: an intervention for the treatment of extreme food selectivity. *Appetite*, 49(3), 708–711. doi:10.1016/j.appet.2007.07.012.
- Piazza, C., Fisher, W., Brown, K., Shore, B., Patel, M., Katz, R., & Blakely-Smith, A. (2003a). Functional analysis of inappropriate mealtime behaviors. *Journal of Applied Behavior Analysis*, 36(2), 187–204. doi:10.1901/jaba.2003.36-187.
- Piazza, C., Patel, M., Gulotta, C., Sevin, B., & Layer, S. (2003b). On the relative contributions of positive reinforcement and escape extinction in the treatment of food refusal. *Journal of Applied Behavior Analysis*, 36(3), 309–324. doi:10.1901/jaba.2003.36-309.
- Reed, G. K., Piazza, C. C., Patel, M. R., Layer, S. A., Bachmeyer, M. H., & Bethke, S. D. (2004). On the relative contributions of noncontingent reinforcement and escape extinction in the treatment of food refusal. *Journal of Applied Behavior Analysis*, 37, 27–41. doi:10.1901/jaba.2004.37-27.
- Riordan, M., Iwata, B., Finney, J., Wohl, M., & Stanley, A. (1982). Behavioral assessment and treatment of chronic food refusal in handicapped children. *Journal of Applied Behavior Analysis*, 17(3), 327–341. doi:10.1901/jaba.1984.17-327.
- Schmidt, J. D., Luiselli, J. K., Rue, H., & Whalley, K. (2013). Graduated exposure and positive reinforcement to overcome setting and activity avoidance in an adolescent with autism. *Behavior Modification*, 37(1), 128–142. doi:10.1177/0145445512456547.
- Schreck, K. A., & Williams, K. (2006). Food preferences and factors influencing food selectivity for children with autism spectrum disorders. *Research in Developmental Disabilities*, 27(4), 353–363. doi:10.1016/j.ridd.2005.03.005.
- Seiverling, L., Williams, K., Sturmey, P., & Hart, S. (2012). Effects of behavioral skills training on parental treatment of children's food

- selectivity. *Journal of Applied Behavior Analysis*, 45(1), 197–203. doi:10.1901/jaba.2012.45-197.
- Shabani, D. B., & Fisher, W. W. (2006). Stimulus fading and differential reinforcement for the treatment of needle phobia in a youth with autism. *Journal of Applied Behavior Analysis*, 39(4), 449–452. doi:10.1901/jaba.2006.30-05.
- Valdimarsdottir, H., Halldorsdottir, L. Y., & Sigurdardottir, Z. G. (2010). Increasing the variety of foods consumed by a picky eater: generalization of effects across caregivers and settings. *Journal of Applied Behavior Analysis*, 43, 101–105. doi:10.1901/jaba.2010.43-101.
- Williams, P. G., Dalrymple, N., & Neal, J. (2000). Eating habits of children with autism. *Pediatric Nursing*, 26, 259–264.