Spring 5-13-2017

A Functional Analysis of Three Treatments for Pica in a Naturalistic Play Environment

Jennifer Darrah
Jdarrah@rollins.edu

A Functional Analysis of Three Treatments for Pica in a Naturalistic Play Environment

A Capstone
By
Jennifer Darrah

Submitted to the Faculty of the Department of Health Professions
at Rollins College in Partial Fulfillment
of the Requirements for the Degree of

MASTER OF ARTS IN APPLIED BEHAVIOR ANALYSIS AND CLINICAL SCIENCE

May 2017
Winter Park, FL

Table of Contents

Abstract

Pica is an eating disorder involving the ingestion of non-food items. In the current study, a functional analysis (FA) screening was conducted to confirm the pica of two subjects diagnosed with autism spectrum disorder (ASD) was maintained by automatic reinforcement. Subsequently, three behavior-analytic treatments (i.e., verbal reprimand, noncontingent reinforcement [NCR], and functional communication training [FCT]) were systematically evaluated in an unstructured play environment using a multi-element design. Findings showed all three treatments decreased pica compared to pre-treatment levels; however, FCT was observed to consistently reduce the rate of pica for both subjects to near-zero levels. Results of this study support the assertion that behavior-analytic treatments for pica might be effective when applied during unstructured play for some subjects.

Keywords: Autism spectrum disorder, functional analysis, functional communication training, noncontingent reinforcement, pica, treatment, verbal reprimand

Introduction

Pica is defined as the consumption of non-food items (Falcomata, Roane, & Pabico, 2007; Napolitano, Blakkman, Khol, Vallese, & McAdam, 2007). Although the topographies of behavior included under the umbrella of pica are varied, within the scope of this study, *pica* is defined as the insertion of non-food items past the plane of both lips. Some individuals who exhibit pica ingest relatively harmless non-food items such as grass, dirt, play dough, or paper (Johnson, Hunt, & Siebert, 1994; Fisher et al., 1994). Individuals who engage in pica, however, can also ingest non-food items that can lead to serious health concerns (e.g., glass or cigarette butts) including digestive problems (e.g., intestinal blockage), parasitic infection, poisoning, and even death (Motta & Basile, 1998; Piazza, Roane, Keeney, Boney, & Abt, 2002). In addition to these consequences, pica is generally recognized as a socially inappropriate behavior.

The prevalence of pica has been difficult to establish for a couple of reasons. First, because the diagnosis of pica relies primarily on self or caregiver report (Baig-Ansari et al., 2008; Edwards et al., 1994), it has been argued there might be a reluctance to disclose abnormal cravings and/or ingestion both by persons engaging in pica and their caregivers (Blinder & Salama, 2008; McAdam, Sherman, Sheldon, & Napolitano, 2004). Additionally, because pica is most often seen in populations diagnosed with developmental delays, it is possible pica is underreported due to limitations in the ability of those affected to communicate about their ingestion of non-food substances (Blinder & Salama, 2008). These factors alone or in combination could contribute to underestimations of the prevalence of pica.

In typically developing populations, pica is most often observed with pregnant women (referred to as "maternal pica"), certain ethnic groups, and young children (Blinder & Salama, 2008). Rainville (1998) reported 76.5% of a sample of 281 pregnant women self-reported

engaging in pica. With maternal pica the consumption of non-food substances is usually attributed to a nutritional deficiency (e.g., lack of iron, calcium, or zinc; Blinder & Salama, 2008). Corbett, Ryan, and Weinrich (2003) found African American women self-reported engaging in pica more frequently than other ethnic groups. In young children, pica is thought to result from a combination of seeking oral stimulation on the part of the individual engaging in the behavior and insufficient supervision from caregivers (Blinder & Salama, 2008). One study estimated between 10-30% of all children younger than six engage in some form of pica (Barltrop, 1966).

Research indicates pica tends to be more prevalent in certain populations such as those with developmental disabilities, including autism spectrum disorder (ASD; Kelly, 2009/2010; Singh, 1983), and mental health diagnoses including, depressive disorder (Jawed, Krishnan, Prasher, & Corbett, 1993), Obsessive Compulsive Disorder (OCD; Luiselli, 1996), and schizophrenia (Foulon, 2003). A study conducted by Danford and Huber (1982) indicated 25.8% of a group of 991 adults residing in an institutional setting and diagnosed with developmental disabilities engaged in pica. Intellectual disabilities (IDs) have a high comorbidity with ASD (LaMalfa, Lassi, Bertelli, Salvini, & Placidi, 2004). LaMalfa et al. estimated 70% of individuals diagnosed with ASD were dually diagnosed with ID. Additional research has indicated between 5.7% and 28.8% of individuals diagnosed with ID engage in pica (Hagopian, Rooker, & Rolider, 2011).

Review of Literature

Within the field of Applied Behavior Analysis (ABA) the preferred methodology for the assessment of pica is an FA (McAdam et al., 2004). This approach seeks to identify the maintaining cause(s) of problem behavior through experimental manipulation of antecedent and

consequent events in a controlled environment (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994). Generally, subject responding is examined under four conditions: Play/control, demand, social attention, and alone (Iwata et al., 1982/1994). Each of the experimental conditions includes manipulating a motivating operation (an antecedent), some discriminative stimulus (an antecedent) and a potential reinforcer (a consequence), which in combination speak to specific maintaining functions (Iwata et al., 1982/1994). Although there are a number of common criticisms of the FA (e.g., it is time-consuming, requires expertise to implement, and relies on manipulation of antecedent and consequent events under analogue conditions which might not occur naturally) research has demonstrated the FA is more accurate at identifying the maintaining function(s) of behavior than other methods of assessment (Erbas, Tekin-Iftar, & Yucesoy, 2006; Gresham, Watson, & Skinner, 2001; Hall, 2005; Iwata et al., 2000; Moore et al., 2002).

To address common criticisms of a traditional FA, studies have evaluated the efficacy of conducting modified FAs (Erbas et al., 2006; Iwata et al., 2000; Moore et al., 2002; Gresham et al., 2001). Northup et al. (1991) demonstrated brief FAs (BFAs) with 5-min conditions can be conducted based on hypotheses generated by indirect assessments conducted with parents and caregivers. The results of the BFAs were similar to those obtained in full FAs. More recently Querim et al. (2013) demonstrated the efficacy of using FA screenings to evaluate the maintaining function of problem behavior in instances when an automatic function is suspected. During FA screenings, a subject's problem behavior is evaluated only during alone or no-interaction conditions. The authors found FA screenings had a high degree of correlation with outcomes of full FAs. Brief functional analyses and FA screenings are empirically based tools to increase the efficiency of behavioral assessment.

Within the field of ABA, research has indicated pica is most often maintained either by automatic reinforcement alone (Piazza et al., 1998; Piazza, Hanley, & Fisher, 1996) or by a combination of socially mediated (i.e., attention) and automatic reinforcement (Mace & Knight, 1986; Piazza et al., 2002). Based on this information, it might be reasonable to assume an FA screening is appropriate to assess pica rather than having to conduct a full FA; FA screening results would likely indicate an automatic function. Behavior maintained by automatic reinforcement can be more difficult to treat because the response itself produces the reinforcer; it can be difficult to manipulate contingencies maintained by automatic reinforcement because the consequence of the behavior is not under the control of a therapist (Vollmer, 1994; Vollmer, Peters, & Slocum, 2015).

Treatment Models

There are three general approaches to the treatment of pica: The cognitive model, the medical model, and the behavior-analytic model (Kelly, 2009/2010). Within the cognitive model, pica is generally attributed to stress and anxiety (Edwards et al., 1994). Of the three treatment models, this approach is used most infrequently; it is also the least consistent with the behavior-analytic approach to pica treatment. Although radical behaviorism advocates for a thoroughgoing analysis of behavior, which includes private events such as stress and anxiety, such events are not attributed with causal properties (Skinner, 1974). Therefore any intervention seeking to treat pica exclusively by manipulating private events is not conceptually systematic to the field of ABA (Baer, Wolf, & Risley, 1968). In light of these factors, the cognitive model will not be discussed in any greater detail.

Medical model. The medical model of pica treatment aligns with and compliments the behavior-analytic model. Best practice in ABA recommends assessing possible underlying

medical factors that might be contributing to or causing problem behavior before implementing behavior-analytic treatments (Behavior Analyst Certification Board, 2014). In instances where an individual's pica is caused by a vitamin, mineral, or nutritional deficiency, research has demonstrated pharmacological interventions can be effective (Kelly, 2009/2010). Additionally, when pica occurs co-morbidly with other mental health diagnoses (e.g., schizophrenia and depressive disorder) pharmacological interventions are sometimes administered as a treatment (Bhatia and Gupta, 2009; Harada, Yamamoto, & Saito, 2006).

Several studies have successfully demonstrated the efficacy of iron supplementation as a treatment for pica in patients dually diagnosed with anemia (i.e., iron deficiency; Arbiter & Black, 1991; Johnson & Stevens, 1982; Pace & Toyer, 2000; Reynolds, 1968). Reynolds (1968) used iron supplementation to reduce the occurrence of pica in a group of male and female subjects ranging in age from 15 – 78. A second study demonstrated iron sulfate therapy as effective in treating one patient's geomelophagia (i.e., ingestion of raw, chilled potatoes) after one week of implementation (Johnson & Stevens, 1982). Although this study included a patient who ingested food substances, in the medical community current definitions of pica have expanded to include the compulsive consumption of food items (Blinder & Salama, 2008; Paisey & Whitney, 1989). Similarly, Arbiter and Black (1991) demonstrated the efficacy of two forms of iron supplementation, sodium iron ededate and iron sulfate, in the treatment of two typically developing male subjects. For one subject, the authors found 5 ml of sodium iron ededate administered three times daily reduced the occurrence of pica to zero levels after two months of treatment. This subject's pica remained at zero levels when a follow up was conducted one year after treatment. For the second subject, a similar reduction in pica was observed with the

implementation of 24 mg of iron sulfate administered three times daily for two months. No follow up was conducted with the second subject post treatment.

Reversal designs (i.e., when treatment is withdrawn and re-implemented) have also been used to evaluate the efficacy of iron supplementation as a treatment for pica. Using a B-A-B design, Pace and Toyer (2000) successfully treated the pica of one 9-year-old patient diagnosed with developmental delays and anemia by providing her with a daily multivitamin. The first phase of treatment (B) involved providing the patient with a multivitamin and an iron supplement. During this phase, latency to pica (i.e., the dependent measure defined as time between presentation of a non-edible item and initiation of the patient reaching for the item) was systematically increased. Phase two of the study (A) involved discontinuing the multivitamin but continuing to administer the iron supplement. When the multivitamin was discontinued, latency to pica was much lower relative to the treatment phases including both multivitamin and iron supplement. During the third treatment phase (B2), the multivitamin was reintroduced and latency to pica again increased.

Pharmacological interventions have also been used alone (Bhatia & Gupta, 2009) or in combination with another type of intervention (Harada et al., 2006; Sharma, Aly, & Kavuru, 2011) when pica occurs co-morbidly with another diagnosis. In one study a patient diagnosed with schizophrenia and pica (specifically coprophagia, the eating of feces) was successfully treated with Perospirone, an antipsychotic drug of the serotonin-dopamine-antagonist type (Harada et al., 2006). The patient had been taking Haloperidol and Zotepine (antipsychotic drugs) for several years; however, his pica remained unaffected. The authors found changing the patient's prescription to Perospirone eliminated his pica. Although the specific action mechanisms remained unknown, the authors suggested because Perospirone interacts with the

serotonin-1A receptors, the patient's coprophagia might have been attributable to some dysfunction with his serotonin neurotransmitters. Selective Serotonin Reuptake Inhibitors (SSRIs) have also been evaluated as a treatment for pica occurring co-morbidly with a patient also diagnosed with depressive disorder (Bhatia & Gupta, 2009). A combination of two SSRIs (Escitalopram and Clonazepam) and talk therapy were used. Although the authors believed the talk therapy reduced the patient's depression, they concluded the reduction in her pica was due to the pharmacological intervention.

Finally, Sharma et al. (2011) treated the pica of one subject diagnosed with Alzheimer's disease, major depressive disorder, and pica using a combination of iron supplementation and behavior therapy. In this instance, the subject was taking several psychotropic medications; however, the authors believed a medication change would not result in a reduction in her pica. They instead began a treatment of iron supplementation combined with a variety of behavior-analytic interventions including contingent presentation of multiple aversive stimuli (i.e., lemon juice, water mist, and ammonia), contingent brief physical restraint, and discrimination training (i.e., teaching the subject to discriminate between food and non-food items). Findings indicated the combined medical and behavior-analytic treatment successfully reduced the subject's pica.

Behavior-analytic model. The introduction of the FA allowed the maintaining function of problem behavior to be identified through experimental manipulation (Iwata et al., 1982/1994). The reinforcer responsible for maintaining problem behavior could then be withheld contingent on problem behavior (i.e., extinction or response blocking) or provided contingent on an alternative, desired behavior (differential reinforcement of alternative behavior [DRA]). Thus, FAs shifted the treatment of problem behavior from punishment-based to reinforcement-based procedures (Vollmer & Iwata, 1992). Several behavior-analytic interventions for pica including

punishment-based procedures, reinforcement-based procedures, and treatment packages combining both punishment and reinforcement-based procedures have been examined in the literature.

Punishment Interventions. Examples of punishment procedures in behavior-analytic literature include verbal reprimand (Bucher et al., 1976), physical restraint (Bucher et al., 1976; Singh & Bakker, 1984), overcorrection (Finney, Russo, & Cataldo, 1982; Foxx & Martin, 1975; Singh & Bakker, 1984), and contingent aversive presentations (Ferreri, Tamm, & Wier, 2006; Rapp, Dozier, & Carr, 2001).

Verbal reprimand and physical restraint have both been shown to be effective as treatments for pica. One study evaluated both procedures on the pica of two 6-year-old subjects and found them equally effective at reducing the occurrence of pica (Bucher et al., 1976). A second study used an alternative treatments design to compare the efficacy of physical restraint and overcorrection on the pica of two female subjects (Singh & Bakker, 1984). After each occurrence of pica, either overcorrection or physical restraint was implemented. The authors concluded while both procedures were effective at reducing pica, physical restraint was more clinically effective because its effects were more immediate. Although Singh and Bakker's findings indicated physical restraint was more clinically effective than overcorrection, the latter procedure has been studied at length in behavior-analytic literature. One study evaluated the effectiveness of overcorrection (i.e., having a subject brush their teeth and rinse with an antiseptic mouthwash contingent on pica) on the pica of four adults dually diagnosed with developmental disabilities and chronic intestinal parasitic infection (Foxx & Martin, 1975). Implementation of the overcorrection procedure reduced the occurrence of pica in all four subjects to near-zero levels within one week.

Another punishment procedure used to treat pica is contingent presentation of aversive stimuli (Ferreri et al., 2006; Rapp et al., 2001). One study successfully used food aversion to treat the pica of one subject (Ferreri et al., 2006). Tapioca was identified as an aversive stimulus based on multiple observations of the subject engaging in food refusal (e.g., pulling away from the spoon, gagging) when presented with the stimulus. Tapioca was used to coat a variety plastic toys that frequently resulted in pica. Results indicated the subject's pica decreased in the initial setting where the intervention was implemented (the subject's classroom). Treatment results were then generalized across multiple settings and treatment implementers. A second study demonstrated the efficacy of contingent presentation of aversive auditory stimuli on the pica of one subject (Rapp et al., 2001). The authors found that presenting 2 – 3 s of an aversive auditory stimulus (between 90 dB – 94 dB) contingent on pica was effective at reducing the occurrence of pica in the analogue environment and in community settings.

Reinforcement Interventions. Examples of reinforcement-based treatments implemented with pica include differential reinforcement of incompatible behavior (DRI; Smith, 1987), DRA (Hagopian et al., 2011; Kern, Starosta, Eshkol, & Adelman, 2006; Ricciardi, Luiselli, Terrill, & Reardon, 2003), functional communication training (FCT; Napolitano et al., 2007), systematic variation of response effort (Carter, 2009; Piazza et al., 2002), response blocking with redirection (Hagopian & Ardelinis, 2001), and noncontingent reinforcement (NCR; Ing, Roane, & Veenstra, 2011; Piazza et al., 1998). These treatments will be discussed in greater detail below.

Differential reinforcement has been extensively evaluated in behavior-analytic literature as a treatment for problem behavior including pica. Differential reinforcement procedures involve providing reinforcement for alternative behavior (DRA), incompatible behavior (DRI), low rates or high rates of behavior (DRL and DRH, respectively), and/or for the nonoccurrence

of problem behavior (DRO; Cooper, Heron, & Heward, 2007). Smith (1987) treated the pica of one male subject using a DRI procedure which involved providing reinforcement for behavior incompatible with the subject's pica including on-task behavior (i.e., quick and accurate completion of presented tasks), staying within designated areas, and having an empty mouth. The treatment was effective at reducing the occurrence of the subject's pica.

Differential reinforcement of alternative behavior procedures have also been shown to be effective at reducing pica (Hagopian et al., 2011; Kern et al., 2006; Ricciardi et al., 2003). In one study subjects were taught "clean up" was a discriminative stimulus for picking up items from the floor. Eventually, stimulus control was transferred to subjects having items in their hand such that subjects learned to put items in the trash, use them appropriately, or put them away (Hagopian et al., 2011). Treatment was initially implemented in a hospital setting where it was effective at reducing the pica of both subjects; treatment effects were successfully generalized to multiple settings in the community. A second study taught a subject to discard items into the trash as an alternative response for pica (Ricciardi et al., 2003). Results indicated the DRA was effective at reducing the subject's pica at school. Treatment effects were maintained during a follow up conducted 4 months post treatment. Another DRA procedure involving an exchange response for food items has been demonstrated to be effective at reducing pica in a naturalistic setting (Kern et al., 2006). When the exchange procedure was introduced across multiple settings, the authors found treatment effects were maintained.

Another type of DRA, FCT, involves training subjects to engage in an alternative communicative response instead of engaging in problem behavior; FCT has been shown to be effective as a treatment for a variety of problem behavior including pica (Tiger, Hanley, & Bruzck, 2008). Napolitano et al. (2007) used a changing criterion design to demonstrate the

efficacy of an FCT procedure on the pica of one 6-year-old subject. The intervention was initially introduced while the subject engaged in structured activities in his normal classroom. The subject was taught to request preferred edibles using least-to-most prompting. A latency measure was incorporated by collecting data on the time between a preferred edible being presented to the subject and when the subject reached for the edible. After the subject was taught to verbally request the preferred edible (the FCT response), a timer was incorporated and acted as a discriminative stimulus (i.e., the timer going off signaled the availability of preferred edibles). The amount of time the subject had to wait to access the preferred edible was gradually increased. Once latency reached 120 s, the authors began implementing FCT throughout the subject's school day (e.g., group activities and transitions between activities) to support generality of results and increase maintenance of treatment effects. The authors found FCT effective at reducing the subject's pica across multiple settings and therapists.

Systematic variation of response effort has also been demonstrated to be an effective treatment for pica maintained by automatic reinforcement (Carter, 2009; Piazza et al., 2002). One study systematically increased the response effort required to engage in pica while decreasing response effort to ingest alternate edible items (Piazza et al., 2002). The authors found as the effort to ingest preferred pica items was increased and alternate items were simultaneously and noncontingently made available, the occurrence of pica decreased for all three subjects. A second study examined manipulating response effort in combination with an exchange procedure as a treatment for the pica of one subject diagnosed with ID (Carter, 2009). First, the subject was taught to exchange non-food items for food items. Once the exchange procedure was in the subject's repertoire, the response effort required to exchange the non-food

items for food items was gradually increased. Findings indicated the occurrence of pica remained at low levels even as the response effort to exchange items was increased.

Response blocking has been evaluated in two notable studies (Hagopian & Adelinis, 2001; McCord, Grosser, Iwata, & Powers, 2005). McCord et al. evaluated two forms of response blocking. With one type, subjects were prevented from inserting items past the plane of their lips. The authors found this was ineffective as a treatment for pica. The other type involved blocking subjects from touching the item altogether; this was effective at treating the pica of all subjects. A second study evaluated response blocking as a treatment for the pica of a 26-year-old subject dually diagnosed with developmental disability and bi-polar disorder (Hagopian & Adelinis, 2001). When response blocking was implemented alone, the authors observed an increase in the subject's aggression. To address this, a redirection component was introduced, which involved prompting the subject to request popcorn. The authors found response blocking with redirection to an FCT response was effective at reducing the subject's pica without an increase in aggression.

Noncontingent access to preferred edibles (NCR) has been demonstrated to be effective as a stand-alone treatment for pica (Ing et al., 2011; Piazza et al., 1998). Piazza et al. (1998) found allowing subjects noncontingent access to stimuli like preferred pica items (i.e., "matched") but appropriate for ingestion, reduced pica for three subjects. Allowing subjects noncontingent access to stimuli dissimilar from preferred pica items (i.e., "unmatched") was not effective at reducing pica for any subjects. Similarly, a second study successfully used noncontingent access to matched stimuli (e.g., edibles similar in color and consistency to preferred pica substances) to treat the coprophagia of one subject (Ing et al., 2011). The authors implemented a treatment of providing the subject with noncontingent access to alternative edible

items. Although treatment effects were generalized to two settings (a bathroom and a barren room containing a trashcan), the authors did not generalize results to the subject's place of residence.

Treatment Packages. Some studies have evaluated the efficacy of treatment packages combining elements of both reinforcement and punishment in the treatment of pica; treatment packages might be used when one approach alone (e.g., reinforcement alone or punishment alone) is ineffective (Finney et al., 1982; Goh et al., 1999; Piazza et al., 1996). One example of a successfully implemented treatment package included discrimination training, DRO (i.e., providing reinforcement to subjects for each 10-min interval in which pica did not occur), and overcorrection (i.e., 1 min of tooth brushing contingent on pica) to treat the pica of four subjects (Finney et al., 1982). For two of the four subjects, discrimination training and DRO (both reinforcement-based procedures) were effective at reducing their rates of pica. The pica of the remaining two subjects remained at high levels until the overcorrection component was introduced.

A second study attempted to treat the cigarette pica (i.e., ingestion of cigarettes or cigarette butts) of one subject using NCR (Piazza et al., 1996). The authors found allowing noncontingent access to preferred edibles was ineffective at reducing the subject's rate of pica. Response interruption (a punishment component) was then incorporated, and the rate of the subject's pica decreased across four settings. Similarly, Goh, Iwata, and Kahng (1999) examined a treatment package involving an exchange procedure and noncontingent reinforcement (NCR) on the cigarette pica of four subjects. This study was conducted with multiple therapists in a variety of environments (e.g., subjects' places of residence, therapy rooms at the day program all subjects attended, subjects' places of work) to promote generality of results and maintenance of

treatment effects. The authors found although NCR was initially effective at reducing the pica of two subjects, the reduction in pica did not maintain as the reinforcement schedule was thinned. A DRA procedure was then implemented during which subjects were taught to exchange cigarette butts for preferred edibles. This treatment also included response blocking. The authors found DRA plus response blocking was effective at reducing pica in three of the subjects.

Statement of the Problem

The literature documenting the efficacy of behavior-analytic treatments for pica are extensive. Although some studies have directly compared the relative efficacy of different interventions using alternating treatment designs (Finney et al., 1982; Hagopian & Adelinis, 2001; Piazza et al., 1996; Rapp et al., 2001), more comprehensive information is needed. Research on treatment comparisons could better inform the selection and application of behavior-analytic interventions, thus contributing to the applied validity of the field of ABA. Additionally, some studies have examined the efficacy of treatment implementation for pica in naturalistic environments (Ferreri et al., 2006; Hagopian et al., 2011; Ing et al., 2011; Kern et al., 2006; Ricciardi et al., 2003); however, more information is needed addressing the efficacy of treatment implementation during unstructured activities (Smith, 1987).

The purpose of this study was to extend previous research by systematically evaluating the relative effectiveness of three treatments for pica maintained by automatic reinforcement in an unstructured play environment following an FA screening. Because research has demonstrated pica is most often maintained by an automatic function, an FA screening measuring the occurrence of pica during alone or no-interaction conditions could be an effective and less time-consuming method of assessing the function of a subject's behavior (Querim et al., 2013). Verbal reprimand (VR; Treatment 1), NCR (Treatment 2), and FCT (Treatment 3) were

implemented in a multi-element design with two subjects. All three treatments included a response-blocking component. The effectiveness of each treatment was evaluated based on the rate of pica for both subjects.

Method

Subjects and Setting

This study included two subjects, a set of twin girls, Michelle and Sarah. The subjects were three-and-a-half years old and were diagnosed with ASD. Neither subject was able to communicate vocally; however, both subjects had undergone mand training in an ABA clinic and were able to mand "open," "eat," and "go" using American Sign Language (ASL) with varying levels of prompting. Michelle was also able to independently sign "all done." Both subjects had a history of engaging in pica in multiple settings and attended an ABA clinic for 1:1 behavior therapy 5 days per week. Neither subject was prescribed or taking any medications at the time of this study.

Pica was identified as an undesirable behavior by the subjects' parents and treatment team at the subjects' ABA clinic due to the potential for ingestion of potentially hazardous substances. At the time of this study, neither subject had been hospitalized for pica-related incidents, but both parents reported they believed hospitalization was likely if the subjects' pica went untreated.

Sessions were conducted while subjects engaged in unstructured play in one of two indoor playrooms (each measured approximately 4.5 m by 9.14 m) at the clients' ABA clinic. One playroom contained a variety of gross-motor items including some combination of the following: an indoor swing, a Bosu Ball®, a ball pit filled with plastic balls, a playhouse, a wagon, a tricycle, multiple bottles of bubbles with bubble wands, a play stove, and a large bin

containing fake food items. The second playroom contained a variety of toys including a large bin of plush puppets, a toy cash register, play money, plastic musical instruments, wooden blocks, large plastic Legos®, and children's books. Due to the naturalistic setting, items in the playrooms were not consistent throughout all conditions and were not regulated by the experimenter (e.g., if any of these items were removed from the rooms, they were not replaced by the experimenter). All items in the rooms were age-appropriate and available noncontingently to both subjects during all conditions described below. Neither subject was unsupervised in the playrooms during the course of the study. Treatments were evaluated while subjects engaged in unstructured play as anecdotal evidence indicated there was a higher likelihood of pica during unstructured activities.

Response Definitions and Interobserver Agreement

Pica was defined as the insertion of a non-food item past the plane of both lips (and any attempt to engage in pica was blocked by the therapist). For the NCR condition, *appropriate behavior* was defined as placing any of the 6 items presented on the green tray past the plane of both lips. For FCT, *appropriate behavior* was defined as manding "eat" using the appropriate ASL sign. Data for pica and appropriate behavior were collected using a frequency count converted to a rate (responses per minute) during all but one condition. During Treatment 2 (NCR) data for appropriate behavior were collected using partial interval recording across 2 s bins. Partial-interval recording was used to measure appropriate behavior during this condition because both subjects were observed to place individual objects from the presented array of 6 items past the plane of the lips for long durations. Because of this, a frequency count would not provide an accurate representation of subject responding during this condition.

Two observers simultaneously but independently collected data across 38% of sessions. An interval-by-interval exact-agreement calculation was used to calculate interobserver agreement (IOA). Each session was divided into 10-s intervals, and each interval was scored as either an agreement (if both observers scored the same number of instances of pica) or a disagreement (if the observers scored a different number of instances of pica). Intervals in which both observers scored zero instances of pica were scored as an agreement. The number of agreements were summed and divided by the number of agreements plus disagreements then multiplied by 100% to obtain a percentage score. IOA was 97% (range 82% – 100%). To calculate IOA for appropriate behavior during NCR, each session was divided into 2-s intervals and each interval was score as either an agreement (if both observers scored the same number of instances of appropriate behavior) or a disagreement (if both observers scored a different number of instances of appropriate behavior). Intervals in which both observers scored zero instances of appropriate behavior were scored as an agreement. The number of agreements were summed and divided by the number of agreements plus disagreements then multiplied by 100% to obtain a percentage score. IOA for appropriate behavior during NCR was 95% (range 80% - 100%).

General Procedures

All sessions were 5 min. Throughout all sessions, the experimenter was always within 1 m of the subject to implement response blocking for pica; response blocking was in place across all conditions. Response blocking was ethically required because subjects could not be allowed to engage in pica due to the potential for choking and/or ingestion of hazardous substances. Subjects were given noncontingent access to all the items in the playrooms across all sessions.

Functional Analysis Screening

Prior to implementation of treatment conditions, an FA screening was conducted using the procedures described by Querim et al. (2013). The purpose of this screening was to confirm pica was maintained by automatic reinforcement. A no-interaction condition was used in lieu of an alone condition so response blocking could be implemented for pica. Small items that presented a choking hazard were removed from the room prior to the FA screening sessions to minimize the need for response blocking. No other verbal or physical attention was provided and no food items were present in the playrooms during the FA screenings. Only the subject, the experimenter, and a behavior assistant (BA) were present during each session. After the FA screening, three treatments were evaluated using a multi-element design where different colored t-shirts signaled different conditions.

Treatment 1: Verbal reprimand (VR). The VR treatment condition was included in this study because it anecdotally was the most likely parent or caregiver response to pica in the naturalistic environment. Prior to the treatment comparison, the subjects' parents were asked how they normally responded to their daughters' pica; in addition, direct observation of parental responses to pica was conducted at the clinic while subjects were engaged in unstructured play during two, 10-min intervals. The observation intervals occurred during the last 10 min of the subjects' clinic sessions on two different days. Data indicated both parents primarily responded with some form of verbal reprimand when their daughters engaged in pica (e.g., "Michelle, no!").

The experimenter wore a blue t-shirt during VR to promote discrimination between conditions. Aside from the stimuli always present in the playrooms, there were no additional items present during this condition. When subjects engaged or attempted to engage in pica, the experimenter stated, "Not in your mouth," while simultaneously blocking the response. No

physical attention other than the minimum required to block pica attempts was provided during this condition.

Treatment 2: Noncontingent Reinforcement (NCR). NCR was selected as a treatment because prior research suggested noncontingent access to competing stimuli might result in a reduction in the rate of pica for some subjects (Goh et al., 1999; Ing et al., 2011; Piazza et al., 1996; Piazza et al., 2002). The experimenter wore a green t-shirt during this condition to promote discrimination between conditions. To further assist with discrimination, a green tray was placed on a small table which held an array of six non-food items appropriate for placing past the plane of the lips (e.g., a red necklace of mouthing beads, a giraffe-shaped teething ring, a banana-shaped infant toothbrush, an aqua-colored bracelet of mouthing beads, a Nutriland® grape-shaped teether, and a Nutriland® strawberry-shaped teether). The six non-food items were chosen by the experimenter to provide a variety of textures and colors; a preference assessment was not used to identify items for inclusion in this condition; however, both subjects sampled each of the six non-food items used in this condition prior to implementation of treatment. Each item was presented noncontingently one-by-one to both subjects for 60 s. Response blocking was not implemented if any items from the tray were placed past the plane of both lips of either subject. During sessions, subjects were permitted to take any of the six items from the tray and carry them around the room as they engaged in other activities. If the subjects removed any of the six items from the tray and dropped them anywhere other than on the green tray, the experimenter picked up the item and returned it to the tray. Pica resulted in response blocking.

Treatment 3: Functional communication training (FCT). Functional communication training was selected as a treatment because it was a competing functional response for the subject's pica and prior research suggested it might be an effective treatment for pica

(Napolitano et al., 2007; Tiger et al., 2008). The experimenter wore a yellow t-shirt during this condition to promote discrimination between conditions. The ASL sign for "eat" was selected as the functional response because it was part of the verbal repertoires of both subjects (i.e., both subjects were observed to consistently and independently emit the mand for "eat") prior to treatment implementation.

A multiple-stimulus-without-replacement (MSWO) preference assessment was conducted with each subject to identify preferred edibles to be included in this condition (Deleon & Iwata, 1996); five food items were identified as highly preferred: goldfish crackers, pieces of nacho chips, pretzels, fruit snacks, and M&Ms. Prior to treatment implementation, both subjects sampled the five food items. During sampling each edible was presented noncontingently one-by-one, while the experimenter verbally labeled the items (e.g., "this is a pretzel") as she presented them in random order to each subject.

Once each edible had been sampled, the subjects underwent a brief training prior to the implementation of this treatment to teach them signing "eat" resulted the presentation of a preferred edible. Least-to-most prompting was used during training. The experimenter began by presenting the sealed bag of edibles to the subject, the experimenter waited 3 s for the subject to emit the ASL sign for "eat" independently. If no mand for "eat" was emitted within 3 s of the presentation of the bag of edibles, the experimenter said the word "eat" and waited 3 s for the mand to be emitted. If a mand for "eat" was not emitted within 3 s of the verbal prompt, the experimenter progressed to a model prompt (i.e., signing "eat"). If no mand was emitted within 3 s after presentation of the modeled prompt, the experimenter used partial-physical prompting to assist the subjects with completion of the response. Every emitted mand for "eat," whether prompted or independent, resulted in an edible from the bag being put into the subject's mouth.

This training was conducted for 10 consecutive trials or until the subject emitted three consecutive independent responses, whichever came first, prior to each FCT session.

During FCT sessions, the edibles were mixed together in one bag, which the experimenter held. The experimenter delivered an edible contingent on a mand for "eat" and put the edible directly into the subject's mouth. No additional attention or prompting was provided. The subjects were not allowed to open the sealed bag independently. It was typical clinical practice for the subjects to be required to emit a mand to gain access to edible items. Subject discrimination was measured by analyzing the rate of appropriate behavior and the rate of pica for both the NCR and FCT conditions. Discrimination was not evaluated in the VR condition, because there was not a specific alternative appropriate behavior.

Results

Michelle and Sarah's data are presented in Figures 1 and 2, respectively. The FA screening followed procedures described by Querim et al. (2013) and was included to confirm the pica of both subjects was maintained by automatic reinforcement. Michelle engaged in pica at a mean rate of 10.4 responses per min (rpm; range 6 – 15 rpm per session) in the FA screening (Figure 1). Responding in the VR, NCR, and FCT conditions was 4.8 rpm (range 4 – 7 rpm per session), 1.8 rpm (range 0 – 4 rpm per session), and 0.6 rpm (range 0 – 2 rpm per session) respectively. VR produced a 54% reduction in pica from baseline levels and NCR produced an 83% reduction in pica from baseline levels. FCT resulted in a 94% reduction in Michelle's rate of pica from what was observed during the pre-treatment FA screening.

Sarah engaged in pica at a mean rate of 19.4 rpm (range 15 – 27 rpm per session) in the FA screening (Figure 2). Responding in the VR, NCR, and FCT conditions was 7.2 rpm (range 4 – 9 rpm per session), 3.2 rpm (range 2 – 5 rpm per session), and 1 rpm (range 0 – 2 rpm per

session) respectively. VR produced a 63% reduction in pica from baseline levels and NCR produced an 84% reduction in pica from baseline levels. FCT resulted in a 95% reduction in Sarah's rate of pica from what was observed during the pre-treatment FA screening.

There was one outlier of note in Sarah's data; during VR session 30 there was a marked increase in Sarah's rate of pica. This was due to the presence of a novel stimulus in the playroom during one session, which included one VR, one NCR, and one FCT condition (sessions 30-32). The item was a 2 in pink-stuffed pig, which was observed to frequently result in pica. During this VR condition, Sarah engaged in 40 instances of pica exclusively with this novel stimulus in spite of verbal reprimand (i.e., "Not in your mouth") and response blocking. The novel stimulus did not increase Sarah's rate of pica in the other treatment conditions; in the presence of the novel stimulus Sarah's pica remained at low rates during the NCR (3 rpm) and FCT (3 rpm) conditions (Figure 2).

Data regarding discrimination for Michelle and Sarah are presented in Figures 3 and 4, respectively. Both Michelle and Sarah engaged in higher rates of appropriate behavior compared to pica in NCR and FCT conditions. During NCR, as shown in the top panel of Figure 3, Michelle engaged in a mean of 11.8 instances of appropriate behavior per session (range 8 – 18 responses per session), and a mean rate of 2 rpm for pica (range 0 – 4 rpm). During FCT, shown in the bottom panel of Figure 3, Michelle engaged in a mean of 6 instances of appropriate behavior per session (range 0 – 9 rpm per session); her mean rate of pica during FCT was 0.8 rpm (range 0 – 2 rpm; Figure 3). During NCR, as shown in the top panel of Figure 4, Sarah engaged in a mean of 18.8 instances of appropriate behavior per session (range 8 – 24 responses per session) and a mean rate of 3.2 rpm for pica (range 2 – 5 rpm). During FCT, shown in the bottom pane of Figure 4, Sarah engaged in a mean rate of 12.2 rpm of appropriate behavior

(range 7 – 18 rpm); her mean rate of pica during FCT was 1 rpm (range 0 – 2 rpm; Figure 4). Michelle's appropriate behavior showed increasing trends during NCR and FCT conditions by the end of the treatment comparison (Figures 3).

Discussion

The rate of pica for both subjects was reduced from baseline FA screening levels across all treatment conditions. Evaluations of both subjects' data indicated FCT resulted in the greatest reduction in the rate of pica for both Michelle and Sarah. Data indicated NCR was also effective at reducing the rate of pica for both subjects. Although the VR condition did result in a reduction in the rate of pica for both subjects from levels observed during the FA screening, rates of pica remained high in this condition for both Michelle and Sarah relative to the rates observed during FCT and NCR.

While the level of pica for both subjects decreased from levels observed during the pre-treatment FA screening, it remained higher in the VR condition relative to the NCR and FCT conditions. This suggests while punishment-based procedures might reduce pica from pre-treatment levels, reinforcement-based procedures might be more effective at reducing the rate of pica for some subjects (Piazza et al., 2002; Goh et al., 1999). The reductive effects of NCR and FCT on the pica of both subjects aligned with findings from prior research (Ing et al., 2011; Napolitano et al., 2007).

Although the VR condition bears some similarities to an attention condition often included in a traditional FA (i.e., attention in the form of a verbal reprimand and response blocking were provided contingent on pica), the confirmation of an automatic function for the pica of both subjects using the pre-treatment FA screening made it unlikely the attention provided during the VR condition resulted in an increase in the rate of pica. Further, we did not

see an increasing trend in pica across the VR condition. Related to this, it could be argued the inclusion of response blocking across all conditions, which was ethically required due to the potential for choking and/or ingestion of hazardous substances, might have confounded the treatment conditions by providing attention contingent on pica attempts. Given the pica of both subjects was maintained by an automatic function, it is unlikely the attention provided to either subject during conditions acted as a reinforcer for pica.

There were a number of limitations in the design of this study. First, only two female subjects were included in the treatment comparison. Additionally, the subjects were a set of identical twins. This raises questions regarding the generality of the results. Findings might also lack generality due to the age and functioning level of both subjects; these treatments might not have been as effective for older, higher-functioning subjects. Research, however, suggests the frequency of pica decreases with age in typically developing populations with a marked decrease in the hand-to-mouth movements associated with pica behaviors by the age of 36 months (Barltrop, 1966; Blinder & Salama, 2008; Lourie, Layman, & Millican, 1964). It is unclear if a similar trend exists in developmentally delayed populations, including individuals diagnosed with ASD. In light of this, the subjects' ages might contribute to (rather than hinder) the applied validity of the findings. Future research could attempt to replicate this research with older, higher-functioning subjects.

A second limitation of the current research is the maintaining function of the subjects' pica was not experimentally determined using a traditional FA. An FA screening was conducted according to the procedures described by Querim et al. (2013) who found FA screenings evaluating problem behavior maintained by automatic reinforcement during brief alone or no-interaction conditions had a high degree of correlation with the outcomes of full FAs. Because

the body of behavior-analytic research suggests pica is most often maintained by automatic reinforcement, this FA screening might be an effective and efficient method of confirming the automatic function of a subject's pica (Querim et al., 2013).

A fourth limitation is there might be practical concerns associated with replacing pica with FCT and edibles, including satiation effects, excessive caloric consumption, and weight gain (Blinder & Salama, 2008; Kern et al., 2006). While satiation effects might have been observed with one subject (Michelle) during the seventh and eighth FCT sessions evidenced by her low rate of appropriate behavior, Michelle's appropriate behavior returned to high and stable levels by the ninth session. More importantly, Michelle's appropriate behavior showed an increasing trend by the end of the treatment comparison. It is possible to address satiation effects by systematically thinning the schedule of reinforcement. Whether this would affect efficacy is an empirical question to be addressed by future research.

With regard to the risks of weight gain or excessive caloric consumption, future research might systematically evaluate the utility of using smaller portions of edibles by conducting a parametric analysis. A progressive ratio reinforcement schedule could also be evaluated to determine if increasing response effort per reinforcer might be an effective way of minimizing the amount of edibles presented/consumed. Within the parameters of this study it was determined the edible reinforcers provided during the FCT conditions were not in excess of the edible reinforcers either subject would potentially consume on an average day at the ABA clinic they both attended.

Fifth, no preference assessment was conducted with either subject to identify items included in the NCR condition. Although an MSWO assessment was conducted to identify preferred edibles for the FCT condition, time constraints prohibited conducting a similar

assessment for the items in the NCR condition. Similarly, the novelty of the items included in the array included in the NCR condition was not systematically manipulated. The data for one subject (Sarah) indicated novelty might be an important factor for competing stimuli evidenced by her high level of pica in the presence of a novel stimulus present in the playrooms. During one VR condition Sarah emitted 40 instances of pica exclusively with the one novel stimulus, specifically a 2 in pink stuffed pig. This item was unlike any of the items included in the array of appropriate items to mouth in the NCR condition. It is important to note the NCR and FCT sessions immediately following the VR session with a high rate of pica were effective at reducing Sarah's pica to near-zero levels in spite of the presence of the novel stimulus. Future research might examine the efficacy of conducting preference assessments designed to assess the appeal of a wider range of items appropriate for placing past the plane of the lips, as it is likely these preferences might be idiosyncratic across subjects.

This study contributes to the body of behavior-analytic research regarding pica and the relative efficacy of various treatments. Pica is a disorder with severe consequences, which require immediate, effective treatment. Determining what treatments will be most effective for each individual diagnosed with pica requires systematic evaluation and individualized assessment. The findings of this study have demonstrated the efficacy of three behavior-analytic treatments for the pica maintained by automatic reinforcement of two subjects. Results also confirmed the efficacy of FA screening procedures (e.g., Querim et al., 2013) as a method of assessment for problem behaviors when an automatic function is suspected.

References

Arbiter, E. A., & Black, D. (1991). Pica and iron-deficiency anaemia. *Child: Care, Health and Development,17*(4), 231-234. doi:10.1111/j.1365-2214.1991.tb00693.x

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis*, *1*, 91-97. doi:10.1901/jaba.1968.1-91

Baig-Ansari, N., Badruddin, S. H., Karmaliani, R., Harris, H., Jehan, I., Pasha, O., et al. (2008). Anemia prevalence and risk factors in pregnant women in an urban area of Pakistan. *Food and Nutrition Bulletin*, *29*, 132-139. doi: 10.1177/156482650802900207

Barltrop, D. (1966). The prevalence of pica. *Archives of Pediatric and Adolescent Medicine, 112*, 116-123. doi:10.1001/archpedi.1966.02090110060004

Bhatia, M. S., & Gupta, R. (2009). Pica responding to SSRI: An OCD spectrum disorder? *The World Journal of Biological Psychiatry*, *10*, 936-938. doi: 10.1080/15622970701308389

Blinder, B. J., & Salama, C. (2008). An update on pica: Prevalence, contributing causes, and treatment. *Psychiatric Times*, *25*(6), 66-66. Retrieved from http://ezprozy.rollins.edu:2048/login?url=http://go.galegroup.com.ezproxy.rollins.edu:2048/ps/i.do?p+AONE&sw=w&u=wint47629&v=2.1&it=r&id=GALE%7CA180317253&asid=5db7a8e5f0f0279a877cb361fac9ac88

Board, B. A. C. (2014). Professional and ethical compliance code for behavior analysts. *Retrieved April*, *30*, 2017.

Bucher, B., Reykdal, B., & Albin, J. (1976). Brief physical restraint to control pica in retarded children. *Journal of Behavior Therapy and Experimental Psychiatry*, *7*(2), 137-140. doi: 10.1016/0005-7916(76)90071-9

Carter, S. L. (2009). Treatment of pica using a pica exchange procedure with increasing response effort. *Education and Training in Developmental Disabilities*, 143-147.

Cooper, J. O., Heron, T. E., & Heward, W. L. (2007). *Applied behavior analysis*. Harlow: Pearson Education.

Corbett, R. W., Ryan, C., & Weinrich, S. P. (2003). Pica in pregnancy: Does it affect pregnancy outcomes? *MCN: The American Journal of Maternal/Child Nursing*, *28*(3), 183-189.

Danford, D. E., & Huber, A. M. (1982). Pica among mentally retarded adults. *American Journal of Mental Deficiency*, *87*(2), 141-146. Retrieved from http://europepmc.org/abstract/MED/7124824

DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis*, *29*(4), 519-533. doi: 10.1901/jaba.1996.29-519

Edwards, C. H., Johnson, A. A., Knight, E. M., Oyemade, U. J., Cole, O. J., Westney, O. E., et al. (1994). Pica in an urban environment. *The Journal of Nutrition, 124*(6), 954S-962S.

Erbas, D., Tekin-Iftar, E., & Yucesoy, S. (2006). Teaching special education teachers how to conduct functional analysis in natural settings. *Education and Training in Developmental Disabilities, 41*(1), 28-36. Retrieved from http://daddcec.org/Portals/0/CEC/Autism_Disabilities/Research/Publications/Education_Training_Development_Disabilities/2006v41_Journals/ETDD_200603v41n1p028-036_Teaching_Special_Education_Teachers_How_Conduct_Functional.pdf

Falcomata, T. S., Roane, H. S., & Pabico, R. R. (2007). Unintentional stimulus control during the treatment of pica displayed by a young man with autism. *Research in Autism Spectrum Disorders*, *1*(4), 350-359.

Ferreri, S. J., Tamm, L., & Wier, K. G. (2006). Using food aversion to decrease severe pica by a child with autism. *Behavior Modification*, *30*(4), 456-471. doi: 10.1177/0145445504272970

Finney, J. W., Russo, D. C., & Cataldo, M. F. (1982). Reduction of pica in young children with lead poisoning. *Journal of Pediatric Psychology,7*(2), 197-207. doi:10.1093/jpepsy/7.2.197

Fisher, W. W., Piazza, C. C., Bowman, L. G., Kurtz, P. F., Sherer, M. R., & Lachman, S. R. (1994). A preliminary evaluation of empirically derived consequences for the treatment of pica. *Journal of Applied Behavior Analysis*, *27*(3), 447-457. doi: 10.1901/jaba.1994.27-447

Foulon, C. (2002). Schizophrenia and eating disorders. *L'Encephale*, *29*(5), 463-466. Retrieved from http://europepmc.org/abstract/med/14615697

Foxx, R. M., & Martin, E. D. (1975). Treatment of scavenging behavior (coprophagy and pica) by overcorrection. *Behavior Research and Therapy, 13*, 153-162. doi: 10.1016/0005-7967(75)90009-1

Goh, H. L., Iwata, B. A., & Kahng, S. W. (1999). Multicomponent assessment and treatment of cigarette pica. *Journal of Applied Behavior Analysis, 32(3)*, 297-316. doi: 10.1901/jaba.1999.32-297

Gresham, F. M., Watson, T. S., & Skinner, C. H. (2001). Functional behavioral assessment: Principles, procedures, and future direction. *School Psychology Review*, *30*(2), 156-172. Retrieved from http://web.a.ebscohost.com.ezproxy.rollins.edu:2048/ehost/pdfviewer/pdfviewer?sid=6a7a0c66-165b-4445-89cf-edb224c714be%40sessionmgr4007&vid=1&hid=4204

Hagopian, L. P., & Adelinis, J. D. (2001). Response blocking with and without redirection for the treatment of pica. *Journal of Applied Behavior Analysis*, *34*(4), 527-530. doi: 10.1901/jaba.2001.34-527

Hagopian, L. P., González, M. L., Rivet, T. T., Triggs, M., & Clark, S. B. (2011). Response interruption and differential reinforcement of alternative behavior for the treatment of pica. *Behavioral Interventions,26*(4), 309-325. doi:10.1002/bin.339

Hagopian, L. P., Rooker, G. W., & Rolider, N. U. (2011). Identifying empirically supported treatments for pica in individuals with intellectual disabilities. *Research in Developmental Disabilities,32*(6), 2114-2120. doi:10.1016/j.ridd.2011.07.042

Hall, S. S. (2005). Comparing descriptive, experimental and informant-based assessments of problem behaviors. *Research in Developmental Disabilities*, *26*(6), 514-526. doi: 10.1016/j.ridd.2004.11.004

Harada, K. I., Yamamoto, K., & Saito, T. (2006). Effective treatment of coprophagia in a patient with schizophrenia with the novel atypical antipsychotic drug perospirone. *Pharmacopsychiatry*, *39*(03), 113-113. doi: 10.1055/s-2006-941487

Ing, A. D., Roane, H. S., & Veenstra, R. A. (2011). Functional analysis and treatment of coprophagia. *Journal of Applied Behavior Analysis*, *44*(1), 151-155. doi:10.1901/jaba.2011.44-151

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1982/1994). Toward a functional analysis of self‐injury. *Journal of Applied Behavior Analysis*, *27*(2), 197-209. doi: 10.1901/jaba.1994.27-197

Iwata, B. A., Wallace, M. D., Kahng, S., Lindberg, J. S., Roscoe, E. M., Conners, J., ... & Worsdell, A. S. (2000). Skill acquisition in the implementation of functional analysis

methodology. *Journal of Applied Behavior Analysis*, *33*(2), 181-194. doi:10.1901/jaba.2000.33-181

Jawed, S. H., Krishnan, V. H., Prasher, V. P., & Corbett, J. A. (1993). Worsening of pica as a symptom of depressive illness in a person with severe mental handicap. *The British Journal of Psychiatry*, *162*(6), 835-837. doi: 10.1192/bjp.162.6.835

Johnson, C. R., Hunt, F. M., & Siebert, M. J. (1994). Discrimination training in the treatment of pica and food scavenging. *Behavior Modification*, *18*(2), 214-229. doi: 10.1177/01454455940182005

Johnson, B. E., & Stephens, R. L. (1982). Geomelophagia: An unusual pica in iron-deficiency anemia. *The American Journal of Medicine*, *73*(6), 931-932. doi: 10.1016/0002-9343(82)90798-7

Kelly, M. (2009/2010). Pica: A literature review. *The Irish Psychologist, 36*(2/3), 41-47. Retrieved from https://www.researchgate.net/profile/Michelle_Kelly14/publication/304353575_Pica_A_literature_review/links/576cfe7708ae3c5c932dfe6c.pdf

Kern, L., Starosta, K., Adelman, B.E. (2006). Reducing pica by teaching children to exchange inedible items for edibles. *Behavior Modification, 30*(2), 135-158. doi:10.1177/0145445505283414

LaMalfa, G. L., Lassi, S., Bertelli, M., Salvini, R., & Placidi, G. F. (2004). Autism and intellectual disability: A study of prevalence on a sample of the Italian population. *Journal of Intellectual Disability Research, 48*(3), 262-267. doi:10.1111/j.1365-2788.2003.00567.x

Lourie, R. S., Layman, E. M., & Millican, F. K. (1964). Why children eat things

that are not food. *Nursing Research*, *13*(2), 186.

Luiselli, J. K. (1996). Pica as obsessive-compulsive disorder. *Journal of Behavior Therapy and Experimental Psychiatry*, *27*(2), 195-196. doi: 10.1097/00006199-196401320-00064

Mace, F. C., & Knight, D. (1986). Functional analysis and treatment of severe pica. *Journal of Applied Behavior Analysis*, *19*(4), 411-416. doi: 10.1901/jaba.1986.19-411

McAdam, D. B., Sherman, J. A., Sheldon, J. B., & Napolitano, D. A. (2004). Behavioral interventions to reduce the pica of persons with developmental disabilities. *Behavior Modification*, *28*(1), 45-72. doi: 10.1177/0145445503259219

McCord, B. E., Grosser, J. W., Iwata, B. A., & Powers, L. A. (2005). An analysis of response-blocking parameters in the prevention of pica. *Journal of Applied Behavior Analysis*, *38*(3), 391-394. doi: 10.1901/jaba.2005.92-04

Moore, J. W., Edwards, R. P., Sterling‐Turner, H. E., Riley, J., DuBard, M., & McGeorge, A. (2002). Teacher acquisition of functional analysis methodology. *Journal of Applied Behavior Analysis*, *35*(1), 73-77. doi: 10.1901/jaba.2002.35-73

Motta, R. W., & Basile, D. M. (1998). Pica. In L. Phelps (Ed.), *Health-related disorders in children: A guidebook for understanding and educating* (pp. 524-527). Washington, DC: American Psychological Association.

Napolitano, D. A., Blakkman, L. A., Kohl, L. B., Vallese, H. M., & McAdam, D. B. (2007). The use of functional communication training to reduce pica. *The Journal of Speech and Language Pathology–Applied Behavior Analysis*, *2*(1), 25. doi: 10.1037/h0100206

Northup, J., Wacker, D., Sasso, G., Steege, M., Cigrand, K., Cook, J., & DeRaad, A. (1991). A brief functional analysis of aggressive and alternative behavior in an outclinic setting. *Journal of Applied Behavior Analysis*, *24*(3), 509-522. doi: 10.1901/jaba.1991.24-509

Pace, G. M., & Toyer, E. A. (2000). The effects of a vitamin supplement on the pica of a child with severe mental retardation. *Journal of Applied Behavior Analysis*, *33*(4), 619-622. doi: 10.1901/jaba.2000.33-619

Paisey, T. J., & Whitney, R. B. (1989). A long-term case study of analysis, response suppression, and treatment maintenance involving life-threatening pica. *Behavioral Interventions*, *4*(3), 191-211. doi: 10.1002/bin.2360040304

Piazza, C. C., Fisher, W. W., Hanley, G. P., LeBlanc, L. A., Worsdell, A. S., Lindauer, S. E., & Keeney, K. M. (1998). Treatment of pica through multiple analyses of its reinforcing functions. *Journal of Applied Behavior Analysis*, *31*(2), 165-189. doi: 10.1901/jaba.1998.31-165

Piazza, C. C., Hanley, G. P., & Fisher, W. W. (1996). Functional analysis and treatment of cigarette pica. *Journal of Applied Behavior Analysis*, *29*(4), 437-450. doi: 10.1901/jaba.1996.29-437

Piazza, C. C., Roane, H. S., Keeney, K. M., Boney, B. R., & Abt, K. A. (2002). Varying response effort in the treatment of pica maintained by automatic reinforcement. *Journal of Applied Behavior Analysis*, *35*(3), 233-246. doi: 10.1901/jaba.2002.35-233

Querim, A. C., Iwata, B. A., Roscoe, E. M., Schlichenmeyer, K. J., Ortega, J. V., & Hurl, K. E. (2013). Functional analysis screening for problem behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis*, *46*(1), 47-60. doi: 10.1002/jaba.26

Rainville, A. J. (1998). Pica practices of pregnant women are associated with lower maternal hemoglobin level at delivery. *Journal of the American Dietetic Association*, *98*(3), 293-296. doi: 10.1016/s0002-8223(98)00069-8

Rapp, J. T., Dozier, C. L., & Carr, J. E. (2001). Functional assessment and treatment of pica: A single-case experiment. *Behavioral Interventions,16*(2), 111-125. doi:10.1002/bin.79

Reynolds, R. D. (1968). Pagophagia and iron deficiency anemia. *Annals of Internal Medicine, 69*(3), 435. doi:10.7326/0003-4819-69-3-435

Ricciardi, J. N., Luiselli, J. K., Terrill, S., & Reardon, K. (2003). Alternative response training with contingent practice as intervention for pica in a school setting. *Behavioral Interventions,18*(3), 219-226. doi:10.1002/bin.135

Sharma, T. R., Aly, M., & Kavuru, B. (2011). Coprophagia and pica in individuals with mild to moderate dementia and mixed (iron deficiency and macrocytic) anemia. *Journal of the American Geriatrics Society*, *59*(12), 2375-2377. doi:10.1111/j.1532-5415.2011.03703.x

Singh, N. N. (1983). Behavioral treatment of pica in mentally retarded persons. *Psychiatric Aspects of Mental Retardation Newsletter*, *2*(9), 33-36.

Singh, N. N., & Bakker, L. W. (1984). Suppression of pica by overcorrection and physical restraint: A comparative analysis. *Journal of Autism and Developmental Disorders*, *14*(3), 331-341. doi: 10.1007/bf02409583

Skinner, B. F. (1974). *About behaviorism*. New York: Random House.

Smith, M. D. (1987). Treatment of pica in an adult disabled by autism by differential reinforcement of incompatible behavior. *Journal of Behavior Therapy and Experimental Psychiatry,18*(3), 285-288. doi:10.1016/0005-7916(87)90012-7

Tiger, J. H., Hanley, G. P., & Bruzek, J. (2008). Functional communication training: A review and practical guide. *Behavior Analysis in Practice*, *1*(1), 16-23.

Vollmer, T. R. (1994). The concept of automatic reinforcement: Implications for behavioral research in developmental disabilities. *Research in Developmental Disabilities*, *15*(3), 187-207. doi: 10.1016/0891-4222(94)90011-6

Vollmer, T. R., & Iwata, B. A. (1992). Differential reinforcement as treatment for behavior disorders: Procedural and functional variations. *Research in Developmental Disabilities*, *13*(4), 393-417. doi: 10.1016/0891-4222(92)90013-v

Vollmer, T. R., Peters, K. P., & Slocum, S. K. (2015). Treatment of severe behavior disorders. In Clinical and Organizational Applications of Applied Behavior Analysis (47-67). Location: Elsevier.

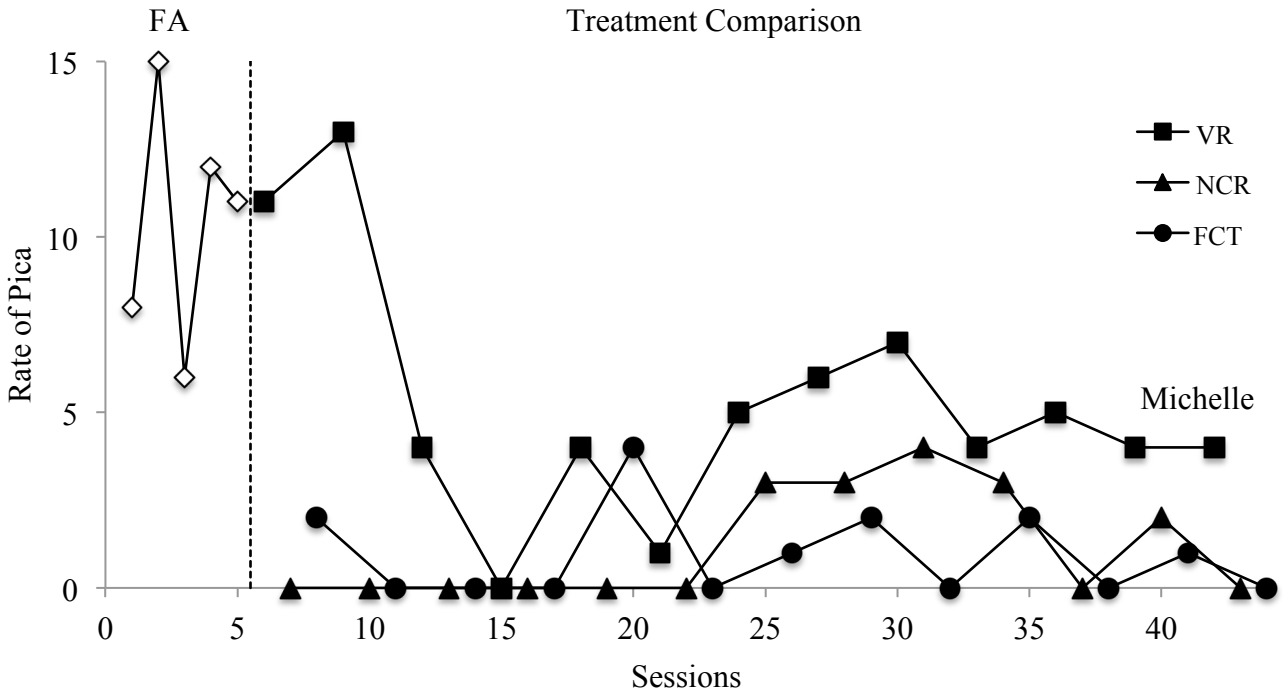

Figure 1. The rate of pica across FA screening and treatment comparison (verbal reprimand [VR], noncontingent reinforcement [NCR], and functional communication training [FCT]) for Michelle.

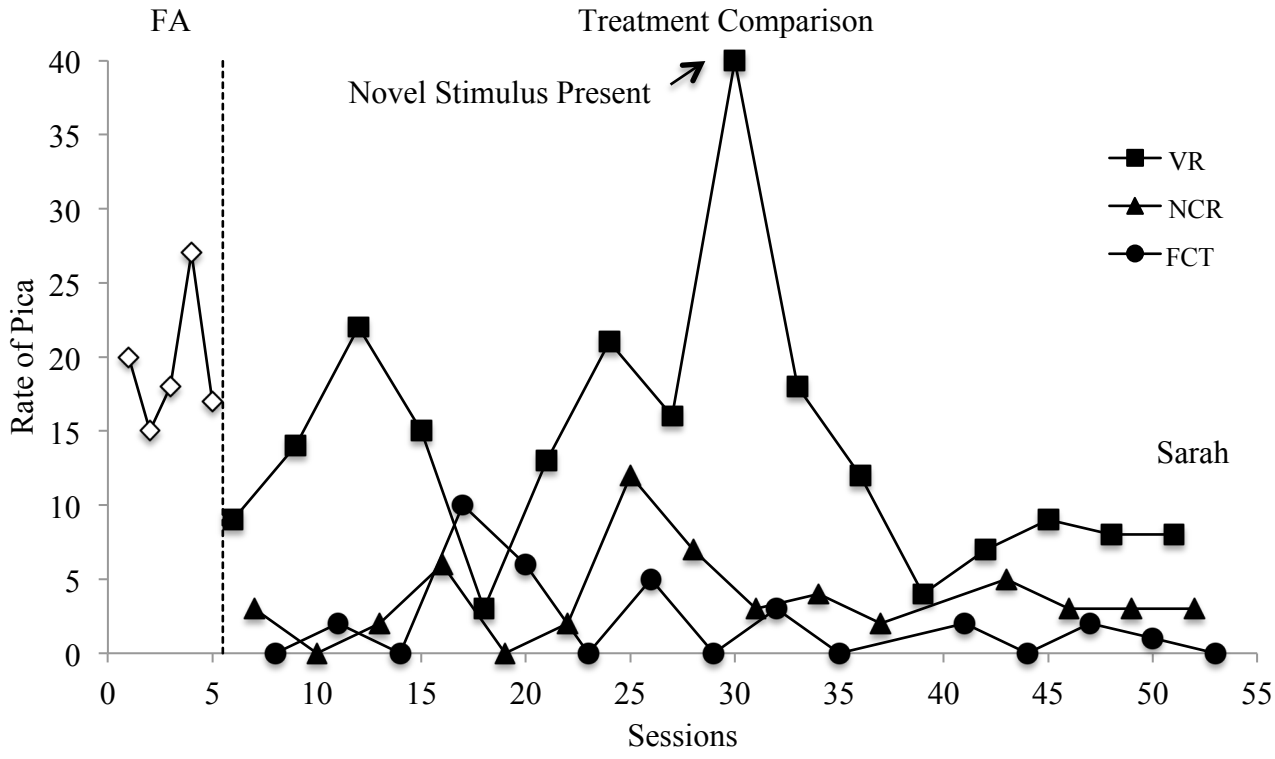

Figure 2. The rate of pica across FA screening and treatment comparisons (verbal reprimand; [VR], noncontingent reinforcement [NCR], and functional communication training [FCT]) for Sarah.

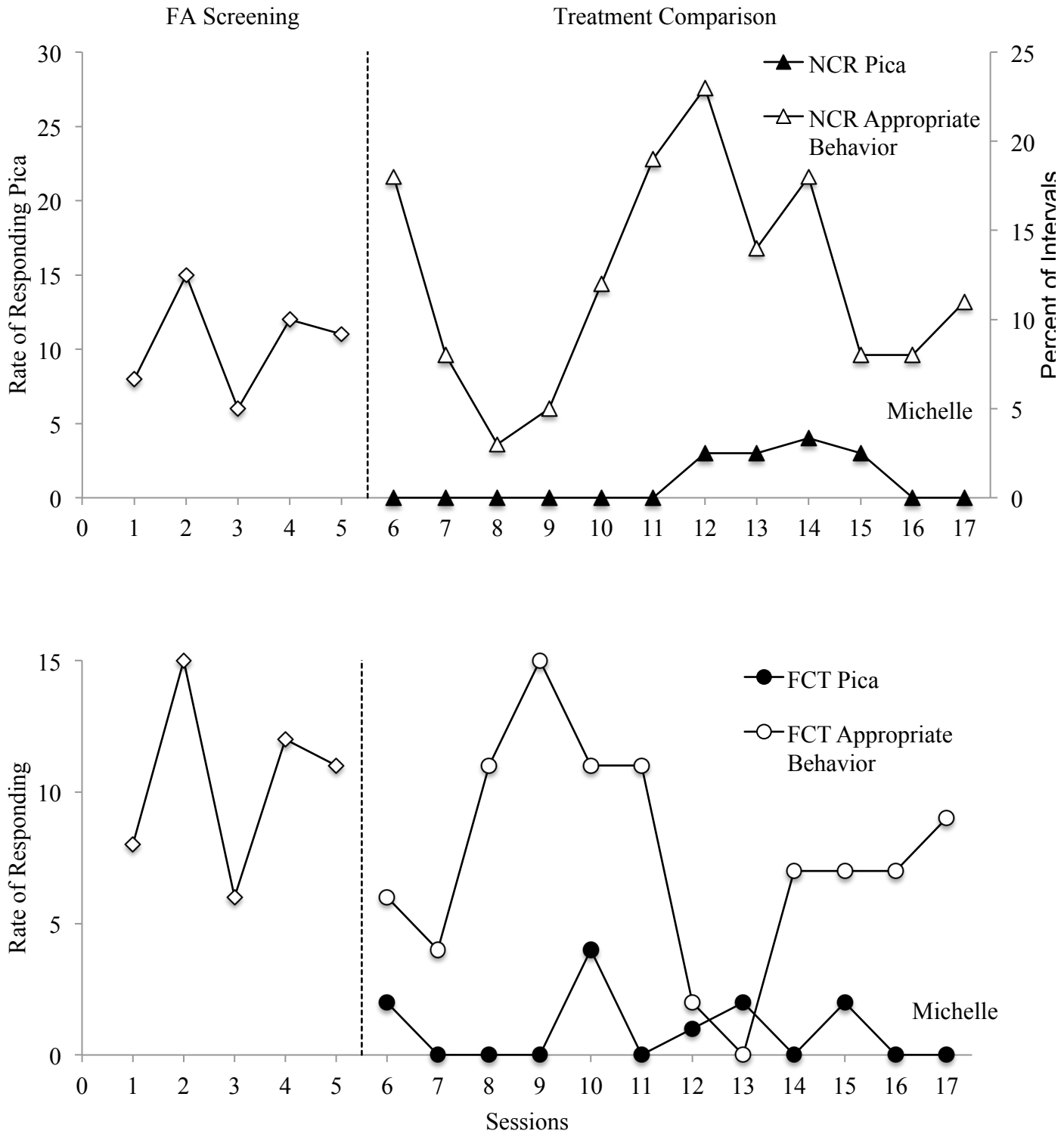

Figure 3. Rate of pica (Y-axis 1) and percent of intervals of appropriate behavior (Y-axis 2; abbreviated axis used to enhance visual analysis of the data) during noncontingent reinforcement

(NCR; top panel) conditions, and rate of pica and appropriate behavior during functional communication training (FCT; bottom panel) conditions for Michelle.

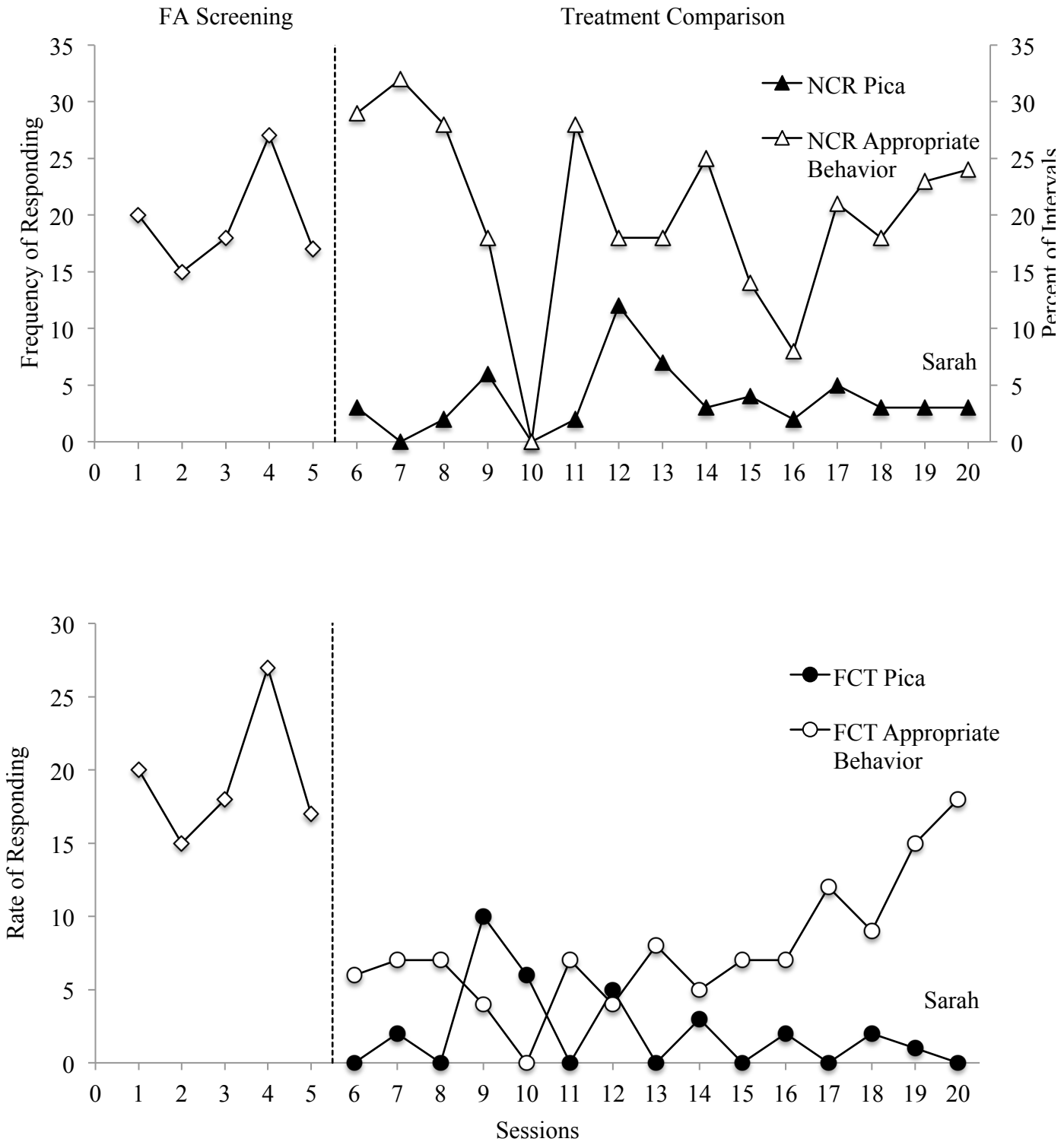

Figure 4. Rate of pica (Y-axis 1) and percent of intervals of appropriate behavior (Y-axis 2;

abbreviated axis used to enhance visual analysis of the data) during noncontingent reinforcement (NCR; top panel) conditions, and rate of pica and appropriate behavior during functional communication training (FCT; bottom panel) conditions for Sarah.