Chained Schedule Thinning to Increase Compliance Within a Functional Communication Training Context

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Chained Schedule Thinning to Increase Compliance Within a Functional Communication Training Context

by

Bryce Bennett

A Thesis
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St. Cloud State University
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Abstract

Functional communication training (FCT) is a popular intervention for reducing problematic behaviors and promoting communication for individuals with developmental disabilities. The present study investigated the application of a chained schedule arrangement to increase compliance for academic instruction and food acceptance within an FCT context for two individuals, and evaluated an expedient thinning procedure for achieving practical response rates. Participants were taught functionally communicative responses (FCRs) to replace problem behaviors. Demands were presented to either complete academic tasks or accept bites of food. Schedules were thinned to increase the number of demands presented per session. Results showed that for both participants, compliance for demands across both skill domains increased, and problem behavior decreased, relative to baseline. The schedule was successfully thinned and terminal criteria were met for one skill for each participant. Treatment effects were generalized to parents for one skill for each participant. Implications of the results are discussed.

Keywords: functional communication training, chained schedules, schedule thinning, compliance, feeding, problem behavior
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# Table of Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td></td>
</tr>
<tr>
<td>I.</td>
<td>Introduction and Literature Review</td>
</tr>
<tr>
<td></td>
<td>Comparison of Compound Schedule Arrangements</td>
</tr>
<tr>
<td></td>
<td>Compound Schedules and FCT</td>
</tr>
<tr>
<td>II.</td>
<td>Method</td>
</tr>
<tr>
<td></td>
<td>Participants</td>
</tr>
<tr>
<td></td>
<td>Setting and Materials</td>
</tr>
<tr>
<td></td>
<td>Response Definitions and Data Collection</td>
</tr>
<tr>
<td></td>
<td>Interobserver Agreement</td>
</tr>
<tr>
<td></td>
<td>Experimental Design and Procedure</td>
</tr>
<tr>
<td>III.</td>
<td>Results</td>
</tr>
<tr>
<td></td>
<td>Functional Analysis</td>
</tr>
<tr>
<td></td>
<td>Demand Assessment</td>
</tr>
<tr>
<td></td>
<td>Baseline and Intervention</td>
</tr>
<tr>
<td>IV.</td>
<td>Discussion</td>
</tr>
<tr>
<td></td>
<td>Interpretations</td>
</tr>
<tr>
<td></td>
<td>Contributions to the Literature</td>
</tr>
<tr>
<td></td>
<td>Limitations and Future Research</td>
</tr>
<tr>
<td>References</td>
<td>51</td>
</tr>
<tr>
<td>Appendices</td>
<td>57</td>
</tr>
<tr>
<td>A. Table 1</td>
<td>57</td>
</tr>
<tr>
<td>Chapter</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>------</td>
</tr>
<tr>
<td>B. Table 2</td>
<td>58</td>
</tr>
<tr>
<td>C. Table 3</td>
<td>59</td>
</tr>
<tr>
<td>D. Table 4</td>
<td>60</td>
</tr>
<tr>
<td>E. Figure 1</td>
<td>61</td>
</tr>
<tr>
<td>F. Figure 2</td>
<td>62</td>
</tr>
<tr>
<td>G. Figure 3</td>
<td>63</td>
</tr>
<tr>
<td>H. Figure 4</td>
<td>64</td>
</tr>
<tr>
<td>I. Figure 5</td>
<td>65</td>
</tr>
<tr>
<td>J. Figure 6</td>
<td>66</td>
</tr>
<tr>
<td>K. Figure 7</td>
<td>67</td>
</tr>
</tbody>
</table>
Chapter I: Introduction and Literature Review

According to Skinner’s (1957) taxonomy, a mand is defined as a verbal operant controlled by relevant conditions of deprivation or aversive stimulation (i.e., establishing operations [EO; Michael, 1982]) and reinforced by a characteristic consequence through the mediation of a listener. Said differently, a mand “specifies… its reinforcement” (Skinner, 1957, p. 36). An individual deprived of a stimulus or exposed to aversive stimulation can emit a mand in the presence of a listener to gain access to said stimulus or escape aversive stimulation. Therefore, a mand is arguably the most crucial tool for meeting one’s needs within a verbal community. In light of this, it is no surprise that interventions designed to reduce problem behaviors often include teaching individuals to mand. One such intervention is FCT (Carr & Durand, 1985).

Since the publication of Carr and Durand’s (1985) seminal study, FCT has become the most widely employed function–based intervention for treating problem behaviors (Tiger, Hanley, & Bruzek, 2008). FCT constitutes a differential reinforcement of alternative behavior (DRA) procedure, in which a problem behavior is placed on extinction (EXT) while a replacement behavior is reinforced. In a typical FCT intervention, a functional analysis (FA) is first conducted to determine the source of reinforcement for a problem behavior, along with the surrounding conditions that alter the value of that reinforcement (Tiger et al., 2008). Next, an FCR (i.e., a mand) is taught that functions to access that same source of reinforcement, under equivalent stimulus conditions. Because the individual makes frequent contact with the functional reinforcer through the emission of the mand, the EO for problem behavior is effectively weakened (Laraway, Snycerski, Michael, & Poland, 2003). Therefore, the likelihood
of the FCR increases while the likelihood of problem behavior simultaneously decreases. Last, the intervention is generalized to other settings and/or caregivers (Tiger et al., 2008).

In the initial stages of teaching, the FCR is reinforced on a dense schedule (i.e., FR 1) to eliminate the putative EOs that control problem behaviors, and as such, rates of FCRs often approximate rates of problem behaviors observed prior to training (Hanley, Iwata, & Thompson, 2001). However, it may be difficult to maintain the dense schedule in the natural environment, as caregivers often have multiple responsibilities that require their attention and are not available to continuously reinforce FCRs (Hanley et al., 2001; Tiger et al., 2008). If FCRs cannot be reinforced consistently, the strength of the response may diminish and eventually extinguish altogether (Hagopian, Boelter, & Jarmolowicz, 2011), which may in turn result in the re-emergence of problem behaviors (i.e., resurgence; e.g., Volkert, Lerman, Call, & Trosclair–Lasserre, 2009).

Numerous studies have evaluated the effects of arranging particular schedules of reinforcement on maintaining FCRs and preventing resurgence of problem behaviors. Once optimal schedule arrangements are identified, treatments are typically designed to gradually thin the schedule to more practical levels, allowing for continued maintenance of the intervention in natural settings. Compound schedule arrangements involve the successive or simultaneous presentation of different schedules of reinforcement, often (but not necessarily) signaled by a discriminative stimulus (SD; Ferster & Skinner, 1957). Schedule thinning for compound arrangements generally entails the gradual increasing of the duration of an EXT component, while the reinforcement component is kept constant (e.g., Hanley et al., 2001).
In a review of 25 studies on compound schedules and thinning procedures, Greer, Fisher, Saini, Owen, and Jones (2016) found that MULT and chained arrangements reduced problem behavior by up to 96% of baseline levels. Furthermore, discriminated FCRs (i.e., those that only occurred in the presence of an S^D) were observed for 92% of the total number of FCRs. Finally, the overall availability of reinforcement was reduced by 82% during schedule thinning, allowing for more practical implementation and accessibility to natural contexts (Greer et al., 2016). A similar review of 31 studies by Saini, Miller, and Fisher (2016) showed an increasing trend in recent years for the use of MULT schedules as a component of treatments for reducing high rates of problem behaviors and/or manding. Indeed, more studies using MULT schedules were conducted from 2010–2014 than the preceding decade (Saini et al., 2016). Although some studies evaluate a given schedule arrangement in isolation, numerous studies compare two or more arrangements in an effort to determine the most effective arrangement for maintaining low rates of problem behaviors and discriminated manding across components.

**Comparison of compound schedule arrangements**

Though many compound schedule arrangements have been explored in the literature, the three most relevant to the current study are multiple (MULT), mixed, and chained schedules. MULT schedules are typically comprised of two components: an FR 1 component and an EXT component, with a specific S^D signaling the onset of each component (e.g., colored laminated cards; Hanley et al., 2001). Mixed schedules are identical to MULT arrangements, with the exception that no stimuli are present to signal FR 1 and EXT components (Hanley et al., 2001). In a comparison of schedule thinning procedures, Hanley et al. (2001) implemented an FCT intervention for three adult participants with profound intellectual disabilities who engaged in...
problem behavior. Results of the study indicated that, compared to mixed schedules, the MULT schedule was more effective in reducing problem behaviors and producing manageable rates of FCRs that were discriminated across schedule components. These results suggest that the schedule–correlated stimuli associated with MULT schedules were a necessary element of the arrangement for producing discriminating response patterns.

In another evaluation of MULT schedules, Fisher, Greer, Fuhrman, and Querim (2015) generalized FCT treatment across settings and therapists for three children with developmental disabilities who engaged in problem behavior. Results showed the gradual emergence of discriminated responding between FR 1 and EXT components when the MULT schedule was introduced. Furthermore, when FCRs were transferred to novel settings and therapists, both participants showed immediate increases in FCRs during FR 1 components but not in the EXT component, suggesting treatment effects of the MULT schedule were readily generalized to novel contexts.

Chained schedules are compound schedules in which the completion of one schedule produces access to the following schedule, and reinforcement is contacted contingent on completion of the final schedule (Ferster & Skinner, 1957). In applied settings, chained schedules typically involve access to reinforcement, generally in the form of escape from a non–preferred activity, contingent on compliance with demands (Greer et al., 2016). As such, chained schedules are valuable assets for targeting noncompliance, which is generally defined as the failure to respond to instructions within a given time period (Fischetti et al., 2012). Chained schedules differ from MULT schedules in that the change in contingency from one schedule component to the next is response–dependent in the chained schedule, as opposed to time–
dependent in the MULT schedule (Zangrillo, Fisher, Greer, Owen, & DeSouza, 2016). As such, chained schedules are most appropriate for treatments aimed at reducing problem behaviors associated with escape from demands and increasing instances of compliance (Greer et al., 2016). Chained schedules can also facilitate discrimination of work periods from non–work periods (Greer et al., 2016). Thinning for chained schedules generally involves gradually increasing the criteria for compliance necessary for reinforcement (Greer et al., 2016). For instance, demands may be delivered on an FR schedule, and following the final ratio requirement, reinforcement is delivered on an FT schedule, at which point the ratio is increased and the process is repeated. In the final phases of schedule thinning, chained schedules are typically switched to MULT schedules matched to terminal component durations (e.g., 240 s), and requirements for compliance are removed (Greer et al., 2016).

Falcomata, White, Muething, and Fragale (2012) applied a chained schedule to FCT for an 8–year–old with multiply controlled problem behavior. The chained schedule involved the delivery of the $S^O$, and in turn reinforcement, contingent on the first FCR following completion of a math worksheet. Completion of the entire worksheet constituted a probe for the terminal goal of treatment, and as problem behavior remained at zero during this probe, no thinning procedures were necessary. Results showed the chained schedule procedure to be effective in establishing discriminated FCRs, reducing rates of multiply–controlled problem behavior, and promoting compliance for academic tasks.

**Compound schedules and FCT**

Several considerations can be taken into account when implementing an FCT intervention. Research supports the use of environmental signals, contingency–specifying verbal
rules, and abrupt schedule thinning. Common to many evaluations of MULT schedule arrangements is the inclusion of different stimuli to signal both FR 1 and EXT components (e.g., Fisher et al., 2015; Hanley et al., 2001; Tiger & Hanley, 2004). In implementing FCT for a 13–year–old with ASD, Jarmolowicz, DeLeon, and Kuhn (2009) sought to determine which signal arrangement produced more desirable patterns of responding during schedule thinning: signaling FR 1 only, EXT only, or both. Results showed that although signaled FR 1 and signaled FR 1/EXT conditions produced a marked decrease in problem behaviors, this decrease was not observed in the signaled EXT condition. Similarly, rates of FCRs were less stable in the signaled EXT condition compared to the other conditions. These results suggest that treatment effects observed for MULT schedules were driven predominately by signaled periods of reinforcement. Additionally, the results suggest that a single–signal arrangement may be sufficient for producing treatment effects similar to a two–signal arrangement. This finding holds important implications for generalizing a schedule thinning procedure to natural contexts, where a two–signal arrangement may not be feasible or socially valid.

Lambert, Clohisy, Barrows, and Houchins–Juarez (2016) evaluated the effect of chained and MULT schedules on the maintenance of FCRs and compliance, and the concurrent reduction of problem behaviors for two children with developmental disabilities. Results for two participants showed immediate and dramatic increases of compliance using the MULT schedule arrangement; however, similar results were only observed for the third participant following the introduction of the chained schedule arrangement. All three participants showed discriminated FCRs and instances of manding that continued through contingency reversals. Finally, treatment effects were maintained following generalization to caregivers.
In an evaluation of the inclusion of contingency–specifying rules to environmental signals, Tiger and Hanley (2004) taught three typically developing preschool children to solicit teacher attention at appropriate times in a classroom. To determine whether manding could be considered contingency–shaped behavior or rule–governed behavior, two conditions were evaluated: MULT plus contingency–specifying rules, and MULT plus rules with varied $S^D$s, which involved the reassignment of the schedule–correlated stimuli each session. The results showed that when contingency–specifying rules were introduced, immediate discriminated responding was observed for all three participants. These findings suggest that rules alone are not sufficient for establishing differentiated manding, but that rules help to facilitate discrimination of contingencies specified by schedule–correlated stimuli. Furthermore, manding was observed exclusively in FR 1 components when $S^D$s were varied, suggesting that manding was governed by rules rather than controlled by contingencies signaled with schedule–correlated stimuli (Tiger & Hanley, 2004). However, it should be noted that because all three participants in the study were typically–developing and had no language deficits, the application of contingency–specifying rules may not be as effective for populations with language deficits, such as those with developmental disabilities.

In an evaluation of the effects of natural and contrived stimuli on establishing discriminated FCRs and generalization to novel contexts, Shamlian et al. (2016) implemented FCT with three children with autism who engaged in problem behavior. The experimenters exposed participants to conditions in which the therapist was engaged in busy or non–busy activities, with or without schedule–correlated signals (i.e., wristband versus bare wrist). When discrimination training was introduced, although results varied considerably across participants,
higher overall rates of FCRs, and higher rates of discriminated FCRs (i.e., when $S^D$ was present), were observed when components were signaled with contrived stimuli. Additionally, resurgence was observed for two of three participants when training was introduced in both contrived and naturally–occurring stimulus conditions. These results suggest that arranging contrived stimuli, as opposed to naturally–occurring stimuli, may facilitate discrimination of FCRs, particularly with the inclusion of contingency–specifying rules. However, neither procedure was effective in preventing resurgence of problem behaviors.

Zangrillo et al. (2016) compared two thinning procedures for chained schedules for two 7–year–olds with developmental disabilities who engaged in problem behavior. During FCT, contingent on compliance, participants either received a 30–s break from demands in one condition, or a break plus access to preferred items in a second condition. During schedule thinning, work demands were increased according to individualized criteria for each participant. Additionally, contingent on low levels of problem behavior (less than 80% of baseline mean), and high levels of compliance (80% or higher), durations of reinforcement components were increased systematically. Results showed a greater decrease in problem behaviors, greater compliance to work tasks, and faster schedule thinning in the escape–to–tangibles condition as compared with the escape–only condition. These results suggest that the combination of positive and negative reinforcement produced more robust effects on compliance and problem behavior than negative reinforcement alone. Additionally, terminal schedules approximating classroom conditions were achieved more readily by combining positive and negative reinforcement. One limitation evident in the study is number of sessions required to reach terminal schedule values,
warranting research on a rapid thinning procedure as has been done with MULT schedules (e.g., Betz, Fisher, Roane, Mintz, & Owen, 2013).

Although Hanley et al. (2001) recommended that component durations be thinned gradually to avoid resurgence and to maintain FCRs over longer periods without reinforcement, several recent studies have demonstrated that this time–consuming process may not be necessary (e.g., Betz et al., 2013; Fisher et al., 2015; Shamlian et al., 2016). The notion of abrupt fading is based on findings presented by Betz et al. (2013), who presented two possible explanations for the effects observed by Hanley et al. (2001) during gradual thinning. For one, participants may have learned to habituate to increased exposure of the EO for problem behavior. On the other hand, initial MULT schedule values may have expedited participants’ discrimination between the two components, thereby forgoing the need to gradually increase durations of EXT. The researchers hypothesized the latter possibility to be more likely. To test their hypothesis, Betz et al. conducted a component analysis of the thinning procedures similar to those employed by Hanley et al. (2001) with four children diagnosed with developmental disabilities.

The researchers compared rates of responding within dense mixed and MULT schedules that were rapidly shifted to lean MULT schedules. Both mixed and MULT sessions alternated FR 1 and EXT components every 60 s and began with the therapist’s delivery of contingency specifying rules; schedules were then abruptly thinned to terminal values (i.e., 60 s FR 1/240 s EXT). Results for the two participants in the MULT group showed immediate discrimination of FCRs during baseline, which continued through the thinning condition. For the two participants in the mixed schedule group, FCRs were undifferentiated during baseline, but the introduction of terminal schedules resulted in immediate discrimination and continued stability. Abrupt thinning
produced a slight increase in problem behaviors for one participant, although rates remained at near–zero levels for the majority of terminal value sessions. Rates of problem behaviors remained at zero or near–zero levels for the remaining three participants throughout baseline and thinning conditions. These results confirmed the researchers’ hypothesis that if ample time is spent establishing discriminative control over FCRs, a gradual thinning procedure is unnecessary for maintaining stable rates of manding and problem behaviors. Whereas the gradual thinning procedure employed by Hanley et al. (2001) involved seven steps to reach terminal criteria, the abrupt thinning procedure used by Betz et al. (2013) achieved comparable results with only two steps. Considering that resurgence was only observed to a small degree, the demonstration of an effective rapid thinning procedure by Betz et al. presents important implications for the feasibility of generalizing FCT interventions to natural environments. Although these findings have been replicated with MULT schedules (e.g., Fisher et al., 2015; Shamlian et al., 2016), no research to date has been conducted to evaluate the effectiveness of a rapid thinning procedure with alternative schedule arrangements (e.g., chained schedules).

The primary purpose of the present investigation was to extend the research of Zangrillo et al. (2016), Falcomata et al. (2012), Lambert et al. (2017), and Betz et al. (2013) by testing the hypothesis that rates of compliance and FCRs will be maintained in the absence of resurgence when terminal schedule values are probed for a chained schedule arrangement. A secondary purpose of the current investigation was to evaluate the utility of an intervention package designed to increase participants’ compliance for food acceptance, as well as a chained schedule thinning procedure to increase participants’ food intake. Furthermore, by probing terminal schedule values when criteria were met, the effects of an abrupt thinning procedure were
evaluated for increasing bite requirements. Finally, a tertiary goal of the present study was to generalize the intervention to parents when terminal criteria were reached.
Chapter II: Method

Participants

Two children from the greater Vancouver area were recruited to participate in the study. Both participants were referred by a Board–Certified Behavior Analyst through an ABA–based preschool center. During the course of the study (but outside the context of the study), both participants entered into general education kindergarten classrooms. Criteria for participation in the study included a formal diagnosis of a developmental disability, reported occurrences of non-compliance with adult instructions and/or problem behavior on at least a weekly basis, and moderate language skills (i.e., able to understand and follow single-sentence instructions).

Mario was a 5-year-old boy diagnosed with ASD. His parents reported that adults’ requests to complete tasks often resulted in Mario eloping or engaging in disruptive behavior (e.g., yelling, throwing items). His parents also reported similar behaviors when instructed to eat non-preferred foods. His food selectivity involved only accepting preferred foods (e.g., rice, noodles, snack foods, and some fruits), and refusing others (e.g., vegetables).

Luigi was a 6-year-old boy diagnosed with ASD. His parents reported that Luigi frequently requested preferred items (e.g., tablet), and engaged in negative vocalizations (e.g., yelling, whining) when they were not delivered. When requested to complete certain tasks or accept non-preferred foods, Luigi refused and/or eloped. Luigi’s food selectivity involved an aversion to certain textures (i.e., chewy), and only accepted foods with a preferred texture (e.g., crunchy, crispy).
Setting and materials

Sessions were conducted in a quiet area in participants’ homes, which were furnished with a table and chairs. Home visits occurred one to two times per week, and between 3–8 experimental sessions were conducted per visit. Visits typically occurred in the morning or early afternoon (i.e., breakfast or lunch times). Sessions were generally 10–15 min in length; however, because escape extinction (EE) was employed for some sessions, session length varied. For Mario, mean session length was 12 min, 42 s. For Luigi, mean session length was 13 min, 30 s.

Experimental materials included a video recording device, iPhone with a timer app, wristband, tally counter, and laminated FCR visual. All sessions were recorded using an iPad set in a corner of the session room, facing the table. The wristband was made of metal rings interwoven with green rubber rings, and was chosen for its durability. The laminated FCR visual featured text reading “I want ______, please.” Additional text and pictures were placed on the visual, including pictures of preferred food items and an illustration of a boy playing with toys.

Materials for food acceptance sessions included two plates, utensils, cup or water bottle, napkin, and food items. Prior to beginning experimental sessions, parents were asked to list 10 food items they would like their child to eat on a regular basis. Food items used throughout the study were based on this list; however, individual food items were subject to change based on availability. Other food items introduced were selected based on their similarity (e.g., food type, color, texture) to previously-introduced items. In general, bites were approximately 1–1.5 cm³.

Academic materials included picture cards, flash cards, paper, writing utensils, printed worksheets, puzzles, and toys (for imitation targets; e.g., Play–Doh, dinosaurs). Academic targets were based on those included in curriculum for the Assessment of Basic Language and Learning
Skills–Revised (ABLLS–R; Partington, 2010). ABLLS–R is a criterion–referenced assessment and curricular protocol aimed at children with language delays that reviews a wide range of skills across 25 domains, including language, imitation, and motor skills (Partington, 2010). Individual targets were selected from skill domains that were either in deficit, or had been mastered prior to the study.

Response definitions and data collection

Problem behavior was generally defined as any behavior that caused harm, damaged or destroyed property, presented safety risks (e.g., elopement), or caused disruption (e.g., negative vocalizations). Mario’s problem behaviors included elopement and disruption. For Mario, elopement was defined as Mario’s entire body leaving contact with his chair for at least 1 s, unless he was instructed to do so. Disruption was defined as any instance of scribbling on or damaging work materials, throwing or swiping items, spitting or blowing raspberries, turning his head or body away for at least 10 s, or yelling above normal volume of voice when accompanied with non–compliance (e.g., louder–than–normal responses to academic questions were not counted as instances of disruption).

Luigi’s problem behaviors included elopement, negative vocalizations, and rubbing. Elopement for Luigi was defined as failure to return to the assigned area within 10 s of being instructed to do so. Negative vocalizations were defined as any vocalizations emitted at a louder volume and a higher pitch (e.g., yell, whine), than Luigi’s normal vocalizations, unless accompanied by a smile and/or laughter. Rubbing was defined as Luigi pressing a food item into his clothing with his hand and moving his hand in a back–and–forth motion. Problem behaviors
for both children were counted as separate instances when at least 3 s had elapsed since the previous instance of that problem behavior.

For both children, compliance for instruction was defined as initiating an appropriate response within 10 s of a verbal or gestural instruction or question. This included both academic targets and general instructions to perform actions relevant to a learning environment (e.g., “sit in your chair,” “give me the tablet” “pick up your pencil”). Responses were counted as instances of compliance whether they were correct or incorrect, so long as they were appropriate to the context of the question/instruction. Compliance for food acceptance was defined as initiating an appropriate response to accept a food item within 10 s of verbal or gestural instructions. Appropriate responses for instructions to approximate swallowing the food (e.g., “touch the food,” “smell the food”) were considered instances of compliance for food acceptance. Compliance for food acceptance also included independently swallowing food items within 10 s per bite, starting from acceptance of the first bite. For example, if 10 bites were presented on a plate, compliance would be scored as 100% if all bites were independently consumed (i.e., self-fed) within 100 s of the first bite. However, during terminal schedules, compliance for food acceptance was scored as the percentage of total bites consumed within 10 min. FCRs were defined as any vocal response consisting of at least two words that included at least one of the words “want,” “need,” “have,” and/or “please.”

Data were collected from video recordings of sessions. Rates of problem behaviors were expressed as responses per minute (rpm). Data for compliance was expressed as the percentage of opportunities (i.e., instructions, questions, food presentations) for which compliance occurred.
Data for FCRs was expressed as rpm, as well as the percentage of FCRs occurring in the presence of the \( S^D \) (i.e., percentage of discriminated responses).

**Interobserver agreement**

Interobserver agreement was collected by a trained secondary observer for 33.33% of baseline and 25.61% of intervention sessions using the same video recordings. Data were recorded as the percentage of agreement out of the total number of agreements plus disagreements for each target behavior. Mean agreement per observation period was calculated by adding the agreement data for each session and dividing by the total number of sessions. Agreement for problem behavior was 91.10% (range = 50.00%–100.00%). Agreement for compliance for instruction was 89.52% (range = 66.67%–100.00%). Agreement for compliance for food acceptance was 91.71% (range = 69.23%–100.00%). Agreement for percentage of discriminated FCRs was 89.30% (range = 50.00%–100.00%). Agreement for rate of FCRs was 90.58% (range = 50.00%–100.00%).

**Experimental design and procedure**

A multiple–baseline–with–reversal design was used to compare rates of responding across behaviors. Experimental control of FCRs was demonstrated through contingency reversals. That is, the signal that initially preceded the reinforcement component, preceded the EXT component during contingency reversals. An ABCDC design, and an ABCBCDCBCB design were used to evaluate interventions for Mario and Luigi’s feeding sessions, respectively. An ABCB design was used for academic sessions for both participants.

**Functional assessment.** Open–ended functional assessment interviews were administered to parents to narrow the putative functions of problem behaviors. An FA was
conducted which included test conditions for putative functions identified in the interview, compared to a control condition (Hanley, Jin, Vanselow, & Hanratty, 2014). Each session lasted 5 min. During control sessions, the putative reinforcers were available non–contingently throughout the session. During demand sessions, the therapist delivered academic targets and/or non–preferred food continuously, and removed the demand for 30 s contingent on problem behavior. Types of demands and foods were based on parent reports during the interviews. During tangible sessions, the therapist removed preferred items and returned them for 30 s contingent on problem behavior. The escape–to–tangible session was identical to demand sessions, except that demands were removed and preferred items were delivered for 30 s contingent on problem behavior.

**Demand assessment.** A demand assessment was conducted using procedures described by Roscoe, Rooker, Pence, and Longworth (2009) to determine high–p and low–p demands. Academic tasks were based on parent reports and included a variety of skill domains, including imitation, receptive language, reading, writing, counting, and motor skills. For each 5–min session, the therapist presented one randomly selected task using a progressive prompting procedure (verbal, gestural, and/or manual guidance). Contingent on compliance, the therapist provided praise and immediately re–presented the same or a similar target. Contingent on noncompliance and/or problem behavior, the demand was removed for 30 s. Based on the percentage of instances of compliance out of the total number of requests, as well as rates of problem behavior, demands were organized in a hierarchy of high–p and low–p tasks. Low–p tasks were initially used as targets for compliance during baseline and intervention. Academic demands selected for each participant are displayed in Appendix A, Table 1.
A food–acceptance assessment was conducted using identical procedures to the demand assessment. A variety of foods was chosen based on parental reports of preference. For each 5–min session, one type of food was presented continuously and removed contingent on problem behavior. Foods that were accepted for 80%–100% of presentations were categorized as high–p, foods that were accepted for 20%–79% of presentations were categorized as medium probability (med–p), and foods that were accepted for 0%–19% of presentations were categorized as low–p. Foods selected for each participant are displayed in Appendix B, Table 2.

**Preference assessment.** A free–operant preference assessment similar to the one described by Roane, Vollmer, Ringdahl, and Marcus (1998) was conducted once every four visits prior to sessions to determine the most potent reinforcers. During the 5–min assessment, participants had non–contingent access to a variety of stimuli chosen from teacher and/or parental reports. The therapist told participants, “choose anything you like,” and modeled manipulation of the stimuli if necessary. Duration of time spent with each stimulus was recorded, and the stimulus with the longest duration was chosen as the most preferred stimulus. Participants had access to highest–preferred items and/or attention for 5 min prior to starting initial sessions per visit.

**Baseline.** For academic tasks, a combined–antecedent baseline was conducted using procedures similar to those outlined by Falcomata et al. (2012). That is, preferred items were removed and a low–probability demand was delivered. Prompts were provided in 10–s intervals contingent on noncompliance; otherwise the therapist provided no attention to participants. Problem behaviors resulted in the removal of demands, as well as the delivery of preferred items and attention for 30 s.
During baseline sessions for food acceptance, a bite of low–p food was presented. If the child accepted the bite, the therapist provided praise and immediately presented another bite. If the child refused the bite, the therapist provided verbal prompts every 10 s until the child either complied or engaged in problem behavior. Contingent on problem behavior, the therapist said “okay, you don’t have to,” then removed the fork and provided a preferred item for 30 s. If the child eloped, the therapist returned him to the table. Baseline academic sessions were identical to baseline food acceptance sessions, but the therapist delivered questions/instructions to complete academic tasks rather than bites of food.

**Functional communication training.** To begin FCT sessions, the therapist provided instructions outlining the use of FCRs. During academic FCT sessions, the therapist presented the laminated visual and said, “it’s time to work. If you want a break to play, you can say, ‘I want [item], please.’” Instructional demands were presented in an identical manner to baseline sessions. Contingent on FCRs, the therapist removed demands and presented preferred items for 30 s. During feeding FCT sessions, the therapist presented a low–p food, and said “take a bite. If you don’t want it, you can say, I want [food], please.” Contingent on FCRs, the therapist removed the low–p food and presented a bite of high–p food. Throughout all intervention phases, compliance resulted in praise, and problem behaviors were placed on EXT, although participants were returned to the table contingent on elopement.

Initially, the therapist provided visual and verbal prompts for participants to emit an FCR immediately following the presentation of an instructional target. The prompts were faded using a most–to–least fading procedure (i.e., visual + verbal, visual + gestural, visual) until participants reliably emitted FCRs independently. Criteria for fading prompts were three consecutive FCRs
emitted at a given prompt level. Prompts were reintroduced at the lowest level (i.e., visual) if three consecutive opportunities (i.e., presentations of the $S^D$) occurred when FCRs were not emitted. Criteria for beginning schedule thinning were two consecutive FCT sessions with at least 80% of FCRs emitted independently.

**MULT schedule exposure.** Prior to beginning schedule thinning, a single discrimination training session was conducted in which the therapist introduced the schedule–correlated wristband, which signaled schedule components during the thinning phase. At the start of the session, the therapist reviewed the contingencies. Specifically, the therapist said, “when I have my bracelet on, you can ask me for things, and I’ll give them to you. When I don’t have my bracelet on, you can ask me for things, but I won’t give them to you.” The therapist alternated wearing and removing the wristband every 30 s for the duration of the session. If participants did not emit FCRs in the presence of the wristband within 10 s, the therapist verbally prompted participants to do so. Preferred items were presented for 30 s contingent on FCRs. No instructional demands were presented during the discrimination training session.

**Chained schedule.** In the chained–schedule phase, demand and reinforcement components were alternated. In the demand component, demands were presented continuously until ratio requirements are met, at which point the $S^D$ was presented and the schedule was switched to the reinforcement component. During the reinforcement component, demands were removed, and participants had access to preferred items contingent on the emission of FCRs, as well as non–contingent access to attention. At the start of each session, the therapist reviewed the contingencies with participants. The initial schedule arrangement for academic sessions was FR 1/ FR 1 30 s, in which a single instance of compliance completed the ratio requirement in the
demand condition, and a single emission of the FCR resulted in 30 s access to the reinforcer. Said another way, once a participant complied with a single demand, the therapist put on the wristband. Following this, the participant manded for preferred items/activities, and the therapist removed demands and presented requested items, along with attention, for 30 s. The therapist complied with all reasonable child mands (i.e., those that could be readily reinforced). For feeding sessions, tangible items and preferred food items were available during reinforcement components. To allow sufficient time for consumption of edible reinforcers, and to establish an EO for accepting non–preferred foods, the duration of reinforcement components was initially doubled during feeding sessions (refer to Appendix C, Table 3 for a list of reinforcement durations). For academic sessions, only tangible items were available. Following the reinforcement component, the therapist removed the item and the wristband, and the schedule was repeated until session time expired.

**Feeding sessions: DRA + EE.** To maximize participants’ appetites, parents were requested not to feed participants for at least one hour before sessions began. Prior to sessions, participants were given access to a preferred item for 5 min to establish motivation for food acceptance. At the start of sessions, the therapist removed the items and reviewed instructions and contingencies. Specifically, the therapist said “when I have my bracelet on, you can ask me for things, and I’ll give them to you. When I don’t have my bracelet on, you can ask me for things, but I won’t give them to you. When you finish your plate, I’ll put my bracelet on.” The therapist set a timer for 10 min.

The therapist then delivered the plate and a specified number of bites of food. During the initial stages of schedule thinning, 10 s for every bite of food were allocated for participants to
finish the plate. If they did not finish within the designated time frame, verbal prompts (e.g., “take a bite,” “swallow”) were provided approximately every 10 s until participants complied or finished the plate. If participants expelled food, a new bite was presented. The therapist provided praise and attention contingent on acceptance of bites. When the plate was cleared, the therapist presented the S\textsuperscript{D} to signal the reinforcement component (i.e., put on the wristband).

If 1 min elapsed in which compliance did not occur, escape extinction in the form of non-removal of the fork was initiated. The therapist placed the fork approximately 1 inch away from participants’ mouths until the bite was accepted, or until the timer sounded and session time expired. Attempts to escape the chair were blocked. For both participants, EE continued until bites were accepted, or until 1 hour elapsed.

**Feeding sessions: DRA + high–p sequence.** If compliance remained below 20%, or problem behaviors increased to 0.50 rpm or more during sessions in which escape extinction was implemented, then a high–p instructional sequence (Penrod, Gardella, & Fernand, 2012) was introduced the following session (Luigi only). The high–p instructional sequence involved presenting the specified number of bites in each trial, and presenting a high–p instruction for contacting the low–p food. The therapist presented the S\textsuperscript{D} for reinforcement components contingent on meeting criteria for the ratio requirement for compliance, whether or not the bite was consumed. The high–p instructional sequence was: 1) smell the food; 2) touch the food on lips; 3) touch the food on tongue; 4) touch the food on teeth; 5) hold food in mouth for 3 s; 6) hold food in mouth for 10 s; 7) chew the food; and 8) swallow the food. Not all steps were included each time the high–p sequence was implemented. High–p instructions were faded within sessions until participants consumed the low–p food. When participants consistently
consumed the food following the high–p instructional sequence, the initial procedure was resumed the following session.

**Academic sessions: DRA + EE.** Academic sessions were conducted similar to feeding sessions, except rather than presenting bites of food, the therapist delivered questions or instructions to complete academic tasks. If participants failed to comply or responded incorrectly, the therapist provided prompts to respond correctly using a graduated prompt sequence (i.e., verbal, gestural, physical). If participants responded correctly, the therapist provided praise and immediately delivered another target.

Initially, academic targets were selected from those presented during the demand assessment, but were expanded to include novel tasks over the course of the study. Targets included a variety of high–p and low–p demands, according to the results of the demand assessment, and were presented randomly throughout sessions. The number of targets was gradually increased until criteria (identical to those for feeding sessions) were met for proceeding to the next step in the fading sequence or conducting terminal probes. The terminal schedule was continuous targets presented for 10 min, followed by 5 min of reinforcement components (FT 600 s/FR1 300 s).

**Schedule thinning.** Schedule thinning involved procedures similar to Zangrillo et al. (2016). When compliance (20% or above) and low levels of problem behaviors (below 50% of mean baseline rate) were observed for two consecutive sessions, ratio requirements were increased. Duration of reinforcement access was also increased on a set schedule (see Appendix C, Table 3 for a complete list of thinning steps). Terminal schedule values were probed when high levels of compliance (80% or above), and near–zero levels of problem behavior (0.20 rpm
or below) were observed for three consecutive sessions. If levels of compliance and problem behaviors were maintained through the probe, the terminal value was continued until terminal criteria for treatment were met (see below). However, if low rates of compliance (20% or below), or high rates of problem behaviors (0.80 rpm or above) were observed, the gradual thinning procedure was resumed the following session.

*Schedule thinning for feeding sessions.* The number of bites presented per trial was determined by the thinning sequence. The number of bites per plate was increased gradually until criteria were met for conducting terminal probes. The required number of bites for the terminal schedule was determined by presenting full plates (i.e., 60 bites) for the first three terminal schedule sessions and calculating the mean number of bites consumed within 10 min. The terminal schedule for Mario was 25 bites, or 10 min of eating, whichever came first (FR 25 [600 s]/FR 1 300 s). Because EE was implemented for Luigi in the final stage of intervention, the terminal schedule for Luigi was 25 bites (FR 25/FR 1 300 s).

Appendix C (Table 3) displays the schedule thinning procedure and corresponding durations of reinforcement components. However, when accounting for terminal schedule probes, the final schedule thinning sequence for Mario was FR 1, FR 2, FR 3, FR 4, FR 5, FR 6, and FR 25 (terminal schedule). Because desirable responding was not maintained at terminal schedules for Luigi, the final schedule thinning sequence for Luigi was FR 1, FR 2, FR 3, FR 4, FR 5, FR 6, FR 7, FR 8, FR 9, FR 10, FR 12, FR 25, FR 15, FR 3, FR 15, FR 25, FR 20, and FR 25 (terminal schedule).

*Preference fading for feeding sessions.* Foods were categorized according to probability of acceptance (i.e., high–p, med–p, low–p), based on the results of the demand assessment.
During the initial stages of treatment (i.e., FR 1–FR 3), only med–p foods were introduced. At FR 4, a low–p food was added to the criteria (i.e., 3 bites of med–p food, 1 bite of low–p food). At FR 6, low–p foods were faded in until the plate consisted of 80% low–p food. For the remaining steps in the fading sequence, including the terminal schedule, plates consisted of 20% high–p bites, 40% med–p bites, and 40% low–p bites. Once a low–p food was consistently accepted (i.e., in the absence of non–compliance or problem behaviors), it was thereafter counted as a med–p or high–p food, and a new low–p food was introduced. Any foods outside of those included in the demand assessment were introduced as low–p foods.

**Schedule thinning for academic sessions.** The number of academic targets presented per trial was determined according to the thinning sequence. The final thinning sequence for Mario was FR 1, FR 2, FR 3, FR 4, VR 6, VR 8, VR 10, VR 20, FT 600 s, and VR 40. Due to an increase in problem behaviors following the onset of the terminal schedule, a thinning procedure was introduced for Mario in which the therapist randomly selected one of the ratio schedules from the fading sequence for each trial. Each of the above schedules was included in the selection pool; however, FT 600 s was replaced with FR 60, which was based on the mean number of responses across all previous terminal schedule sessions. Therefore, the schedules for Mario’s last five treatment sessions were VR 10, VR 16, VR 8, VR 26, and VR 19. The thinning sequence for Luigi was VR 2, VR 4, VR 6, VR 10, VR 15, VR 20, and FT 600 s (terminal schedule).

**Generalization and maintenance.** Terminal criteria for the intervention were met when acceptable levels of compliance (80% or above) was maintained, and near–zero levels of problem behavior (0.20 rpm or below) were observed for five consecutive sessions at terminal
schedule values. When terminal criteria were met, the intervention was generalized to parents. Parent training involved a behavioral skills training package that included written and verbal instruction, demonstration and video modeling, role play, and feedback. Treatment fidelity was measured as the percentage of steps of an implementation checklist completed correctly. After ensuring treatment fidelity was upheld (i.e., 90% of steps or higher), follow-up probes were conducted after one month.

**Social validity.** Following termination of the study, parents were sent a satisfaction questionnaire in which various elements of the intervention were rated on a Likert scale of 1–5. The questionnaire was adapted from Hoch, Babbitt, Coe, Krell, and Hackbert (1994), and included items related to the effectiveness and ethical integrity of the intervention, as well as the overall performance of the therapist (see Appendix D, Table 4 for a complete list of questionnaire items).
Chapter III: Results

Functional analysis

Figure 1 (Appendix E) displays the results of the FAs for Mario and Luigi. For Mario, mean rates of problem behaviors in the control, escape, and escape–to–tangible conditions were 0.00 rpm, 0.68 rpm, and 0.86 rpm, respectively, which suggested escape–to–tangible to be the most likely function of his problem behavior. However, comparable rates were also observed in the escape condition, suggesting escape from demands alone may have also functioned to reinforce problem behaviors. For Luigi, mean rates of problem behaviors in the control, tangible, and escape–to–tangible conditions were 0.00 rpm, 0.78 rpm, and 0.10 rpm, respectively, which suggested tangible reinforcement to be the most likely function of his problem behaviors.

Demand assessment

Figure 2 (Appendix F) displays the results of the demand assessment for academic tasks for both participants. Mario’s assessment suggested that labeling numbers (100.00%), cutting (100.00%), and mazes (100.00%) were the targets with the highest probability of compliance, and picture sequencing (50.00%) was the target with the lowest probability of compliance. Luigi’s assessment suggested that labeling numbers (100.00%), and labeling letters (100.00%) were the targets with the highest probability of compliance, and rote counting (50.00%) was the target with the lowest probability of compliance. For Luigi, high–p targets were associated with the lowest rates of problem behaviors, and conversely, low–p targets were associated with the highest rates of problem behaviors. Academic targets selected for each participant are displayed in Appendix A, Table 1.
Figure 3 (Appendix G) displays the results of the demand assessment for food acceptance for both participants. Mario’s high–p foods were milk (100.00%) and apple (100.00%), and his low–p foods were grape, carrot, lettuce, and green pepper (0.00% for each). Mario’s problem behavior was variable across high–p and low–p food items. Luigi’s high–p foods were chips, orange, granola bar, mango, goldfish crackers, and rice crackers (100.00% compliance and 0.00 rpm problem behavior for each). His low–p foods were tomato, sweet potato, olive, egg, and chicken (0.00% compliance for each). An inverse relation between compliance and problem behavior was observed for Luigi’s assessment for food acceptance. Foods selected for each participant are displayed in Appendix B, Table 2.

**Baseline and intervention**

**Compliance and problem behavior: Mario.** Figure 4 (Appendix H) displays Mario’s rates of compliance and problem behavior during baseline and intervention phases for feeding and academic sessions. During baseline for feeding sessions, Mario’s mean rate of compliance was 0.00%, and mean rate of problem behavior was 1.00 rpm (range = 0.70 rpm–1.20 rpm). Following intervention, mean rates of compliance increased to 74.50% (range = 15.00%–100.00%) during feeding sessions. Mean rates of problem behavior decreased to 0.31 rpm (range = 0.00 rpm–1.94 rpm), which represents a 69.00% decrease from baseline rates.

During the initial stages of feeding intervention, compliance and rates of problem behavior were variable, which suggests possible extinction burst effects. This was evidenced at the 15th treatment session, when rates of problem behavior increased to near double mean baseline rates. However, following that session, rates of problem behavior remained stable below
50.00% of mean baseline rates. Furthermore, compliance was observed at 100% for 13/17 (76.47%) of terminal schedule sessions. Terminal criteria were met on the 42nd treatment session.

During baseline for academic sessions, Mario’s mean rate of compliance was 46.70% (range = 13.30%–77.30%), and mean rate of problem behavior was 0.93 rpm (range = 0.00 rpm–1.40 rpm). Following intervention, Mario’s mean rate of compliance was 95.80% (range = 77.80%–100.00%) for academic sessions, which represents a 51.26% increase from baseline rates. Mean rates of problem behavior decreased to 0.21 rpm during intervention phases, which represents a 77.42% decrease from baseline rates.

During baseline for Mario’s academic sessions, compliance and rates of problem behaviors were variable. Following intervention, compliance increased immediately and remained stable above 77.00% for the remainder of intervention. Rates of problem behavior decreased immediately following intervention; however, an increasing trend was observed during schedule thinning, and problem behaviors surpassed mean baseline rates at session 50 (1.40 rpm). When ratio requirements were randomized starting on session 51, rates of problem behaviors were observed at near–zero levels, and compliance remained at 100.00%, for the remainder of treatment. Although desirable levels of behavior were achieved in the final stage of treatment, criteria for terminating intervention were not met at terminal schedule values.

**Compliance and problem behavior: Luigi.** Figure 5 (Appendix I) shows Luigi’s rates of compliance and problem behavior during baseline and intervention phases for feeding and academic sessions. During baseline for feeding sessions, Luigi’s mean rate of compliance was 0.00%, and mean rate of problem behavior was 1.53 rpm (range = 1.50 rpm–1.6 rpm). Following intervention, mean rates of compliance increased to 62.90% (range = 0.00%–100.00%). Mean
rates of problem behavior decreased to 0.19 rpm (range = 0.00 rpm–1.08 rpm), which represents an 88.00% decrease from baseline rates.

Luigi’s compliance for food acceptance and rates of problem behavior were variable throughout intervention. Trends in the data suggest that the combination of DRA and EE was effective in maintaining rates of compliance, and that DRA alone was insufficient to maintain compliance during terminal schedules. When DRA + EE was implemented in the final terminal schedule, mean compliance for the final four sessions was 79.00% (range = 62.00%–100.00%). However, criteria for terminating intervention were not met.

During baseline for academic sessions, Luigi’s mean rate of compliance was 33.35% (range = 10.50%–60.90%), and mean rate of problem behavior was 1.00 rpm (range = 0.49 rpm–1.18 rpm). Following intervention, mean rates of compliance increased to 89.74% (range = 63.20%–100.00%), which represents a 62.84% increase from baseline rates. Mean rates of problem behavior decreased to 0.15 rpm, which represents an 85.00% decrease from baseline. Although increased rates of problem behavior on the 7th and 11th treatment sessions suggest extinction burst effects, problem behavior remained below, and compliance remained above, mean baseline rates throughout treatment. Stability was achieved for both measures on the 12th treatment session and was maintained until terminal criteria were achieved. Criteria were met for terminating intervention on the 22nd academic intervention session.

**FCRs.** Figure 6 (Appendix J) shows Mario’s rate of FCRs, and the percentage in which they were discriminated to reinforcement components. Throughout feeding intervention phases, Mario’s mean rate of FCR emissions was 0.81 rpm (range = 0.10 rpm–2.11 rpm), 86.70% of which were emitted during reinforcement components (range = 50.00%–100.00%). During
academic sessions, Mario’s mean rate of FCR emissions was 0.44 rpm (range = 0.07 rpm–1.34 rpm), 83.90% of which were discriminated (range = 50.00%–100.00%).

Figure 7 (Appendix K) shows Luigi’s emission rate of FCRs and the percentage in which they were discriminated to reinforcement components. During feeding intervention phases, Luigi’s mean rate of FCR emissions was 0.61 rpm (range = 0.07 rpm–1.97 rpm), 73.49% of which were discriminated (range = 9.00%–100.00%). Throughout academic sessions, Luigi’s mean rate of FCR emissions was 0.84 rpm (range = 0.07 rpm–2.52 rpm), 54.51% of which were discriminated to reinforcement components (range = 22.20%–100.00%).

**Generalization and maintenance.** A single follow-up session was conducted for Mario (feeding), and Luigi (academics), one month after terminal criteria were met. For participants, high levels of compliance (100.00%) were observed in the absence of problem behavior (0.00 rpm). Furthermore, 100.00% of FCRs were discriminated to reinforcement components for both children. Moreover, parents implemented the intervention with high fidelity (Mario: 90.00%; Luigi: 91.67%). Because terminal criteria were not met for Mario (academics), and Luigi (feeding), generalization probes were not conducted for those sessions.

**Social validity.** Appendix D, Table 4 displays parents’ ratings of items on the satisfaction questionnaire. Parents of both children provided very high (i.e., 5) ratings for overall satisfaction with the intervention and for service from the therapist. These ratings provide evidence of strong social validity for the intervention.
Chapter IV: Discussion

The present study sought to evaluate the effects of a schedule thinning procedure within an FCT context to reduce problem behaviors, increase FCRs, and increase compliance for academic demands and food acceptance. Overall, the intervention was successful in reducing rates of problem behavior for both participants, across both skill domains. Compliance for non-preferred activities increased for both participants following treatment. Furthermore, participants were taught FCRs to access preferred items, which were reliably discriminated to reinforcement components. This is the first known study that has applied schedule thinning to food acceptance in the context of FCT.

Interpretations

Overall, chained schedule thinning was effective in increasing rates of compliance for non-preferred demands to substantial ratios. However, the FT 600 s demand component values employed during terminal schedules were ineffective in maintaining compliance for Mario (academics), and Luigi (feeding). One possible explanation for this is that participants contacted reinforcement following FT components whether or not compliance was observed. This arrangement may have inadvertently reinforced problem behavior and/or non-compliance. For instance, if session time expired while refusal and/or problem behaviors were occurring, and reinforcement components were initiated immediately afterwards, a contingency may have been established in which those undesirable behaviors were reinforced. This is consistent with limitations of MULT schedules reported in the literature (e.g., Lambert et al., 2016). As such, it was deemed necessary to alter the terminal schedule for those sessions so that criteria for reinforcement were based on ratio of compliance, rather than an FT schedule. For Mario, the
gradual thinning procedure was resumed (FR 40); however, because rates of problem behaviors were not reduced at this schedule value, the thinning procedure was altered again so that ratio requirements for access to reinforcement were randomly selected within trials per session. Results showed that compliance was maintained and problem behaviors were reduced following this procedural change, which provides evidence to support the hypothesis that Mario’s problem behaviors were a function of the increased ratio of demands through the thinning process.

It is noteworthy that during the randomized ratio sequence, problem behaviors remained at near–zero levels for trials when terminal schedules were emulated (i.e., VR 60). A likely explanation for this is the wide range of ratio requirements in the selection pool made criteria for reinforcement unpredictable (i.e., intermittent reinforcement), which maintained compliance for longer periods of time and limited the EO for problem behavior. It is also of note that although ratios were randomized, the total number of demands presented per session was comparable to those presented at original terminal schedules. This finding has important implications for schedule thinning procedures, in that increasing demand ratios randomly, rather than sequentially, may produce favorable effects on compliance and problem behavior. Further research is necessary to evaluate the effects of randomized VR schedules on compliance to determine the extent of those implications.

Each time terminal schedules were probed, criteria were met to continue sessions at terminal schedule values. However, criteria were met to continue terminal schedules until the intervention was terminated for only two of the four behaviors: feeding sessions for Mario, and academic sessions for Luigi. For Mario’s academic sessions and Luigi’s feeding sessions, desirable levels of responding were not maintained following initial terminal schedule probes,
and resurgence was evident throughout treatment sessions. This was likely attributable to the increased demand ratio, rather than to inconsistent reinforcement of FCRs (Volkert et al., 2009). This was evidenced in that FCRs were typically emitted at a low rate and were discriminated throughout the study, even for sessions when problem behavior was observed. Moreover, FCRs were emitted for every session, suggesting that although rates of FCRs were reduced, at no point were FCRs extinguished altogether.

Research suggests abruptly thinning schedules can greatly reduce the total number of treatment sessions necessary to achieve desirable levels of responding at terminal schedule values (e.g., Betz et al., 2013). In the current study, this occurred on two occasions—Mario’s feeding sessions and Luigi’s academic sessions. Mario met criteria for terminal schedule probes on the 26th treatment session, at FR 6. Because the probe was successful, seven steps of the thinning sequence were bypassed, allowing for terminal criteria of the intervention to be met significantly sooner than would have had the gradual thinning procedure resumed throughout treatment.

For Luigi’s academic sessions, criteria were met for a terminal schedule probe after only 14 treatment sessions, and one of the thinning steps (VR 40) was bypassed. Although terminal schedules were reached more rapidly for these sessions, this was achieved not by abruptly thinning the schedule from initial dense schedule values to lean terminal values, but by reducing the overall number of thinning steps in the gradual thinning procedure. Luigi reached terminal schedule values in seven steps, which is consistent with Mario, but did so in nearly half the number of treatment sessions as Mario. Although there are a number of variables to consider when comparing these findings, they nonetheless call into question the arrangement of the
gradual thinning sequences within the study. For instance, it is possible that terminal criteria could have been met sooner on other occasions (e.g., Mario’s academic sessions) had the overall number of thinning steps been reduced. Further research is required to compare schedule arrangements in which thinning occurs abruptly from initial to terminal schedules, to those in which thinning occurs consistently, but rapidly (e.g., VR 2, VR 4, VR 6, etc.).

For Mario’s academic sessions and Luigi’s feeding sessions, the abrupt thinning procedure was unsuccessful in reaching terminal schedule values sooner than would be expected with a gradual thinning procedure. Because desirable levels of responding were not maintained at terminal schedule values for those sessions, an opposing argument could be made that the terminal schedule probes served to prolong the thinning procedure rather than reduce it. By increasing the number of demands too quickly, participants may have been exposed to aversive conditions which evoked problem behavior to a degree that reinitiated the gradual thinning procedure, thus contributing to an increase in the overall number of treatment sessions. However, were this the case, one would expect that undesirable rates of responding would be observed during terminal schedule probes, whereas in the current study, criteria were met for continuing terminal schedules each time probes were conducted.

Due to a decrease in compliance and an increase in problem behavior on Luigi’s 39th feeding treatment session, the gradual thinning procedure was altered to substantially reduce the ratio requirement (FR 3) for the following session. The rationale for this decision was to reduce demands such that compliance would occur consistently and instructional control could be re-established prior to resuming the thinning procedure. An interesting finding that resulted from this clinical decision was that once responding returned to desirable levels on the 42nd treatment
session, the gradual thinning procedure was abruptly thinned to resume the previous step in the thinning sequence (FR 15). This instance of abrupt thinning successfully bypassed eight steps in the thinning sequence in the absence of resurgence. Furthermore, desirable levels of responding were observed in the sessions following such that criteria were met for a terminal schedule probe. As such, the schedule was rapidly thinned from FR 3 to the terminal schedule over the course of four sessions. This finding has important implications for research on abrupt thinning procedures in that schedules may be thinned more rapidly when an individual has previously experienced the reinforcement contingencies for those steps.

A treatment package designed to increase compliance for food acceptance was implemented in the schedule thinning phase. Treatment was effective in increasing compliance for low–p and med–p foods, as well as in introducing a wide variety of novel foods into participants’ diets. This is an important finding considering that children diagnosed with ASD often have limited repertoires of foods, and as such, the literature describes a high prevalence of inadequate nutrient intake for this population (Castro et al., 2016; Sharp et al., 2013). Because adequate food consumption is necessary for sustenance and proper developmental growth (Sharp et al., 2013), an expanded repertoire of accepted foods holds important implications for improving the overall health of an individual.

Mario’s results suggest that DRA alone was effective in maintaining compliance and low rates of problem behavior at the terminal schedule for feeding sessions. However, the results of Luigi’s feeding sessions show that compliance was reduced each time EE was withdrawn, and that DRA alone was insufficient in maintaining compliance. This is consistent with the findings
of Piazza, Patel, Gulotta, Sevin, and Layer (2003), who determined that the combination of DR and EE produced more favorable results than either treatment alone.

Due to the inconsistency in compliance observed for Luigi during feeding sessions, an additional treatment component was introduced in the form of the high–p instructional sequence. The high–p sequence is based on the notion of behavioral momentum, which follows the premise that establishing compliance for a preceding series of high–p instructions will increase the likelihood of compliance with a low–p instruction (Ledford & Gast, 2006). For Luigi, the high–p sequence was effective in re–establishing instructional control following sessions in which low levels of compliance were observed. Because of the increased levels of compliance observed when EE and the high–p sequence were in effect, the decision was made that both interventions would remain in effect (along with DRA) during Luigi’s final terminal schedule. Although this was successful in maintaining rates of compliance, problem behaviors remained such that criteria for terminating intervention were not met.

An interesting finding of the current study is that although all bites were presented simultaneously, participants tended to eat high–p foods first and low–p foods last. Doing so may have created a natural high–p instructional sequence, in which behavioral momentum may have affected the likelihood of compliance for low–p foods. On the other hand, had low–p bites been consumed prior to high–p bites, an additional contingency of reinforcement may have been established for consuming low–p foods, which may have affected rates of compliance (i.e., Premack principle; Ledford & Gast, 2006). Further research is necessary to determine the effects of presenting foods based on order of preference on compliance.
A texture sensitivity was presumed for Luigi based on parental reports and frequent gagging observed during feeding sessions for certain foods (e.g., eggs). To reduce the likelihood of gagging, and to maintain the child’s safety, bites of certain foods were diced into smaller bites. However, this practice may have functioned to increase the response effort of the demand rather than decrease it (Kerwin, Ahearn, Eicher, & Burd, 1995). For example, if a 1 cm³ bite was cut into four smaller pieces, and if Luigi ate them one piece at a time (which he was often observed to do), he would then be required to consume a non–preferred, albeit smaller bite, four times as opposed to just once. This may provide some explanation regarding the variability in compliance and rates of problem behavior observed during his feeding sessions.

Overall, results of the current study suggest that FCRs were maintained at low rates and were discriminated to reinforcement components. Discriminative control was achieved for FCR emissions for both participants; however, FCR discriminations were negligible for Luigi during academic sessions (54.51%). A likely reason for this is that although Luigi had in his repertoire an appropriate FCR for manding for more time with a preferred item, this request was often made following the switch from reinforcement to demand components, in the absence of the S

Additionally, rates of FCRs per minute were variable for both participants. This is most likely a reflection of the types of reinforcement being delivered, as certain tangible items (e.g., tablet) required only a single FCR, while other items (e.g., high–p foods, tickles), required several FCRs for continuous delivery. However, a visual inspection of the graphs reveals a decreasing trend in FCRs for both participants, in both skill domains. This is consistent with the findings of Hanley et al. (2001), whose results showed that during the initial stages of treatment, rates of FCRs were
comparable to baseline rates of problem behavior, but decreased to manageable levels as schedules were thinned.

Although the results of the FA showed different functions for Mario (escape–to–tangible) and Luigi (tangible), FCRs relevant to a tangible function were taught to both children (i.e., “I want [item], please”). This decision was based in part on the findings of Zangrillo et al. (2016), who determined that the combination of positive and negative reinforcement accessed in an escape–to–tangibles condition produced more favorable results for reducing escape–maintained behaviors than negative reinforcement alone. Additionally, an FCR for tangible items could serve the dual function of appropriately requesting an escape from instructional demands and acquiring a preferred item, while reinforcement for an FCR relevant to escape (e.g., “I want a break, please”) would only be applicable to a single behavioral function (i.e., escape). Furthermore, FCRs relevant to obtaining preferred tangible items were more conducive to maintaining instructional control during session times. That is, by presenting requested items contingent on FCRs, the EO for elopement was removed, such that, for the most part, participants remained seated at the table throughout sessions. On the other hand, FCRs relevant to escape might have functioned to remove non–preferred activities, but would likely have been insufficient to reduce the likelihood of elopement from the table.

Each time reversals were conducted, rates of FCRs were comparable to those observed during sessions with typical contingency arrangements. For the most part, percentages of discriminated FCRs during reversals were also comparable to typical sessions; however, discriminations were observed at lower levels for reversals during Mario’s feeding sessions. One implication of this finding is that the wristband had acquired stimulus control over Mario’s
FCRs, rather than other stimuli (e.g., contingency–specifying rules). In other cases, however, the extent to which other stimuli influenced FCRs is unknown. For instance, the presentation of the wristband was often paired with other stimuli (e.g., removal of work materials, enthusiastic praise, timer ring) which may have signaled the availability of reinforcement. In light of this, it is possible that the wristband could have been faded out over the course of the study, which may have promoted participants’ discrimination of less salient natural stimuli (e.g., adult busy versus adult non–busy; Shamlian et al., 2016). However, one rationale for continuing use of the wristband in the current study was that consistency in stimuli would theoretically promote generalization of behaviors to novel adults (i.e., parents).

A secondary aim of the present study was to generalize behaviors to parents once terminal criteria were met for intervention. Because desirable levels of responding were not observed for Mario (academics) and Luigi (feeding) at terminal schedule values, not all behaviors were generalized to parents. However, programmed generalization was possible for one behavior for each participant (Mario–feeding, and Luigi–academics). Results of one–month follow–up sessions showed that desirable levels of these behaviors were generalized to parents, and maintained over time. Furthermore, both parents delivered the interventions with high fidelity after only one training session per parent. This finding provides evidence to support the hypothesis that generalization and maintenance may have been possible for all target behaviors had intervention continued beyond the time frame allotted for the study.

**Contributions to the literature**

The current study contributes to the literature in a number of ways. First, no studies to date have implemented an intervention aimed at increasing compliance for academics and food
acceptance simultaneously. As such, results of the current study provide evidence to support the notion that food selectivity can be viewed and treated as a form of non-compliance (e.g., Dawson et al., 2003). Furthermore, the current findings support the hypothesis that schedule thinning is an effective means of increasing compliance for both academic instructions and food acceptance.

Second, although several studies have employed the use of chained schedules to increase compliance for non-preferred tasks within an FCT context (e.g., Falcomata et al., 2012; Lambert et al., 2017; Zangrillo et al., 2016), no studies have evaluated an abrupt schedule thinning procedure for chained schedules. Future studies should seek to replicate this process, and to compare the effectiveness of abrupt thinning for chained and MULT schedules. Third, of the studies conducted on abrupt schedule thinning, few have established criteria for conducting terminal schedule probes and/or resuming gradual schedule thinning. Results of the current study suggest that terminal schedule probes may be a practical treatment element for assessing the likelihood that treatment goals may be achieved without executing all steps in a thinning sequence.

Fourth, in the current study, demand assessments were administered for academic targets and food acceptance. Although demand assessments have been employed in studies to inform treatment decisions (e.g., Roscoe et al., 2009) no known studies have used the results of demand assessments to categorize foods according to preference and inform the systematic delivery of food items. Future studies should seek to emulate this practice when targeting food selectivity, as well as to inform the presentation order of food items (i.e., high–p sequence; e.g., Meier, Fryling, & Wallace, 2012).
Fifth, no studies have targeted a feeding routine within the context of an FCT intervention package. Findings of the current study provide important implications for the applicability of FCT to a wide range of target behaviors. Future studies should seek to evaluate the utility of FCT embedded within routines for various skill domains. Sixth, although feeding interventions have commonly employed the use of stimulus fading to increase the number of bites consumed (e.g., Nadjowski et al., 2010), no studies have framed the fading procedure within a chained schedule arrangement. An important difference in the current study is that when participants completed ratio requirements during feeding sessions, access to reinforcement was contingent on FCRs, rather than on completion of the ratio requirement alone. Because of this, functional communication was promoted and maintained throughout the intervention. Because FCRs are functionally related to problem behaviors, this finding provides important implications for the reduction of problem behaviors during feeding interventions. Further research is required to evaluate the effect of FCR contingencies on problem behaviors for treating food selectivity. Finally, no studies have probed terminal schedule values for bite fading sequences. Future studies should seek to evaluate the application of an abrupt thinning procedure (e.g., Betz et al., 2013) on feeding routines to determine their utility for reducing the overall time required for intervention.

Limitations and future research

There are several limitations to the present study that must be accounted for when interpreting the results. First, treatment was not withdrawn to demonstrate experimental control. As such, although treatment effects were evident immediately following the implementation of intervention, the possibility that extraneous variables affected treatment outcomes cannot be
eliminated. Additionally, terminal criteria were not met for Mario (academics), and Luigi (feeding) prior to termination of the study. Although improvements in behavior were observed for both participants, further intervention may be necessary to achieve desirable levels of responding. Moreover, because of this, generalization phases were not reached for all target behaviors.

One possible reason that terminal criteria were not met is that criteria for both terminal schedule probes, as well as termination of the intervention, may have been too high. For instance, despite terminal criteria not being met for these target behaviors, problem behaviors were reduced substantially for Mario and Luigi (77.42% and 88.00% reductions from mean baseline levels, respectively). It may have been more plausible to base criteria on percentages of mean baseline rates than specific response rates. However, because both participants did meet terminal criteria for other target behaviors (Mario–feeding; Luigi–academics), evidence is provided that criteria were in fact attainable for both participants.

For both participants, problem behaviors were not extinguished entirely throughout feeding sessions. This is consistent with the findings of Marshall, Ware, Ziviani, Hill, and Dodrill (2014), whose meta–analysis of feeding intervention articles showed a small to negligible effect size for studies reporting a decrease in undesirable behaviors. Although the current study provides evidence of a reduction in problem behaviors during feeding intervention, a component analysis was not conducted to evaluate the effects of specific feeding interventions on problem behavior. Future studies may seek to isolate independent variables and treatment components to determine their individual effects on behavior.
Demands presented during the FA were based on parental reports. Roscoe et al. (2009) conducted demand assessments to determine which demands to include in the demand condition of FAs. It is possible that results of FAs in the current study may have differed if demand assessments had been conducted prior to FAs. For example, results of Luigi’s FA suggested a tangible function, rather than escape–to–tangible. However, when low–p demands and foods were presented during the demand assessments (when no tangible reinforcement contingency was arranged), the low rates of compliance and increased rates of problem behavior observed suggest that Luigi’s problem behavior was escape–maintained, at least in part. Thus, it is likely that demands presented during the escape–to–tangible conditions during Luigi’s FA were not sufficiently aversive to evoke problem behavior. Moreover, had escape–maintained behaviors emerged such that tangible reinforcement was contacted with sufficient frequency to establish a contingency, it is possible that levels of responding consistent with baseline would have been observed. Additionally, although demand assessments were initially conducted to assess the likelihood of compliance for various demands and food items, several novel academic targets and food items were introduced throughout the intervention without undergoing further assessments. Future studies may seek to conduct periodic assessments throughout treatments to evaluate the need for inclusion of certain demands for targeting.

Because data were collected retroactively from video recordings, some clinical decisions were made within sessions that did not conform to data–based criteria. For example, if an increase in problem behavior was observed in one session, a decision may have been made to alter the schedule (e.g., resume gradual thinning procedure) for the next session (within the same visit), without first collecting the appropriate data. Although it would have been more effective
and efficient to collect data using direct observation during sessions, this was not logistically possible with a single therapist.

While data were collected on compliance with academic instructions, no data were collected on the accuracy of responses during baseline or intervention. Future studies should seek to address this limitation by tracking the accuracy of responses and probing for mastery of academic targets within interventions targeting compliance. This may provide insight towards the relation between compliance and academic accuracy. Similarly, no data in the present study were collected on the overall amounts of specific food types consumed. Such data may have informed treatment decisions based on food preference and provided insight towards the overall health of participants.

Finally, reinforcement components in the present study were increased systematically throughout treatment to match increasing demand ratios throughout schedule thinning. While durations of reinforcement components should be sufficient to create an EO for compliance, future studies may seek to examine the extent to which reinforcement components can be systematically thinned, while maintaining desirable levels of responding.
References


## Appendix A: Table 1

### Table 1: Academic Targets Introduced Throughout Treatment for Each Participant

<table>
<thead>
<tr>
<th>Mario</th>
<th>Luigi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matching identical letters/numbers</td>
<td>Matching identical letters/numbers</td>
</tr>
<tr>
<td>Matching numbers to objects</td>
<td>Matching numbers to objects</td>
</tr>
<tr>
<td>Matching identical pictures</td>
<td>Matching similar pictures</td>
</tr>
<tr>
<td>Sorting by feature/function/class</td>
<td>Sorting by feature/function/class</td>
</tr>
<tr>
<td>Tacting pictures of objects/actions/emotions</td>
<td>Tacting pictures of objects/actions/emotions</td>
</tr>
<tr>
<td>Tacting letters/numbers</td>
<td>Tacting letters/numbers</td>
</tr>
<tr>
<td>Tracing letters/numbers/shapes</td>
<td>Tracing letters/numbers/shapes</td>
</tr>
<tr>
<td>Rote counting</td>
<td>Rote counting</td>
</tr>
<tr>
<td>Gross/fine motor imitation</td>
<td>Leveled–reading passages</td>
</tr>
<tr>
<td>Body parts (tacting/identifying)</td>
<td>Number sequencing</td>
</tr>
<tr>
<td>Imitating multiple–step components</td>
<td>Addition/subtraction</td>
</tr>
<tr>
<td>Patterns</td>
<td>More/less</td>
</tr>
<tr>
<td>Rhyming words</td>
<td>Patterns</td>
</tr>
<tr>
<td>Identifying adjectives</td>
<td>Phonics</td>
</tr>
<tr>
<td>Phonics</td>
<td>Reading comprehension</td>
</tr>
<tr>
<td>More/less</td>
<td>Fill in missing letter</td>
</tr>
<tr>
<td>Color by numbers</td>
<td>Identifying adjectives</td>
</tr>
<tr>
<td>Puzzles</td>
<td>Puzzles</td>
</tr>
<tr>
<td>Mazes</td>
<td>Mazes</td>
</tr>
</tbody>
</table>
Appendix B: Table 2

Table 2

*Foods Introduced Throughout Treatment for Each Participant*

<table>
<thead>
<tr>
<th>Mario</th>
<th>Luigi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard-boiled egg</td>
<td>Spinach</td>
</tr>
<tr>
<td>Peanut butter</td>
<td>Celery</td>
</tr>
<tr>
<td>Peanut butter sandwich</td>
<td>Bacon</td>
</tr>
<tr>
<td>Grape</td>
<td>Lettuce</td>
</tr>
<tr>
<td>Apple</td>
<td>Cheese (marble)</td>
</tr>
<tr>
<td>Banana</td>
<td>Cheese (mozzarella)</td>
</tr>
<tr>
<td>Strawberry</td>
<td>Broccoli</td>
</tr>
<tr>
<td>Blueberry</td>
<td>Tomato</td>
</tr>
<tr>
<td>Peach</td>
<td>Sweet potato</td>
</tr>
<tr>
<td>Honeydew melon</td>
<td>Hard-boiled egg</td>
</tr>
<tr>
<td>Carrot</td>
<td>Scrambled egg</td>
</tr>
<tr>
<td>Mango</td>
<td>Chick pea</td>
</tr>
<tr>
<td>Tofu</td>
<td>Grilled chicken</td>
</tr>
<tr>
<td>Cheese (marble)</td>
<td>Quiche</td>
</tr>
<tr>
<td>Nectarine</td>
<td>Grape</td>
</tr>
<tr>
<td>Raspberry</td>
<td>Orange</td>
</tr>
<tr>
<td>Bell pepper (red, orange)</td>
<td>Black bean</td>
</tr>
</tbody>
</table>
### Appendix C: Table 3

**Schedule Thinning Steps and Corresponding Reinforcement Durations**

<table>
<thead>
<tr>
<th>Step number</th>
<th>Schedule</th>
<th>SR+ Academic</th>
<th>SR+ Foods</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FR 1/FR 1</td>
<td>30 s</td>
<td>60 s</td>
</tr>
<tr>
<td>2</td>
<td>FR 2/FR 1</td>
<td>30 s</td>
<td>60 s</td>
</tr>
<tr>
<td>3</td>
<td>FR 3/FR 1</td>
<td>30 s</td>
<td>60 s</td>
</tr>
<tr>
<td>4</td>
<td>FR 4/FR 1</td>
<td>45 s</td>
<td>90 s</td>
</tr>
<tr>
<td>5</td>
<td>FR 5/FR 1</td>
<td>45 s</td>
<td>90 s</td>
</tr>
<tr>
<td>6</td>
<td>FR 6/FR 1</td>
<td>45 s</td>
<td>90 s</td>
</tr>
<tr>
<td>7</td>
<td>FR 7/FR 1</td>
<td>60 s</td>
<td>120 s</td>
</tr>
<tr>
<td>8</td>
<td>FR 8/FR 1</td>
<td>60 s</td>
<td>120 s</td>
</tr>
<tr>
<td>9</td>
<td>FR 9/FR 1</td>
<td>60 s</td>
<td>120 s</td>
</tr>
<tr>
<td>10</td>
<td>VR[FR] 10/FR 1</td>
<td>60 s</td>
<td>120 s</td>
</tr>
<tr>
<td>11</td>
<td>VR[FR] 15/FR 1</td>
<td>90 s</td>
<td>120 s</td>
</tr>
<tr>
<td>11</td>
<td>VR[FR] 20/FR 1</td>
<td>120 s</td>
<td>120 s</td>
</tr>
<tr>
<td>12</td>
<td>VR 40/FR 1</td>
<td>300 s</td>
<td>N/A</td>
</tr>
<tr>
<td>13</td>
<td>FT 600 s [FR 25]/FR 1</td>
<td>300 s</td>
<td>300 s</td>
</tr>
</tbody>
</table>
Appendix D: Table 4

Table 4

Satisfaction Questionnaire Items and Parent Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Mario</th>
<th>Luigi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. In an overall, general sense, how satisfied were you with the service you received?</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2. In general, how effective were treatment recommendations for this child?</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>3. The training sessions were presented in a concise and easy to understand manner.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>4. The amount of work required by the program was at a reasonable level to be most effective.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5. If a friend were in need of similar help, would you recommend this program to him/her?</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>6. At home, will you continue to use the treatment program?</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. I feel that when I do use these recommendations, they will be effective when applied consistently.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>8. I feel that the methods involved in with the treatment recommendations were ethically sound.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>9. The therapist was:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Flexible and open to work with.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>b. Was knowledgeable and thoroughly trained.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>c. was cooperative and easy to work with.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>d. Was helpful in solving problems as they arose.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>e. Showed positive regard for the child.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>f. Showed positive regard for the family.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>g. Was empathetic and sensitive to the child.</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>10. Has the implementation of the treatment program helped reduce any other behavior problems or increase any other skills?</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>11. At the time of discharge, were your child’s problems worse (1), the same (3), or absent (5)?</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>12. If for some reason you needed to seek help again, would you seek the therapist out again?</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>13. Have you noticed an improvement in your child’s health?</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>14. To what extent has the treatment program achieved the goals set at admission?</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

Appendix E: Figure 1

Figure 1. Rate of problem behaviors per minute across functional analysis conditions.
Appendix F: Figure 2

Figure 2. Percentage of compliance out of total number of opportunities (bars) and rates of problem behaviors per minute (squares) across academic targets for demand assessments.
Appendix G: Figure 3

Figure 3. Percentage of acceptance out of total number of opportunities (bars) and rates of problem behaviors per minute (squares) across food types for food acceptance assessments.
Appendix H: Figure 4

Figure 4. Percentage of Mario’s compliance out of total number of opportunities and rates of problem behavior across baseline, intervention, and reversals, for feeding and academic sessions.
Appendix I: Figure 5

Figure 5. Percentage of Luigi’s compliance out of total number of opportunities and rates of problem behavior across baseline, intervention, and reversals, for feeding and academic sessions.
Figure 6. Rates of FCRs per minute and percentage of discriminated FCRs across intervention and reversals during feeding and academic sessions for Mario.
Appendix K: Figure 7

Figure 7. Rates of FCRs per minute and percentage of discriminated FCRs across intervention and reversals during feeding and academic sessions for Luigi.