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PRODUCING MEANINGFUL IMPROVEMENTS IN PROBLEM BEHAVIOR OF CHILDREN WITH AUTISM VIA SYNTHESIZED ANALYSES AND TREATMENTS

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Problem behaviors like self-injury, aggression, or disruption will likely require intervention at some point in the life of a person diagnosed with autism. Behavioral intervention has been proven to be effective for addressing these problems, especially when a functional assessment is conducted. Comprehensive treatment for problem behavior is, however, often fractured across studies, resulting in a dearth of studies that show socially validated improvements in these problem behaviors or illustrate the assessment and treatment process from start to finish. In this article, we describe an effective, comprehensive, and parent-validated functional assessment and treatment process for the severe problem behaviors of 3 children with autism. After an 8- to 14-week outpatient clinic consultation, no problem behavior was observed at the clinic and in the home. Furthermore, behavior that did not occur during baseline (e.g., functional communication, delay and denial tolerance, and compliance with instructions) occurred with regularity.

Key words: autism, compliance, delay tolerance, functional analysis, open-ended interviews, functional communication, severe problem behavior, social validity

About 1 in 50 children have been identified as having an autism spectrum disorder (Blumberg et al., 2013). There is no biological determination of autism; however, the behavioral symptoms are typically apparent before 3 years of age. Autism is characterized by impairments in social interaction and communication and by restricted, repetitive, or stereotyped patterns of behavior (Blumberg et al., 2013). Children with autism often display additional problem behaviors such as self-injurious behavior (SIB), aggression, disruption, extreme emotional outbursts, or sleep disturbance (Dominick, Ornstein Davis, Lainhart, Tager-Flusberg, & Folstein, 2007; Murphy, Healy, & Leader, 2009).

Single-subject analyses (Carr & Durand, 1985; Iwata, Pace, Cowdery, & Miltenberger, 1994) and meta-analyses (Kahng, Iwata, & Lewin, 2002; Scotti, Evans, Meyer, & Walker, 1991) provide robust evidence to support the short-term efficacy of behavioral intervention, in general, and function-based treatments, in particular, for self-injury, aggression, and disruption. For example, Campbell (2003) conducted a meta-analysis that showed the short-term positive effects of behavioral intervention for these problem behaviors among persons with autism. Campbell also found that larger reductions in problem behavior were evident when the treatment was based on a functional assessment; even larger reductions were apparent when a functional analysis was part of the functional assessment process (see also Betz & Fisher, 2011).

Functional assessment is a general process aimed at identification of the variables that influence problem behavior before treatment. The functional assessment usually involves some sort of combination of indirect assessment (e.g., interviews), descriptive assessment, and functional analysis (Iwata & Dozier, 2008). Descriptive assessment entails observation and measurement

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of the problem behavior and the context in which the behavior occurs. By contrast, functional analysis consists of observation and measurement of problem behavior in at least two contexts, each distinctly designed so that the variables suspected of influencing problem behavior are conspicuously present in the test condition and absent in the control condition (Hanley, Iwata, & McCord, 2003).

Functional analyses of problem behavior are prominent in the behavioral assessment literature, having appeared in at least 435 studies through 2012 with at least 117 involving persons with autism (Beavers, Iwata, & Lerman, 2013; Hanley et al., 2003). Functional analysis research often focuses on detection and evaluation of the impact of single variables, and as a result, useful technologies relevant to effective assessment and treatment of problem behaviors associated with autism are often fractured across studies. In fact, few, if any, individual studies have illustrated the assessment and treatment process from start to finish, a comprehensiveness required for producing socially valid improvements in SIB, aggression, or disruption in children with autism. In addition, there is considerable variability in the manner in which functional assessments are conducted, the speed and success of the initial analysis in detecting a function of problem behavior, and the extent to which types of indirect and descriptive assessments are used in the functional assessment process (Beavers et al., 2013; Hagopian, Rooker, Jessel, & DeLeon, 2013; Hanley et al., 2003).

Hanley (2010, 2011, 2012) recently described a particular functional assessment process that was intended to increase its efficiency while preserving its scientific rigor. He emphasized starting with an open-ended interview to identify the type of contingencies that may influence problem behavior. The interview results were then used to design individualized and intimately matched test–control analyses that differed only in that the test condition included the putative reinforcement contingency and the control condition did not. This test–control analysis was presented as an alternative to the standardized, comprehensive functional analysis (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994), which typically involves multiple test conditions that evaluate generic contingencies and a single control condition that varies from the test conditions in multiple ways. Hanley also argued against the use of closed-ended indirect assessments (e.g., rating scales) and formal descriptive assessments due to recurrent problems with measurement reliability for the former and the predictive validity of both (Iwata, DeLeon, & Roscoe, 2013; Newton & Sturmey, 1991; Nicholson, Konstantinidi, & Furniss, 2006; Shogren & Rojahn, 2003; St. Peter et al., 2005; Thompson & Iwata, 2007; Zarcone, Rodgers, Iwata, Rourke, & Dorsey, 1991).

We applied the functional assessment model described by Hanley (2010, 2011, 2012) in the current study to address the severe problem behavior of three children who had been diagnosed with autism. Our purpose was to demonstrate the utility of the model in an outpatient clinic with the first three families who attended the clinic by implementing, generalizing, and socially validating the treatments designed from the results of the interview-informed analyses. Single-subject designs demonstrated the influence of the separate treatment components that were progressively synthesized to produce socially valid outcomes for participating families.

METHOD

Participants

The three participating families learned of the university-based outpatient clinic through their local pediatrician's office. Services were provided without charge as part of the research and training mission of the university. All children engaged in episodes of problem behavior multiple times each day and had been receiving behavior-analytic services for at least 1 year prior to being served in our clinic. Gail was a 3-year-

old girl with pervasive developmental disorder not otherwise specified, Dale was an 11-year-old boy with autism, and Bob was an 8-year-old boy with autism. All children could follow multistep vocal instructions (but usually did not do so), imitate, and speak in short sentences. Dale and Bob attended specialized classrooms in public schools and received one-on-one paraprofessional support. Both were included in regular classrooms with paraprofessional support for about 1 hr each day. Gail was receiving speech language services at the time of her evaluation. Parents reported that their children exhibited problem behavior when they could not have their way and that the form, intensity, and duration of the problem behavior were highly disproportionate with the situation. The goal of treatment for all three children was to reduce problem behavior and increase the amount of time they would comply with adult instructions and accommodate others' preferences.

Gail reportedly had difficulty when her mother asked her to clean up her toys or play independently while her mother was working on other tasks. For example, when her mother attempted to cook dinner or clean the house, Gail screamed, cried, and hit her mother or her sister. Gail's mother frequently repeated instructions to "go play" or to "wait a bit," but problem behavior persisted for long periods (i.e., from minutes to hours). It was reported that Gail frequently controlled the activities of the household with her problem behavior.

Dale reportedly had trouble tolerating periods of time when adults did not honor his requests for items or idiosyncratic activities. Parents also reported that his problem behavior reliably occurred when adults interrupted his ongoing activity (e.g., watching movies or wandering through the house) with an instruction to do something else. Parents accommodated as many of Dale's requests as possible and rarely instructed him to engage in any adult-led activities. Parents also reported spending a lot of money to accommodate his preferences and to avoid problem behavior (e.g., purchasing movies, games, and particular foods). The intensity of problem behavior had resulted in the termination of several home-based behavioral support services prior to this study.

Bob was reported to have trouble regulating his emotions when parents or teachers said "no" and when there was some loss of control in his environment. He was reported to often have a "meltdown" (i.e., screaming and aggression) when parents took away his iPad or interrupted his games on the iPad or other electronic devices. Meltdowns also occurred when teachers corrected his math work or instructed him to transition to a nonpreferred (nonmath) academic task. Parents and teachers had gone to great lengths to accommodate Bob's preferences, but his meltdowns reportedly occurred multiple times per day. Bob had physically injured children and adults in both the home and at school. Parents reported that they had not taken Bob out of the house to anywhere but school (i.e., no restaurants or family day trips) for over 2 years due to the frequency of, and risks associated with, his meltdowns.

Setting

All functional analysis and treatment sessions were conducted in therapy rooms (4 m by 3 m) with one-way observation panels and audio-video equipment located in the psychology department of a university. All session rooms contained a table, two chairs, and other materials relevant to ongoing observations. Due to the nature of some of Dale's requests, some of his sessions were also conducted in a computer lab, hallway, and classrooms in the psychology department. The classroom was equipped with a computer and overhead projector that could play DVDs that the family brought to sessions. Visits to the clinic occurred 3 to 4 days per week and lasted about 1 hr. Sessions were conducted three to six times per visit. Session duration for Gail was 5 min throughout the analysis, treatment, and treatment extension. Session duration

for Dale was 5 min and increased to 10 min approximately halfway through his assessment. Session duration for Bob was 4 min and increased to 6 min approximately halfway through his assessment. Gail's treatment extension sessions began in the home. Treatment extension sessions for Dale and Bob began in the session rooms and other areas around the psychology department and outside the building (e.g., walking to the car in the parking lot). Eventually, treatment for all children was implemented in various locations in the participants' homes (e.g., kitchen, bedroom, etc.).

Measurement

Trained observers collected data using software on small laptops. Data were collected during continuous 10-s intervals and were summarized as number of responses per minute or percentage of session. Data were collected on the number of problem behaviors, functional communicative responses (FCRs), tolerance responses, and reinforcement duration. Data were also collected on the duration and type of instructions and compliance to the instructions. Problem behavior for all participants included loud vocalizations (e.g., shouting, screaming, or yelling), disruption (e.g., throwing items or tearing homework sheets), and aggression (e.g., head butting, hitting, grabbing, spitting, or punching). Observers scored two types of FCRs, simple and complex, that varied slightly for each participant based on their language abilities and the reinforcers that maintained their problem behavior. Gail's simple communication response was "toys, please." Dale and Bob's simple communication response was "my way, please." The complex response required the participant to say "excuse me" and then wait for adult acknowledgment before engaging in a longer FCR. Gail was required to say, "May I have toys, please?" "Will you play with me?" or "May I have —, please?" Bob's and Dale's complex FCR was "May I have my way, please?" Tolerance responses were scored anytime the child stopped what he or she was doing, oriented toward the adult, and said "okay." Independent FCRs and tolerance responses were recorded when the correct phrasing was emitted with appropriate tone and volume. FCRs and tolerance responses were considered to be prompted if the analyst or parent provided a vocal model of all or any part of the response before the child independently emitted the complete response correctly (e.g., "Excuse me, may I have my way please?"). Only independent responses are plotted on the figures.

The percentage of session with reinforcement was calculated by dividing the duration of reinforcement time by the session duration. Reinforcement duration included all of the session time in which the participant had access to the reinforcer identified in the functional analysis. For Gail, reinforcement duration was scored when she was allowed access to both toys and her mother's attention. For Dale, reinforcement duration was scored when the analyst or parent removed demands, provided access to the preferred activity, and honored his request for idiosyncratic reinforcers (e.g., sitting in a particular place, changing the movie). For Bob, reinforcement duration was scored when the analyst or parent allowed Bob to play with the iPad or solve the math problems his way.

Observers began recording the duration of a particular type of demand as soon as that demand was given and stopped recording when another type of demand was given or the reinforcer was delivered. Observers scored compliance with demands when the participant actively responded to or oriented toward task materials, toys, or other activities as instructed by the analyst or parent without problem behavior, refusal (e.g., "no" or "I don't want to"), or physical guidance to complete an activity. Compliance continued to be scored between instructions if the child continued to behave in this manner. For example, the analyst might take time between instructions to erase the board and draft a new math problem; compliance

continued to be scored during this time if the child remained at the board and did not engage in problem behavior. The percentage of compliance with each type of demand was calculated by dividing the duration of compliance with the demand by the total duration during which the demand was given.

Interobserver agreement was assessed by having a second observer collect data on all target behaviors simultaneously but independently during at least 20% of each condition for all participants. Observers' records were compared on an interval-by-interval basis, and agreement percentages were calculated by dividing the smaller number of responses or duration (in seconds) in each interval by the larger number. If both observers scored zero, the interval was scored as 100% agreement. Quotients were then averaged and converted to a percentage. Interobserver agreement averaged 99% (range, 80% to 100%) for Gail, 98% (range, 82% to 100%) for Dale, and 98% (range, 73% to 100%) for Bob.

Design

A multielement design was used to compare the test and control conditions of the functional analysis, and a reversal design was used to compare parent- and therapist- implemented analyses (Gail only). The design for the treatment analyses followed the logic of a changing-criterion design. Functional control was demonstrated by showing that levels of problem behavior and alternative responses closely corresponded, in the predicted direction, to four successive changes in reinforcement contingencies for those responses.

Functional Assessment

An open-ended functional assessment interview with the participants' parents (see Appendix in Hanley, 2012) followed by, or concurrent with, a brief observation of the child was arranged to discover potential factors that may influence problem behavior. The open-ended interview lasted between 30 and 45 min and included questions about the participants' current abilities (e.g., "Describe your child's language abilities" and "Describe your child's play skills and preferred toys or leisure activities"), problem behavior (e.g., "What are the problem behaviors?" and "What is the single most concerning problem behavior?"), contexts in which problem behavior is likely to occur (e.g., "Under what conditions or situations are the problem behaviors most likely to occur?"), and parents' responses to problem behavior (e.g., "What do you do to calm you child down during a meltdown?"). Questions were sometimes individualized as the open-ended interview progressed based on the content of the parents' responses. During the 15- to 30-min observation, the analyst noted the language ability of the child and any problem behavior that occurred while the analyst interacted with the child. The analyst initially sat and made him- or herself available to the child and then provided and removed toys, attention, and activities as well as instructions during the observation.

A functional analysis, informed by the results of the interview and observation, was then conducted to test the apparent reinforcement contingencies. Functional analyses involved alternating between a test and a control condition (or for Gail and Bob, a series of test and control conditions). During each control condition, which was always conducted first, the putative reinforcers were available throughout the session. During each test condition, the putative reinforcers were removed every 30 s and were only returned contingent on problem behavior. The same materials were always available across each corresponding test and control condition, and reinforcers that were not part of the suspected controlling contingency were available noncontingently in both the test and control conditions. Therefore, the only difference between test and control conditions was the suspected reinforcement contingency.

Gail. Results of the interview and brief observation suggested that problem behavior

was evoked when adult attention was diverted or when preferred activities were removed and that contingent access to adult attention, preferred activities, or both, reinforced Gail's problem behavior. Both attention and tangible reinforcement contingencies were simultaneously evaluated first. In the synthesized tangible and attention control condition, both tangible items (e.g., dolls, dress-up clothes, picture books, and puzzles) and adult attention were available throughout the entire session, and no instructions were provided. In the synthesized tangible and attention test condition, both were removed at the beginning of the session, and both were returned contingent on problem behavior for 30 s. A control session was conducted first; test and control sessions were then alternately conducted. The analyst and mother also alternated implementation of the test and control conditions. The analyst was present in the room when the mother implemented the sessions and provided coaching on implementation as needed.

Attention and tangible reinforcement contingencies were also analyzed in isolation. The control condition was as described above: The analyst or mother provided attention throughout the session, and tangible items were continuously available (no instructions were provided). In the attention test condition, Gail was allowed to access a variety of preferred toys (e.g., dolls, dress-up clothes, and puzzles); however, at the beginning of the session, the analyst or mother removed attention by turning away from Gail and working on another task (Gail could continue to play with the available toys in the absence of adult interaction). Attention was returned for 30 s immediately following problem behavior.

In the tangible test condition, Gail was placed at a table away from tangible items; however, the analyst or parent was at the table with Gail and provided attention. Gail was allowed to leave the table and play with the toys for 30 s contingent on problem behavior; however, the parent or analyst remained at the table and did not interact with Gail while she played with the toys.

Dale. Results of the open-ended interview and brief observation suggested that Dale's problem behavior was evoked by an adult's interruption of activities that were initiated by Dale or when his requests were denied, and that terminating adult instructions, regaining access to his activity, or having his requests honored were maintaining Dale's problem behaviors. In the control condition, he was given uninterrupted access to the activities of his choosing (e.g., watching movies, playing on a computer, talking about preferred topics), no demands were made, and the analyst honored all reasonable requests. Reasonable requests were those that could be granted in the space provided and with accessible materials (e.g., changing the movie in the DVD player); unreasonable requests were those that were impossible to grant at the time (e.g., asking to go to a movie theater, asking to buy a new toy) or those that created a nuisance for others if granted (e.g., providing access to the laptop and projector in a classroom occupied by a graduate seminar). In the test condition, the analyst interrupted the ongoing activity initiated by Dale and instructed him to complete homework (e.g., math worksheets, writing and reading assignments). A three-step prompting hierarchy was used to promote compliance with the homework-related instructions. The analyst delivered praise if Dale complied with instructions, but the occurrence of problem behavior resulted in the removal of demands, reaccess to the activity Dale originally initiated, and the analyst complying with his reasonable requests. Contingencies involving attention, escape, tangible items, or compliance with his requests were not evaluated in isolation because the interview suggested that they often occurred simultaneously. Only synthesized contingencies were analyzed with Bob for similar reasons.

Bob. The results of the interview and brief observation suggested that Bob's problem behavior was evoked by an adult's interruption and

redirection of his play with his iPad or interruption and correction of his math work, and that regaining access to his way of interacting with his iPad or math work were maintaining Bob's problem behavior. It is important to note that Bob was very skilled with both math and with most of the applications on his iPad. Two contexts defined by the activity, iPad or math workbooks, were arranged as separate analyses. In the control conditions for both analyses, Bob was allowed his way of playing with the iPad or solving the math problems throughout the session. An adult was present and commented on his activity but did not interrupt, redirect, or correct him. In the test conditions, the analyst or the parent either interrupted and redirected Bob's iPad play (e.g., requested that he turn off the open application and open a different application) or interrupted, redirected, or corrected his math work. The iPad was not available during sessions with the math materials, and math materials were not available during sessions with the iPad. When problem behavior occurred, the analyst immediately stopped the interruption, redirection, or correction and allowed Bob 30 s to play his way with the iPad or work on his math workbooks.

Treatment

Treatment for all children included (a) teaching a simple FCR to replace problem behavior (Carr & Durand, 1985), (b) increasing the complexity and developmental appropriateness of the FCR, (c) introducing delays and denials from an adult and teaching a specific response to cues of reinforcement denial and delay, (d) chaining simple responses during denial- and delay-tolerance training, (e) chaining more difficult responses during denial- and delay-tolerance training, and (f) extending the treatment to ecologically relevant situations (see Table 1).

Baseline. The test condition sessions from the differentiated functional analyses were used as the baselines for the treatment process with all children.

Simple FCT. Immediately before the simple FCT sessions, the analyst taught each child a simple FCR using behavior skills training (BST; instructions, modeling, role play, and feedback).

Table 1
Steps for Addressing Severe Problem Behavior and the Time Expended and Extrapolated Costs

	Participants							
	Gail		Dale		Bob		Average	
Steps	Visits[a]	Cost[b]	Visits	Cost	Visits	Cost	Visits	Cost
Interview*	1	200	1	200	1	200	1	200
Functional analysis*	4	800	0.8	160	2.2	440	2.3	460
Functional communication training	1	200	2.7	540	2.3	460	2	400
Complex FCT	2	400	1	200	4.3	860	2.4	480
Tolerance response training	7	1,400	1.5	300	5.2	1,040	4.6	920
Easy response chaining	2	400	4.8	960	1	200	2.6	520
Difficult response chaining*	3	600	11.2	2,240	2	400	5.4	1,080
Treatment extension*	2	400	9	1,800	9	1,800	6.7	1,340
Total	22	4,400	32	6,400	27	5,400	27	5,400
Supervision meetings[c]	16	1,000	28	1,750	16	1,000	20	1,250
Report writing and planning[d]	4	500	4	500	4	500	4	500
Grand total		5,900		8,650		6,900		7,150

[a]Each family visit lasted 1 hr; lead BCBA and BCaBA were present at each visit.
[b]Cost is in US dollars; hourly rate of supervising and lead BCBA was $125; hourly rate of BCaBA was $75.
[c]Supervision meetings between supervising and lead BCBA lasted 30 min and occurred approximately twice per week.
[d]Report writing and planning periods required 1 hr and occurred after each step noted by an asterisk.

Gail was taught to say "toys, please" to access toys and attention. Bob and Dale were taught to say "my way, please" to terminate adult instructions (corrections, etc.) and regain access to preferred activities (and preferred ways of interacting with activities for Bob and having requests honored for Dale). If the child did not engage in the response within 5 s, the adult verbally prompted the response by saying, "say —." Problem behavior no longer resulted in reinforcement (i.e., extinction was programmed). If the FCR was closely preceded by problem behavior, the adult did not provide access to the reinforcer (i.e., the adult ensured that at least 5 s elapsed between the occurrence of problem behavior and the FCR; this was exclusively relevant to Dale).

Complex FCT. After the child emitted independent FCRs for at least two sessions, the adult attempted to increase the complexity of the response. The complex FCR consisted of teaching the child to say "excuse me" slowly and softly while making eye contact with an adult, and then waiting for an adult to acknowledge them before emitting a more developmentally appropriate FCR. The child was taught to say "May I have —, please?" slowly and softly to request access to the reinforcers. If the child did not engage in the appropriate FCR within 5 s, a verbal prompt, an expectant look, or both were provided. The analyst withheld access to the reinforcers if problem behavior occurred.

Delay and denial baseline. After the child acquired the complex FCR and problem behavior remained at low levels, the adult introduced denials by saying "no" or some variant (e.g., "not now," "later") after 60% of the FCRs (three of every five FCRs produced the denial response from the adult; the remaining two produced reinforcement). In addition, if problem behavior (rather than another FCR) followed the denial, the adult then delivered the reinforcer contingent on problem behavior. In other words, during the delay and denial baseline, problem behavior remained on extinction until the child emitted the complex FCR and the adult denied access to the reinforcer. After the adult denied access to the reinforcer, subsequent problem behavior produced the reinforcer. This condition was designed to emulate conditions under which parents reported to give in after telling their child "no" in order to prevent escalation of problem behavior. This condition also served to show that the reinforcement contingency determined from the functional assessment process was still controlling problem behavior.

Delay- and denial-tolerance training. In this condition, as in the previous, two of every five FCRs resulted in immediate reinforcement, and three of every five FCRs resulted in a delay or denial response from the analyst or parent. All problem behavior was placed on extinction. Using BST, the analyst taught the child a specific response to the denial cue which was to take a breath and say "okay" while orienting toward the adult when the adult said "no" (or other terms that signaled a delay or denial of the requested reinforcer). The requested reinforcer was initially provided immediately after the child emitted this tolerance response. The delay to reinforcement was then gradually increased by requiring Gail to engage in an alternative and less preferred activity (i.e., she was directed to play alone and with less preferred toys), requiring Bob to tolerate redirection or correction and comply with any adult instructions, and requiring Dale to comply with adult instructions. Delays were gradually increased until each child accommodated adult directives for approximately 67% of the session (i.e., the child spent at least 67% of the session in the less preferred activities without access to the reinforcers that maintained their problem behavior). The delay was increased only when the FCR was independent and when the rate of problem behavior was zero. It is also important to note that initially, the adult required little behavior from their child (Gail) or provided only a few simple and brief instructions (Dale and Bob). We refer to these as Level 1 instructions; these included simple motor instructions for Gail and Dale or a brief (2 to 30 s) requirement to engage

in less preferred activities for Bob and Gail. The complexity and duration of the play requirement or instructional periods were gradually increased during this phase to produce long chains of developmentally appropriate responding that yielded the functional reinforcer. Level 2 instructions involved simple academic tasks and transitions for Gail and Dale and a longer duration of engagement in less preferred activities for Bob and Gail (45 to 90 s). Level 3 instructions were introduced last and involved alternate play, self-help activities (e.g., washing hands), and developmentally appropriate and challenging preacademic (Gail) or academic tasks (e.g., math and reading comprehension for Dale) or extended engagement in less and nonpreferred activities (e.g., transitioning, meals for Bob).

Approximately halfway through delay- and denial-tolerance training, enhanced differential reinforcement was introduced with Dale due to some persistence of problem behavior during delays. If Dale engaged in no problem behavior during the delay and complied with instructions without requiring physical guidance to complete an activity, the analyst provided a longer reinforcement period (3 min) with high-quality reinforcers (e.g., preferred movies, snack foods, and high-quality attention). Any problem behavior or noncompliance during the delay resulted in a relatively brief reinforcement period (30 s) with lower quality reinforcers (e.g., a movie with no snack).

Treatment extension. To evaluate the practicality and generality of the treatment, the intervention was extended outside the therapy rooms to more relevant situations. The manner in which treatment was extended differed slightly for each child according to their parents' initial goals. In most cases, parents (or the teacher for Bob) were taught to implement the session contingencies in the session room first. The parents then were coached on implementation of the treatment in various areas of the outpatient clinic. The analyst then went to the child's home and coached the parents to implement the treatment during tasks typical of the home environment (e.g., eating dinner, cleaning up toys, and completing homework) that had been described as being the most troublesome during the initial interview.

Social Validity

To assess whether the functional assessment and treatment process was acceptable and resulted in socially meaningful outcomes for the participating families, parents were given a questionnaire at the end of the treatment. We asked parents four questions about the extent to which they (a) found the assessment acceptable, (b) found the treatment procedures acceptable, (c) were satisfied with amount of improvement observed in problem behavior, and (d) were satisfied with the overall helpfulness of consultation. We also asked the parents about their comfort levels with presenting the situation reported to evoke problem behavior before and after the transfer of the treatment to their homes (e.g., comfort level in removing electronic devices, telling the child "no," interrupting the child's preferred activity, and telling them to do homework or other nonpreferred activities).

RESULTS

Functional Assessments

The interview resulted in the hypotheses that Gail's problem behavior was maintained by social positive reinforcement in the form of adult attention, tangible items, or both. When both tangible items and adult attention were provided contingent on Gail's problem behavior by the analyst (Figure 1, left), undifferentiated analyses were obtained. Differentiation between the test and control conditions was, however, obtained when Gail's mother implemented the conditions. The effect of the implementer was then replicated. When the independent effects of the tangible and attention reinforcement contingencies were assessed, neither appeared to influence problem behavior, despite Gail contacting each

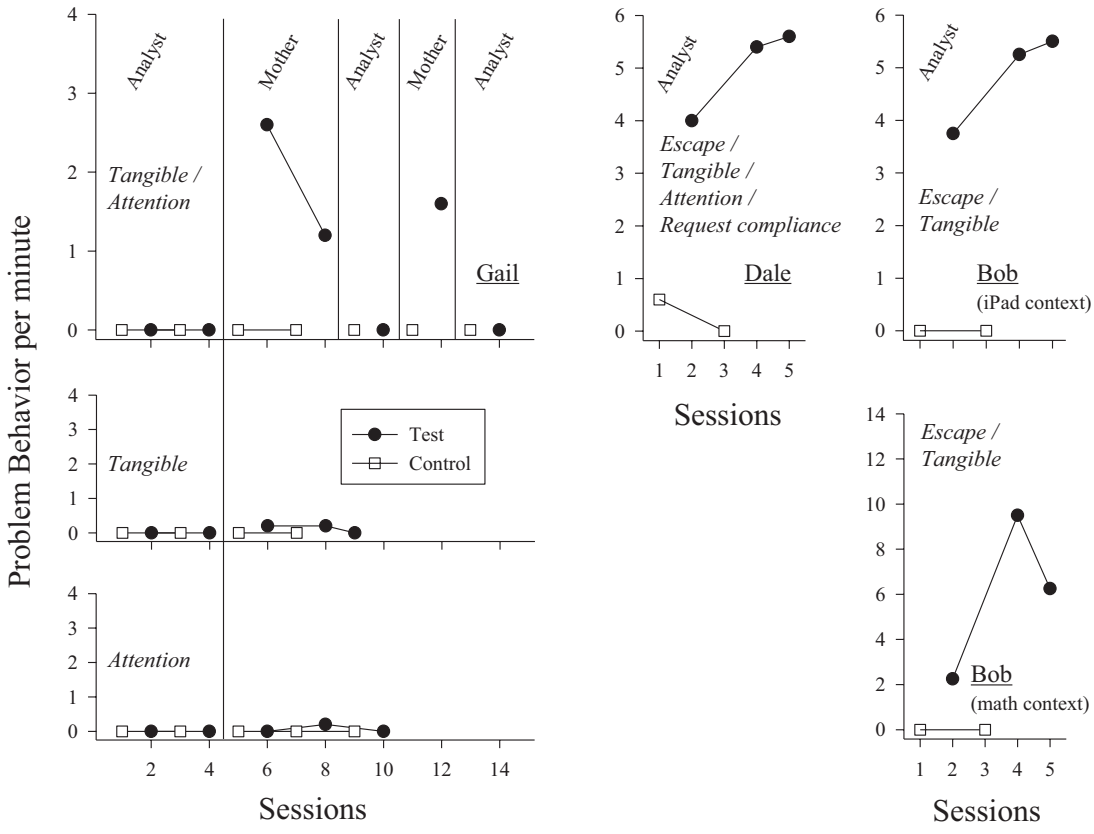

Figure 1. Interview-informed functional analyses for all three participants. The contingencies assessed with each child are noted in italics.

contingency. The results of the functional assessment process with Gail showed that her problem behavior was sensitive to the combination of tangible items and attention as reinforcement when provided by her mother.

Parents reported during the interview that Dale's problem behavior occurred primarily when he was interrupted from preferred activities or when his requests were not reinforced. Problem behavior was observed at zero or near-zero rates when he was allowed to engage without interruption in preferred activities and when his reasonable requests were granted during his control condition (Figure 1, top right). When his problem behavior yielded escape from adult instructions and access to preferred activities, adult attention, and having his reasonable requests granted, we observed relatively high rates of problem behavior. Results of the functional assessment process showed that his problem behavior was probably maintained by multiple social positive and negative reinforcement contingencies. Speaking loosely, it appeared that his problem behavior was maintained by access to "his way," which was usually specified by Dale either before or after engaging in problem behavior (cf. Bowman, Fisher, Thompson, & Piazza, 1997).

Parents reported that Bob's problem behavior occurred whenever someone attempted to prompt him to engage his electronic devices or assigned math problems in a different way than

that which he was doing. Problem behavior was observed exclusively in the test sessions (Figure 1, middle and bottom right), which is when his problem behavior terminated interruptions and allowed him to regain access to his way with the iPad or math workbook. As with Dale, Bob's problem behavior appeared to be maintained by access to his way, or more technically, maintained by the termination of adult interruption and prompting (social negative reinforcement), access to his self-directed activity with his iPad or math workbook (positive reinforcement; cf. Fisher, Adelinis, Thompson, Worsdell, & Zarcone, 1998), or some combination.

Comprehensive Treatment Evaluations

The test conditions of the functional analyses served as the baselines from which to evaluate the effects of teaching FCT and delay-tolerance skills with all three children (see Figures 2, 3, and 4). FCT resulted in immediate elimination of problem behavior for Gail and acquisition of the simple FCR of "play with me." Five sessions were required for the complex FCR to begin to occur independently. At this point, when toys and attention were removed by her mother, Gail obtained her mother's attention by saying "excuse me." After being acknowledged by her mother, Gail would then say "May I have toys, please?" or some variation. The denial baseline resulted in reemergence of problem behavior and some emotional responding (the latter is not depicted in the figure).

In denial- and delay-tolerance training, problem behavior returned to near-zero levels while complex FCRs and tolerance responses persisted. Gail's mother then added in instructions to either play independently with nonpreferred toys or to complete nonpreferred tasks when complex FCRs yielded delays or denials. As additional responses were being chained to the tolerance response or longer periods of independent play was required, (a) problem behavior remained at near-zero levels, (b) complex FCRs and tolerance responses persisted, (c) the amount of time with reinforcement gradually decreased (i.e., Gail played without her mother and with less preferred toys for longer periods of time), and (d) compliance with the mother's instructions occurred at high levels despite the gradual introduction of more challenging instructions (e.g., playing alone). Some small variability in all responses was observed as the treatment was extended to different contexts; nevertheless, when the evaluation was terminated, Gail's problem behavior was at zero and her complex FCRs, tolerance responses, and compliance persisted despite the fact that her requests were honored only about half the time, the amount of reinforcement time was routinely less than 50%, and her mother placed difficult demands on her to play independently and with nonpreferred activities. Control of the treatment was evident via the return of problem behavior in the denial baseline and by the fact that the social skills emerged when and only when the reinforcement contingency was assigned to those responses.

The results obtained with Gail were systematically replicated with Dale. The main differences were (a) slightly more variability in problem behavior for Dale than that observed for Gail prior to the treatment extension phase of the evaluation, (b) more time spent on the gradual introduction of more challenging situations during the delay, and (c) less variability in problem behavior during the treatment extension phase. The variability in problem behavior was probably a function of not being able to reinforce all his requests during the reinforcement interval in the initial treatment phases, because some of his requests were unreasonable. The extended time during delay-tolerance training was primarily due to the greater amount of developmentally advanced behaviors that needed to be introduced, given his age and parental expectations. Multiple consecutive sessions with zero levels of problem behavior towards the end of the evaluation were probably a function of the qualitative difference in the type of reinforcers available for him to request which depended on

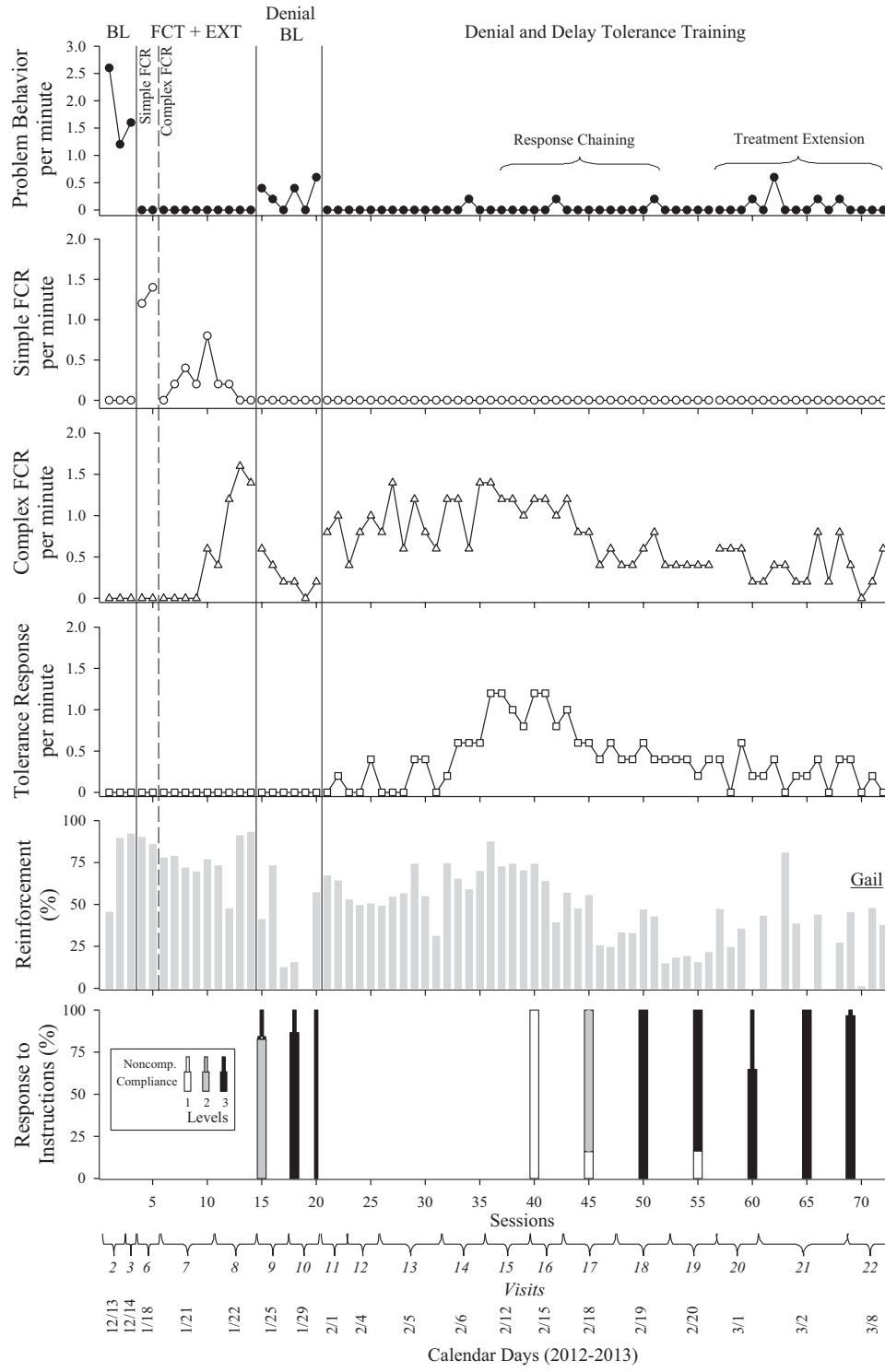

Figure 2. Treatment analysis for Gail. FCT + EXT = functional communication training and extinction.

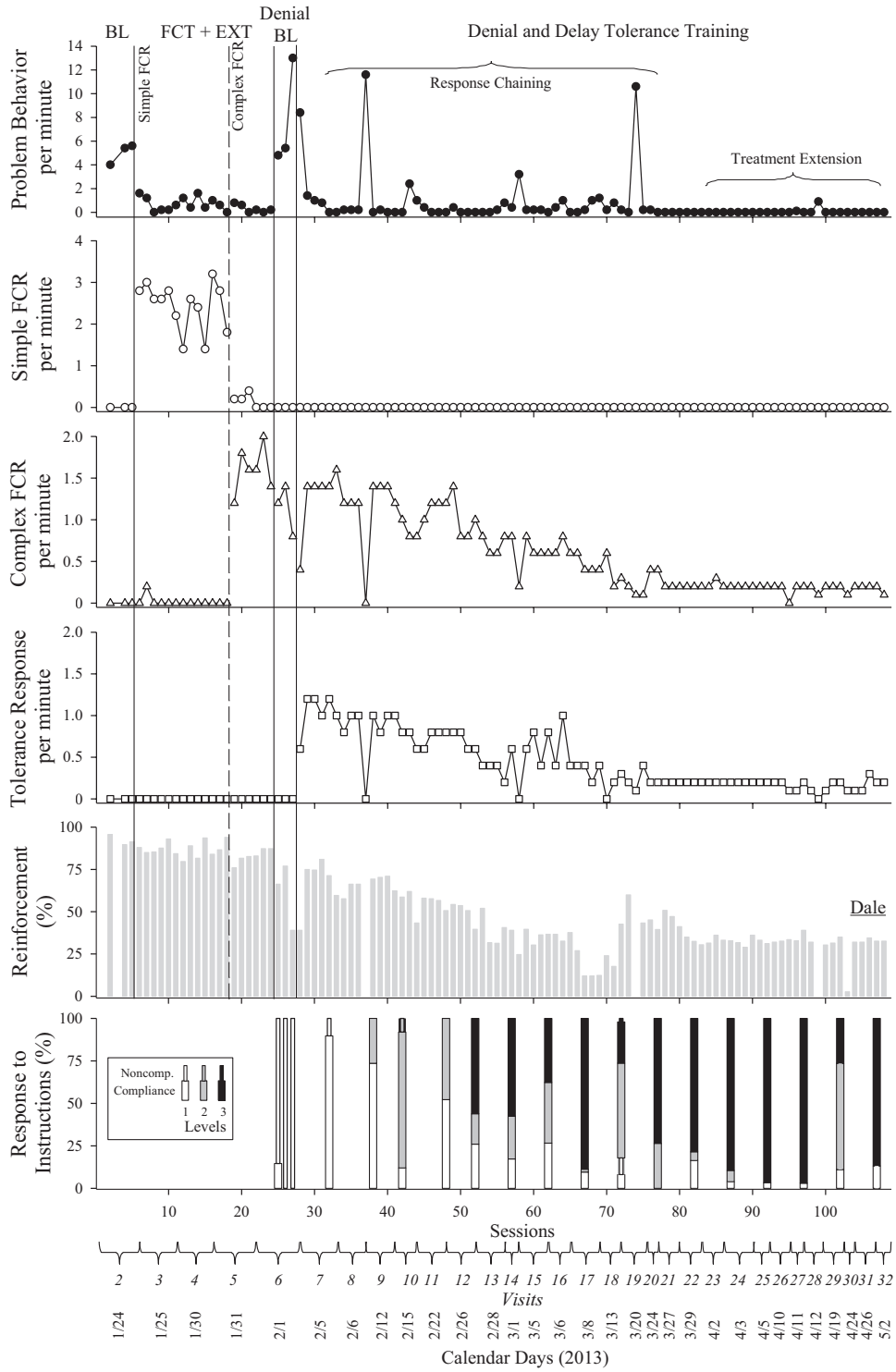

Figure 3. Treatment analysis for Dale.

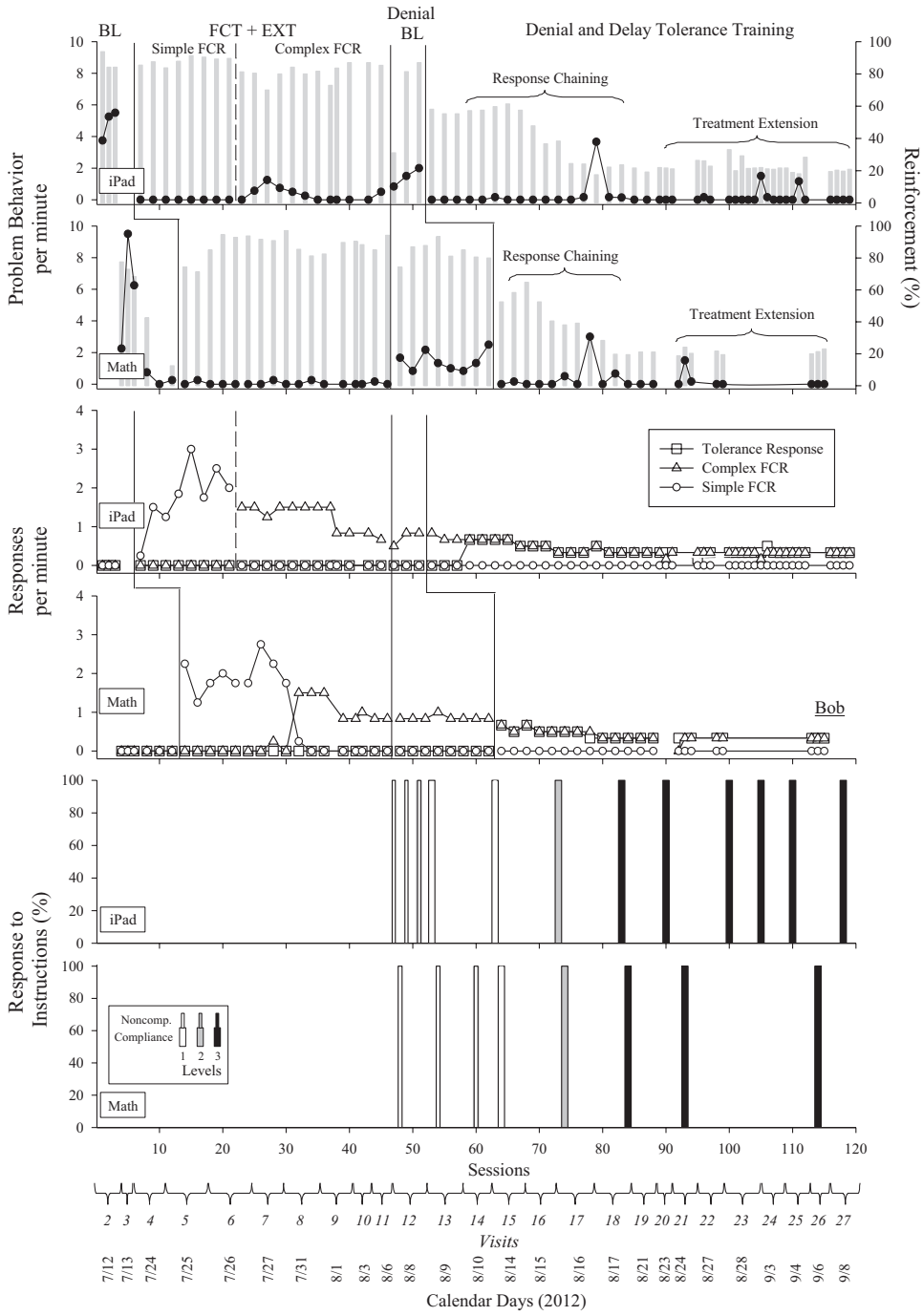

Figure 4. Treatment analyses for Bob.

his behavior during the delays. Nevertheless, when the evaluation was terminated, Dale's problem behavior was at zero and his complex FCRs, tolerance responses, and compliance persisted despite the facts that his requests were honored only about 40% of the time, the amount of reinforcement time was routinely less than 40%, and his parents placed difficult demands on him during the delays.

The effects of the comprehensive skill-based treatments observed with Gail and Dale were also systematically replicated with Bob in both the iPad and math contexts. We observed what appeared to be generalized extinction of problem behavior in the math context when FCT was initiated in the iPad context, but FCT was necessary for the simple FCR to be acquired in the math context. Some variability in problem behavior was observed while the complex FCR was being taught in the iPad context. After the complex FCR was acquired in the iPad context, it generalized to the math context. As with Gail and Dale, problem behavior reemerged when delays and denials were introduced following some complex FCRs. Nevertheless, by the end of the evaluation and despite having "his way" only 20% of the time, Bob engaged in zero levels of problem behavior, consistently engaged in the complex FCR and tolerance responses, and complied with instructions to play with his electronics or do his math in the manner requested by his parent and teachers.

Social Validity Evaluations

After the final treatment extension session, families returned to the outpatient clinic to complete a social validity questionnaire and to ask any questions about treatment implementation. All parents reported that they found the assessment procedures and treatment packages highly acceptable, the improvement in problem behavior highly acceptable, and overall consultation very helpful ($M = 6.9$ on a 7-point Likert scale for the four social validity questions for the three families). When asked about their comfort level with presenting the specific situations that were initially reported to evoke problem behavior, ratings improved for all parents between the initial and final meetings with the behavior analyst (mean improvement was 3.7, ranging from 2 to 6 units, with 6 being the most improvement possible), and the parents reported being very comfortable with presenting evocative situations following the consultation process.

Time and Cost Expenditures

Although families were not charged for participation, it is informative to consider time and cost expenditures if fees had been rendered. The outpatient consultation lasted 8 to 14 weeks ($M = 11.3$ weeks) and required 22 to 32 1-hr visits ($M = 27$ visits) for the three families. A lead and assistant behavior analyst were present at each visit. Assuming an hourly rate of \$125 per hour for the lead analyst ($27 \times \$125 = \$3{,}375$) and a rate of \$75 per hour for the assistant behavior analyst ($27 \times \$75 = \$2{,}025$), and factoring in the costs associated with supervision (5 sessions per patient at $\$200 = \$1{,}000$) and report writing (4 reports per patient at $\$125 = \$500$), the extrapolated costs of this effective and socially validated assessment and treatment process was between \$5,900 and \$8,650 ($M = \$6{,}900$). The costs of the different steps in the assessment and treatment process are shown in Table 1.

DISCUSSION

The problem behavior of three children with autism was effectively eliminated and multiple important social skills were acquired when behavioral interventions were developed from an abbreviated functional assessment process and then gradually brought to scale in an outpatient clinic. The effective treatments were then implemented by the parents of the children in their homes and during the conditions initially reported as evoking severe problem behavior. Despite the length of the consultation process, all

parents reported that the consultation was very helpful and that they were satisfied with the process and the amount of improvement in their child's problem behavior.

Almost 1,000 distinct functional analyses of severe problem behavior have been published in over 430 highly analytic studies over the last 50 years (Beavers et al., 2013). Many studies that involve functional analyses of problem behavior are methodological and aim to improve readers' understanding of how to best conduct an analysis. Methodological functional analysis studies are important because they can improve the efficiency (Bloom, Iwata, Fritz, Roscoe, & Carreau, 2011; Northup et al., 1991; Wallace & Iwata, 1999) or accuracy (Fisher, Piazza, & Chiang, 1996; Hagopian et al., 1997; Thompson, Fisher, Piazza, & Kuhn, 1998) of the functional assessment process. In most other research, functional analyses serve as the primary criterion to include participants in studies that evaluate treatment for a particular function of behavior, and the treatment analyses usually evaluate a single aspect of the treatment process via comparative analysis (e.g., Fisher et al., 1993; Fisher, Piazza, & Hanley, 1998; Hanley, Piazza, & Fisher, 1997; Horner & Day, 1991; Kahng, Iwata, DeLeon, & Worsdell, 1997; Zarcone, Iwata, Hughes, & Vollmer, 1993). These sorts of analyses are important, in that they permit a function-based treatment technology to emerge while influential variables (e.g., the importance of extinction) are isolated, thus resulting in a precise behavior-change technology.

The behavior-analytic literature relevant to the treatment of severe problem behavior is not, however, without its limitations. The almost exclusive focus on the analysis of single features of assessments or on single aspects of treatments has drawn behavior analysts away from publishing studies that are capable of presenting the entire assessment and treatment process and demonstrating socially meaningful effects on severe problem behavior. In the current study, we focused on synthesizing particular assessments and multiple treatment components with each child to obtain large and socially valid effects. These case examples illustrate a synthesis of behavioral technology, most of which has already been demonstrated to be efficacious and interpreted in conceptually systematic ways. Without the highly analytic studies that focus on single features of assessments or treatments, case examples of the synthesized approach, like those in the current study, would not be possible. However, without empirical syntheses of these analytic studies, we will not create sufficiently large and meaningful changes in behavior that occurs across enough contexts for the change to be considered socially acceptable and recognized as important by colleagues and constituents who are not behavior analysts.

Although hundreds of highly analytic studies have informed the technology applied in the current study, the relation between these studies and the type of empirical synthesis found in the current study is not unidirectional. Outcomes from highly analytic studies can be stitched together to form applied behavioral syntheses that yield socially important changes in problem behavior; for recent examples, see Luczynski and Hanley (2013), Jin, Hanley, and Beaulieu (2013), or Potter, Hanley, Augustine, Clay, and Phelps (2013). Empirical syntheses may also present new independent variables that are in need of further analysis, in addition to replicating the effects of previously described variables. Hence, there is a bidirectional relation between highly analytic and highly synthetic studies in that each can occasion the other variety.

Replications of important variables from the extant assessment-based treatment literature, as well as some independent variables worthy of additional analysis, can be gleaned from the practice commitments evident in the treatment applied in this study. First, it is important to begin with a simple high-probability request (see Horner & Day, 1991, for the importance of simple FCRs during the initial stage of FCT) that yields all relevant reinforcers (i.e., an

omnibus request) in the context of extinction for problem behavior (see Fisher et al., 1993; Iwata, Pace, Cowdery et al., 1994; Worsdell, Iwata, Hanley, Thompson, & Kahng, 2000, for the importance of extinction during FCT). Second, it is important to teach children to say "excuse me" and wait to be acknowledged before they engage in a more developmentally and socially appropriate omnibus request (see Hernandez, Hanley, Ingvarsson, & Tiger, 2007, for the importance of teaching framed requests). Third, it is important to teach all children a specific response (e.g., taking a breath and saying "okay" while looking at an adult) to a variety of intermittently presented cues that signal reinforcement delay or denial (see Luczynski & Hanley, 2013). Fourth, it is important not only to gradually increase the amount of time reinforcers will be delayed but also to require specific behaviors during the delay (e.g., playing independently, playing someone else's way, or complying with adult instruction) and then provide that delayed reinforcer contingent on those required behaviors (see Fisher, Thompson, Hagopian, Bowman, & Krug, 2000, for the importance of alternative activities during delays, and see Dixon & Cummings, 2001, for a translational analysis suggesting the importance of requiring engagement in alternative activities to access delayed reinforcers). Fifth, it is important to gradually increase the behavioral expectations during the delays until they emulate those conditions parents reported as most challenging in the home. Sixth, it is important to introduce parents into the context in which treatment effects were originally achieved before transitioning treatments into the home.

It should be noted that several commitments were not followed by a relevant reference; these represent opportunities for future highly analytic research. For instance, teaching an omnibus request (e.g., "May I have my way, please?") that provides access to various reinforcers (escape, preferred activities, adult attention, and a period during which more specific requests will be granted) seems to confer advantage over attempting to teach specific FCRs for each distinct reinforcer because, with the latter, problem behavior persists while each FCR is being taught (Ghaemmaghami, Hanley, Jin, & Vanselow, 2013). Nevertheless, future research on the importance of teaching an omnibus request when multiple reinforcers influence problem behavior is necessary. There is indirect support for teaching children to obtain adult attention via an "excuse me" response and wait for acknowledgement before making more specific requests for attention, materials, or breaks from instructions or other nonpreferred tasks. These commitments are found in Hanley, Heal, Tiger, and Ingvarsson (2007) and in Luczynski and Hanley (2013), studies that showed the weakening or prevention of problem behavior in preschoolers, respectively. More rigorous analyses should be conducted to determine the precise benefits of teaching children to request and wait for adult attention. Advantages of teaching a specific response to delay cues (a commitment in our treatment process) versus simply providing the reinforcer after progressively longer delays also await more systematic inquiry, as does the importance of gradually increasing the duration and developmental complexity of the expectations during delay-tolerance training. In all, highly synthetic studies are important for providing socially meaningful behavior changes, for contributing systematic replications of published findings, and for occasioning relevant future research.

Another distinct advantage of empirical syntheses is that useful data regarding time and cost expenditures can be determined. Our extrapolated cost analysis showed that severe problem behaviors commonly seen in children with autism can be eliminated while important social skills are developed, at least in some cases, for between roughly $6,000 and $9,000. Given the rise in insurance legislation relevant to autism and applied behavior-analytic services (National Conference of State Legislatures, 2012) and the

current ambiguity regarding how much time and resources are needed to adequately address problem behaviors, publication of time and cost assessments from additional behavioral syntheses will be needed to determine more accurate time and cost ranges associated with assessment and treatment of problem behaviors associated with autism. These analyses may also occasion researcher and practitioner commitments to assessment and treatment procedures of optimal utility and efficiency.

The functional assessment process in the current study was sufficiently useful for discovering via interview and demonstrating via analysis one or more functions of the severe problem behavior of the participating children. The functional analyses differed from most functional analyses in that we manipulated multiple contingencies in a single test condition rather than arranging the analyses to assess the independent contributions of each contingency. Thus, following Dale's and Bob's synthesized analyses, it was not known whether their problem behavior was exclusively sensitive to negative reinforcement in the form of escape from adult instructions or corrections or sensitive to positive reinforcement in the form of access to preferred activities or adult attention. Because these contingencies were reported to occur in concert in their homes (and in school for Bob), isolation of these contingencies in a functional analysis seemed less important than the assessment and treatment of problem behavior in the context in which it typically occurred.

For instance, when adult instructions or corrections were terminated at home or school, Bob was then able to engage in his activities in the manner he apparently preferred. His functional analysis, which involved arranging both positive and negative reinforcement simultaneously, was clearly analogous to the conditions under which his behavior was reported to occur; arranging single test conditions for each contingency would not have emulated the conditions described as evoking his problem behavior. In addition, the synthesized contingency analyses for all children detected behavioral function at a contextual level and provided a useful baseline from which to teach functionally equivalent responses and appropriate responses to reinforcement denial and parental instructions. Further support for the synthesized contingency analyses used in this study comes from the meaningful outcomes produced for all three participants.

The importance of synthesizing contingencies, which has been implied in previous work (e.g., Bowman et al., 1997; Fisher, Adelinis, Thompson, Worsdell, & Zarcone, 1998), was best demonstrated in Gail's analyses. Her analyses captured two important interactions: The effect of the synthesized contingency depended on the mother's implementation of the contingency, and the effect of each distinct social-positive reinforcement contingency (i.e., attention and tangible contingencies) depended on the availability of the other contingency. It seems reasonable to conclude that the mother established the value of the attention and interactive play as a reinforcer for her daughter's problem behavior and thus evoked problem behavior in her presence (see Ringdahl & Sellers, 2000, for a similar effect). It also seems likely that the presence of toys may have abolished the value of attention and that the presence of attention may have abolished the value of the toys so that problem behavior was evoked when and only when both contingencies were simultaneously arranged for problem behavior. The implication of Gail's analysis is that when contingencies are only assessed separately, behavioral function may go undetected. When caregivers report multiple changes that occur simultaneously following problem behavior (e.g., "I calm my child down by giving her a toy she likes and playing with her"), it may be prudent to assess both contingencies simultaneously and analyze the independent effects of the individual elements only when there is a clear reason to do so (e.g., to simplify the treatment or to answer a research question).

The synthesized contingency analyses, individualized from the interviews with families, allowed us to move to treatment quickly. Treatment sessions required about 90% of the consultation time, with delay and denial training and treatment extension requiring the majority of the total treatment duration (see Table 1). The large literatures on functional analysis (Beavers et al., 2013; Hanley et al., 2003; Iwata, Pace, Dorsey, et al., 1994) and FCT (Hagopian, Fisher, Sullivan, Acquisto, & LeBlanc, 1998; Tiger, Hanley, & Bruzek, 2008) have allowed greater efficiency with respect to these assessment and treatment strategies, but more research is clearly needed on teaching children to tolerate delays and denials of function-based reinforcers and on strategies for extending treatment to homes and schools. Other additional research is apparent when the three primary limitations of our study are considered: (a) the lack of measures to show the effect of this assessment and treatment process throughout the day and over an extensive period of time following the consultations, (b) the omission of global measures of functioning before and after the consultations, and (c) the omission of additional participants randomly assigned to receive this particular assessment and treatment process or to receive traditional care. Greater recognition of and support for highly efficacious functional assessment and treatment processes is probably dependent on the inclusion of these additional measures in randomized controlled trials in future research.

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