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BRIEF REPORT

Practical Functional Assessment: A Case Study Replication and Extension with a Child Diagnosed with Autism Spectrum Disorder

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Abstract Recent literature has described the analysis and treatment of problem behavior that involves an open-ended interview to inform the conditions under which problem behavior is likely to occur, conducting a synthesized contingency analysis, and implementing treatment that includes functional communication training, delay and denial tolerance training, and increasing the amount of demands presented after a denial (e.g., Hanley et al. *Journal of Applied Behavior Analysis*, *47*(1), 16–36, 2014). This process has been described as an Interview-Informed Synthesized Contingency Analysis (IISCA) or practical functional assessment. Much of the literature evaluating the practical functional assessment has originated from authors within the same research group. The purpose of the present study was to replicate and extend previous research on the practical functional assessment with a different group of researchers and in a different setting (i.e., an early intensive behavioral intervention clinic). This study sought to extend previous literature by including additional measures of social validity on the open-ended interview, contingency analysis, treatment, and pre-post measures on parental stress. The results were similar to previous research with an overall reduction in problem behavior and increases in functional communicative responses and compliance with demands.

Keywords Precursor and serious problem behaviors · Autism spectrum disorder · Practical functional assessment · Functional communication training

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Introduction

Individuals diagnosed with autism spectrum disorder (ASD) often exhibit higher rates of problem behavior, including, but not limited to, aggression, self-injurious behavior, stereotypy, property destruction, yelling, and other disruptive behaviors (Matson and Nebel-Schwalm 2007). Within clinical practice and behavior analytic research, the common approach to treating problem behaviors consists of first conducting a functional assessment (Ala'i-Rosales et al. 2018). A functional assessment can take many forms, including indirect assessments such as questionnaires or interviews (Durand and Crimmins 1988), descriptive assessments based on observations (Bijou et al. 1968), or experimental functional analyses such as a trial based functional analysis or a standard experimental functional analysis (Iwata et al., 1982/Iwata et al. 1994). The results of the functional assessment then inform treatment, which often consists of teaching a functionally equivalent response to replace the problem behavior. Commonly, the response that replaces problem behavior is a functional communicative response that is taught through functional communication training (FCT). FCT includes

teaching a functional communicative response that will be reinforced while all other problem behavior is extinguished. This process has been shown to be effective in decreasing problem behavior and increasing the communicative response (e.g., Carr and Durand 1985).

Recent research has described a contingency analysis informed by an interview (e.g., Hanley et al. 2014; Jessel et al. 2016; Jessel et al. 2018; Santiago et al. 2016; Slaton et al. 2017; Strand and Eldevik 2018). Test and control conditions are based on information obtained during the interview. Unlike a standard experimental functional analysis, test conditions can involve a combination of contingencies or synthesized contingencies (Hanley et al. 2014; e.g., escape from demands to attention and tangibles) instead of isolating one contingency (e.g., escape from demands). The results of the functional analysis then informs treatment. With this approach, treatment involves several components, including teaching an appropriate functional communicative response, delay and denial tolerance training, compliance chaining, and extension of the treatment to relevant people, contexts, and time periods (Hanley et al. 2014).

The results of the synthesized contingency analysis and the corresponding treatment within this body of research has demonstrated socially valid improvements (i.e., overall decreases in problem behavior, increases in appropriate behavior, and positive ratings from stakeholders). Although this is a promising line of research, much of the literature evaluating the interview informed synthesized contingency analysis (IISCA) or practical functional assessment has originated from researchers within the same group and occurred within a university outpatient clinical setting, which families would visit 3 to 4 days per week for 1 h of treatment (e.g., Hanley et al. 2014). To date, only one other research group has published a successful replication of an IISCA and treatment in a home-based setting within an early intensive behavior intervention program (Strand and Eldevik 2018). However, given the perceived drastic change in the approach to problem behavior, replication across multiple sites and researchers is still warranted. Therefore, the purpose of the present study was to replicate and extend previous research on the practical functional assessment with a different group of researchers in a different setting (i.e., an early intensive behavioral intervention clinic). This study also sought to extend previous literature by assessing the social validity of the open-ended interview, contingency analysis and treatment, as well as assessment of parental stress prior to and following intervention.

Methods

Participant

Heather was an 8-year-old female with an independent diagnosis of ASD. She had received ABA-based services since she was 3 years old, but had only been receiving ABA-based services from the current clinic for 1 year at the time of this study. Heather had a Vineland-3 (Sparrow et al. 2016) overall adaptive behavior composite score of 81. Her Vineland-3 communication standard score was 102, scoring in the age-typical range for an 8-year-old. Her standard scores for the socialization and daily living skills were below the normative range, 72 and 78, respectively. Heather's scores on the Aberrant Behavior Checklist (ABC; Aman and Singh 1986) irritability subscale was 21 and hyperactivity was 27; both of which were elevated. Heather was above grade level academically but had a long history of problem behavior in the school setting. Heather's problem behavior included hitting, kicking, biting, and punching staff members and parents, screaming, yelling threats (e.g., "I'm going to kill you"), eloping from rooms and buildings, spitting, throwing items, property destruction (e.g., drawing on walls, tearing wallpaper off of walls, knocking over furniture, etc.), and sometimes self-injurious behavior (e.g., biting self, hitting head on wall or floor). Relevant functional relationships that had been determined by her current clinical supervisor prior to the study were attention, escape, and access to tangibles, but addressing these functions separately through behavior analytic interventions (e.g., differential reinforcement of alterative behaviors, functional communication training, offering choices) had not been successful at decreasing rates of problem behavior. In 2nd grade, 3 months into the school year, Heather had been removed from her general education classroom due to problem behavior and started to receive 30 h per week of behavioral intervention at a private clinic as an alternative setting to school. Due to the intensity and frequency of problem behavior Heather displayed, she was only able to be in one specific room within the clinic for safety reasons in which all the furnishings had been removed. The remainder of her 2nd grade school year (i.e., 10 months) was spent at the private clinic. She was in 3rd grade at the time of this study, 2 months into the school year, having resumed attending public school for 4.5 h one day a week with paraprofessional support (~25 h was still at the clinic). However, she was only

placed in general education for 30 min due to high rates of problem behavior.

Setting and Materials

All sessions were conducted at a private clinic in Southern California. Sessions were conducted 1 to 5 days a week and between 2 to 28 times per day. The schedule of sessions per day and week was determined by the interventionists' schedule and availability. The contingency analysis (described below) was conducted in a small room at the clinic equipped with a one-way mirror. All intervention sessions were conducted as part of Heather's regular programming and occurred in a regular therapy room in the clinic (i.e., a room in which individual therapy sessions were regularly scheduled and designed for behavioral intervention). During the parent training phase of intervention, sessions occurred at Heather's home or in the community once a day up to 6 days a week.

During all sessions, materials included various academic instructional materials (e.g., textbooks, pens, pencils, workbooks), preferred items and activities (identified through the interview conducted) such as Pokémon figurines, Pokémon cards, Nintendo DS, Nintendo Switch, dinosaur figurines, and an iPad with various preferred games and apps.

Interventionists

Heather's contingency analysis and intervention was conducted by two Board Certified Behavior Analysts® (BCBAs®). The first author and second author served as the interventionists. The first author had 6 years of experience providing ABA services to children diagnosed with ASD and had worked with Heather for over a year at the time of the study as a direct interventionist at the clinic. The second author had 9 years of experience providing ABA services to children diagnosed with ASD, was Heather's case supervisor, and had worked with her for 2 years at the clinic. Sessions were conducted by just one of the interventionists at a time. The determination of who conducted the session was based on the scheduling availability of each interventionist.

Dependent Variables

There were nine dependent variables evaluated within the research study: (1) problem behavior, (2) functional communication responses (FCRs), (3) functional delay responses (FDRs), (4) tolerating responses, (5) compliance with easy demands, (6) compliance with hard demands, (7) social validity, (8) parental stress, and (9) clinical session behavior.

Problem Behavior The first measure was the frequency of problem behavior. Two types of problem behavior were identified, *precursor behavior* and *severe problem behavior*. Precursor behaviors that typically preceded more dangerous problem behaviors were defined prior to conducting the contingency analysis so that the interventionist could reinforce the precursor behaviors during the analysis in order to keep Heather and the interventionist safe. Heather's *precursor behaviors* were defined as threats (e.g., "I'm going to kill you"), yelling, and tensing (e.g., clinching/tensing her whole body). Heather displayed four topographies of *serious problem behavior*, which were defined as aggression (e.g., kicking, hitting, pinching, biting) and property destruction (e.g., breaking items, throwing items). Taken collectively, the precursor behaviors plus the serious problem behaviors constituted the set of problem behaviors to be addressed in this analysis.

Functional Communication Responses (FCRs) FCRs were separated into four topographies with varying levels of complexity. *Simple FCRs* were defined as Heather saying, "my way." *Intermediate FCRs* were defined as Heather asking, "Can I have my way please?" *Complex FCRs* were defined as Heather saying, "Excuse me [name], can I have my way please?" *Ideal FCRs* were verbally identical to the complex FCR but required Heather to be seated in a chair, not have preferred tangible items in her hands, and to look at the interventionist while stating, "Excuse me [name], can I have my way please?"

Functional Delay Responses The *FDR* was defined as Heather asking, "Can I wrap it up?"

Tolerating Response The tolerating response was defined as Heather saying, "Okay, no problem" while giving a thumbs up to the interventionist.

Compliance with Easy Demands Easy demands consisted of any non-academic tasks already within Heather's behavioral repertoire (e.g., clapping hands, touching head, or naming three colors). Compliance with easy demands was defined as Heather completing the given task without engaging in problem behavior.

Compliance with Hard Demands Hard demands consisted of any academic tasks (e.g., math facts or writing). Compliance with hard demands was defined as Heather completing a given task without engaging in problem behavior.

Social Validity A social validity questionnaire was provided to Heather's parents at two times during the study. The first was immediately following the interview and contingency analysis, and the second was after the intervention. The questionnaires were provided to Heather's parents in unmarked folders that could be provided to an individual not associated with the study after their completion (e.g., receptionist). On each instance that the questionnaires were provided, Heather's parents took the questionnaires home and brought them back 1 to 2 days later. The researchers were not present while Heather's parents filled out the questionnaires since they were completed at their home. The social validity questionnaire for the interview and contingency analysis consisted of five questions using a 7-point Likert scale (1 representing "not acceptable/comfortable" and a 7 representing "highly acceptable/comfortable"). The social validity questionnaire following intervention consisted of 10 questions using the same 7-point Likert scale and one open-ended question to provide any additional comments about treatment and outcomes.

Parental Stress To evaluate parental stress, we provided Heather's mother with the Parenting Stress Index-4 Short Form (PSI-4 SF; Abidin 2012) prior to and following intervention. The PSI-4 SF is a standardized assessment consisting of 36 questions using a 5-point Likert scale, and consists of three subscales: (a) parental distress, (b) parental child-dysfunctional interaction, and (c) difficult child subscale. Scores on each subscale and the total stress score are considered elevated if they fall above the 86th percentile.

Clinical Session Behavior Data were also collected on Heather's behavior during her regularly scheduled clinical sessions prior to and following the study. Data were collected on whether Heather was *in programming*, *out of programming*, or in *play/reinforcement*. *In programming* was defined as Heather engaging in behaviors related to her current programming or teaching (e.g., following instructions or attending to the interventionist) in the absence of problem behavior. *Out of programming* was defined as Heather engaging in problem behavior (defined above). *Play/reinforcement* was defined as Heather engaging in play or on a break from interventionist led activities. A 20 min momentary time sampling procedure was used to score each of these behaviors.

Measurement and Reliability

All contingency analysis and intervention sessions were video recorded. A stopwatch or smartphone was used to time the duration of the sessions. All sessions at the clinic were scored in vivo via paper and pencil. Parent training sessions were video recorded and scored the next day using the same scoring procedures. Sessions in the clinic lasted 5, 10, or 15 min based upon the phase of intervention (described below). Parent training sessions averaged 23 min (range, 10 to 36 min).

Interobserver agreement (IOA) was collected for 33% of sessions. IOA was calculated by dividing the number of agreements by the number of agreements plus disagreements and multiplying by 100. IOA for problem behavior averaged 99.0% across conditions and sessions (range, 93.3–100%). IOA for simple FCRs averaged 98.6% (range, 93.3–100%), intermediate FCR IOA was 100%, complex FCR IOA averaged 98.4% (range, 93.3–100%), and IOA for ideal FCRs averaged 98.9% (range, 90–100%). IOA for the tolerating response averaged 99.2% (range, 93.3–100%) and for the FDR IOA was 99.8% (range, 96.7–100%). The IOA for compliance with easy demands was 99.5% (range, 93.3–100%) and IOA for compliance with hard demands was 99.5% (range, 90–100%). IOA for clinical session behavior was 100% for in programming, out of programming, and play/reinforcement. Treatment integrity was not measured throughout the analysis and intervention.

Design

A multielement design (Kazdin 2011) was used during the contingency analysis to compare test and control conditions. A changing criterion design (Hartmann and Hall 1976) was used to evaluate the effectiveness of the intervention. The criteria for moving up a phase during treatment was contingent upon (1) the absence of problem behavior for two consecutive sessions, (2) independent communicative and/or tolerating responses, and (3) compliance with task demands (if applicable).

Functional Assessment Procedure

Open-Ended Interview An open-ended interview was conducted with Heather's parents prior to conducting the contingency analysis. The interview was conducted by the first author and consisted of 20 questions from the interview developed by Hanley (2012). The interview was intended to help define problem behavior, determine various contextual variables to be included in contingency analysis (e.g., evocative stimuli), and hypotheses of behavioral function. Heather's parents were interviewed together but were each given an opportunity to provide a response to each question.

Contingency Analysis The control and test conditions present during the functional analysis were developed using the answers from the open-ended interview. The purpose of the control condition was to establish a context in which problem behavior was least likely to occur. The control condition consisted of providing Heather non-contingent access to preferred items and activities, no explicit demands, non-contingent access to attention from the interventionist, and interventionist compliance with any reasonable requests from Heather. Unreasonable requests were any request that could not be fulfilled by the interventionist (e.g., going to the ice cream store, purchasing apps on the iPad, or going to Disneyland). If any unreasonable request was made, the interventionist responded by telling Heather it was unreasonable and that s/he could not fulfill the request.

The test condition included evocative events in which the interventionist restricted access to all preferred items and activities, placed demands, and denied any of Heather's requests. The evocative events stopped contingent upon any instance of problem behavior displayed by Heather. The contingency analysis consisted of five sessions: a control condition, a test session, a control session, and two consecutive test sessions. The analysis was concluded following differentiation between conditions.

Intervention

Functional Communication Training Functional communication training consisted of verbal instructions, modeling, practice, and feedback. Functional communication training occurred with Heather prior to intervention sessions. To teach Heather the targeted FCR the interventionist instructed her that if she was told to do something she did not want to do she could say the FCR (e.g., "my way"), and then she could go back to engaging in the activity of her choice. After instructing Heather of what she could say, Heather and the interventionist then role-played the interaction. The role-plays consisted of the interventionist providing a general instruction (e.g., "Okay Heather, it is time to work") to set the occasion for Heather to engage in the target FCR. If Heather engaged in the targeted FCR then the interventionist said, "Okay you can have your way" which signaled to Heather that she could go back to engaging with the activity of her choice, with attention from the interventionist, and the interventionist complying with all reasonable requests Heather made. After role-playing with the interventionist, the interventionist provided feedback (e.g., praise or corrective) based on how she performed in the role-play. Once Heather was consistently stating the target FCR independently during role-play scenarios, intervention sessions began. Intervention sessions lasted 5 min. The criterion to move from one phase to the next was Heather independently engaging in the targeted responses 100% of opportunities in the absence of any problem behavior for two consecutive sessions.

Simple Functional Communicative Response During this condition, simple FCRs were targeted (previously described) following an evocative event (e.g., demand from the interventionist, restricting access to a preferred item/activity). Evocative events were presented by the interventionist on an average of every one minute (i.e., 5 evocative events presented per session). Once Heather engaged in the simple FCR the evocative event was terminated, and she had free access to reinforcing items and activities. If Heather did not engage in the simple FCR independently, then the interventionist verbally prompted her to state the simple FCR. Once she engaged in the prompted response, the evocative event was terminated, and she had free access to reinforcing items and activities.

Intermediate Functional Communicative Response Intermediate FCRs were targeted during this condition following an evocative event. Evocative events were presented by the interventionist on an average of once per minute (i.e., five evocative events presented per session). Once Heather engaged in the intermediate FCR she was allowed access to any preferred items or activities and the evocative event was

terminated. If Heather engaged in the previously targeted FCR (i.e., simple FCR) the interventionist either waited for Heather to self-correct and emit the intermediate FCR independently or prompted her to state the intermediate FCR before terminating the evocative event.

Complex Functional Communicative Response Once the complex FCR was taught, the prior FCRs (i.e., simple and intermediate) were placed on extinction and no longer reinforced. The complex FCR consisted of Heather saying "Excuse me [interventionist name], can I have my way please?", waiting for the interventionist to respond with "yes", then Heather could go back to "her way" consisting of free access to all preferred items and activities, no demands placed by the interventionist, access to attention from the interventionist, and the interventionist would comply with all reasonable demands placed by Heather. Evocative events were presented by the interventionist on an average of once per minute (i.e., 5 evocative events presented per session).

Ideal Functional Communicative Response Similar to the other FCRs, once the ideal FCR was taught the other FCRs were placed on extinction. Once Heather engaged in the ideal FCR she had access to "her way" which was set up to be the same as the control condition in the functional analysis. The ideal FCR consisted of the interventionist presenting an evocative event about every minute (e.g., "Okay, it is time to get to work"), Heather moving to sit in a chair at a table, orienting to the interventionist, and stating, "Excuse me [interventionist name]", waiting for the interventionist to acknowledge her, and then asking, "Can I have my way please"? Once Heather engaged in this response the interventionist reinforced this response by allowing Heather access to "her way". If Heather did not engage in the ideal FCR, then the interventionist would prompt her through the interaction with verbal prompts (e.g., "Remember to look at me when you ask for your way") and reinforced the prompted ideal FCR by allowing Heather access to "her way".

Denial and Delay Tolerance Training A denial from the interventionist consisted of stating "no" or "not right now" following an ideal FCR emitted by Heather. Heather was taught the tolerating response of saying, "Okay, no problem," while giving a thumbs-up sign, and orienting toward the interventionist. Teaching the tolerating response was similar to functional communication training. Teaching the response occurred outside of intervention sessions and consisted of instructions, modeling, role-play, and feedback based on Heather's performance during the role-play. During denial and delay tolerance intervention sessions, Heather was told "no" or "not right now" after an ideal FCR on 40–60% of opportunities (i.e., following an evocative event, two or three of every five ideal FCRs were denied by the interventionist and required Heather to engage in the tolerating response, the remaining two or three produced reinforcement following the ideal FCR). Responses to reinforce (i.e., ideal FCR or tolerating response) were randomly determined prior to sessions. If the trial was planned as a tolerating response trial, she would be reinforced for producing the tolerating response (i.e., saying "OK no problem" and giving thumbs up gesture) by allowing Heather to go back to "her way". If Heather did not engage in the tolerating response following a denial, then the response was verbally prompted by the interventionist (e.g., "Say, okay no problem") and once Heather engaged in the tolerating response, she could go back to "her way". Sessions during this phase of intervention lasted 5 min and an evocative event occurred five times throughout the session.

Functional Delay Response During the denial and delay tolerance phase of intervention, Heather continued to engage in consistent, but low levels of problem behavior. Problem behavior typically occurred while Heather was playing a game on the iPad that could not be paused and was asked to stop and engage in instructional activities. As a result, the interventionists taught Heather a functional delay response (i.e., saying, "Can I wrap it up?") that allowed her an extra 30 s to produce the ideal FCR. Heather was taught the FDR through verbal instructions, modeling, role-play, and feedback. The functional delay response consisted of a series of interactions between Heather and the interventionist. The interaction began with the interventionist providing an evocative event (e.g., "Time to get back to work") which set the occasion for Heather to engage in the FDR. If Heather engaged in the FDR, the interventionist always responded, "Yes". Heather was then given 30 s to find a point at which the activity or game could be paused or ended. Once she paused or ended the game/activity Heather emitted the ideal FCR. If Heather did not end the activity or game within 30 s the interventionist

would begin to provide instructions (e.g., "Okay, it's time to work") until Heather ended the game and produced the ideal FCR.

Compliance Chaining Compliance chaining consisted of nine phases (See Table 1). Each phase increased the number and difficulty of demands. Five planned evocative events occurred in each session during compliance chaining. Table 1 displays the responses that Heather would need to engage in in order to receive reinforcement in the form of access to "her way". Phases 1 and 2 had one sequence of responses that were candidates for reinforcement. The order of the responses that would be reinforced was randomized and determined prior to each session. Phases 3 through 9 had two sequences of responses that were candidates for reinforcement in which the sequences were alternated between per session. The order of responses to reinforce within each session was randomized and determined before each session began. Sessions during phases 1 through 3 were 5 min long. Sessions during phases 4 through 8 lasted 10 min, and sessions during phase 9 lasted 15 min. The criterion for moving up through the phases was fulfillment of all the following for two consecutive sessions: absence of problem behavior, producing all independent communicative and tolerating responses, and independently complying with all task demands presented.

Treatment Extension-Parents Once Heather had completed all phases of compliance chaining at the clinic, treatment extension with Heather's parents began. Sessions were conducted by either Heather's mother (65% of sessions) or father (35% of sessions) and only one session was conducted per day. Parent training with Heather's parents occurred prior to the treatment extension sessions and consisted of written and verbal instructions, modeling, role-play, and feedback on how to conduct intervention sessions with Heather. Heather's parents were first trained to reinforce the ideal FCR, then training focused on reinforcing the tolerating response, and then reinforcing compliance with task demands after a denial. Training progressed as Heather's parents were accurately implementing the treatment and reinforcing the target response in role-play scenarios with Heather. Parent training lasted 1.5 h in duration for Heather's mother and lasted 2 h in duration for Heather's father. When treatment extension sessions began at Heather's home, her parents started implementing phase 6 of compliance chaining. Criteria to move from one phase of compliance chaining to the next was contingent on Heather independently engaging in the targeted responses 100% of opportunities in the absence of any problem behavior for two consecutive sessions.

Table 1 *Responses to reinforce during compliance chaining**

Phase	Responses reinforced per trial	
1	1. Ideal FCR 2. Ideal FCR 3. Tolerating response 4. 1 easy task 5. 1 easy task	
2	1. Ideal FCR 2. Tolerating response 3. 1 easy task 4. 1 easy task 5. 2 easy tasks	
3	1. Ideal FCR 2. Tolerating response 3. 2 easy tasks 4. 3 easy tasks 5. 1 hard task	1. Ideal FCR 2. Tolerating response 3. 2 easy tasks 4. 1 hard tasks 5. 3 hard tasks
4	1. Ideal FCR 2. Tolerating response 3. 3 easy tasks 4. 5 easy tasks 5. 1 hard task	1. Ideal FCR 2. Tolerating response 3. 1 easy task 4. 5 easy tasks 5. 3 hard tasks
5	1. Ideal FCR 2. Tolerating response 3. 4 easy tasks 4. 6 easy tasks 5. 2 hard tasks	1. Ideal FCR 2. Tolerating response 3. 2 easy tasks 4. 4 hard tasks 5. 6 hard tasks
6	1. Ideal FCR 2. Tolerating response 3. 5 easy tasks 4. 7 easy tasks 5. 3 hard tasks	1. Ideal FCR 2. Tolerating response 3. 7 easy tasks 4. 3 hard tasks 5. 5 hard tasks
7	1. Ideal FCR 2. Tolerating response 3. 2 easy tasks 4. 10 easy tasks 5. 7 hard tasks	1. Ideal FCR 2. Tolerating Response 3. 7 easy tasks 4. 2 hard tasks 5. 10 hard tasks
8	1. Ideal FCR 2. Tolerating response 3. 2 easy tasks 4. 13 easy tasks 5. 10 hard tasks	1. Ideal FCR 2. Tolerating response 3. 13 easy tasks 4. 2 hard tasks 5. 10 hard tasks
9	1. Ideal FCR 2. Tolerating response 3. 3 easy tasks 4. 10 easy tasks 5. 20 hard tasks	1. Ideal FCR 2. Tolerating response 3. 10 easy tasks 4. 3 hard tasks 5. 20 hard tasks

*Order of responses to reinforce was randomized prior to each session

Results

Functional Analysis

The answers provided by Heather's parents during the open-ended interview suggested Heather's problem behavior occurred during adult-directed activities in which Heather's access to preferred items and activities was restricted and when an adult was not complying with Heather's requests. Figure 1 provides the results of the contingency analysis. Heather did not engage in any instances of problem behavior during the control condition. Heather only engaged in problem behavior during the test condition, during which problem behavior occurred upon every instance of an evocative event occurring at an average rate of 0.93 instances per minute.

Intervention

Figure 2 displays Heather's behavior during functional communication training and delay and denial tolerance training. The first panel of Fig. 2 represents Heather's compliance with instructions placed; however, no instructions were placed during this phase, and this panel is provided to remain consistent with the subsequent figures. The remaining panels of Fig. 2 consist of problem behavior (second panel), FCRs (third panel), and tolerating responses (fourth panel). Once the simple FCR was taught, there was an immediate decrease in problem behavior and an increase in the frequency of simple FCRs. When the intermediate FCR was taught, problem behavior remained at low rates with the exception of only two instances of problem behavior during this phase of functional communication training. It should be noted, the problem behavior that occurred during this phase was tensing, a behavior that was considered a precursor to other dangerous problem behavior. During the intermediate FCR condition, the frequency of simple FCRs decreased with an increase in the frequency of intermediate FCRs. No instances of problem behavior occurred during the complex FCR condition, and the previously reinforced intermediate FCRs decreased in frequency, and the frequency of complex FCRs increased. During teaching of the ideal FCR, the frequency of complex FCRs decreased while the frequency of ideal FCRs increased. During this phase, there were four sessions during which problem behavior occurred. Similar to the intermediate FCR phase, these instances of problem behavior were instances of body tensing.

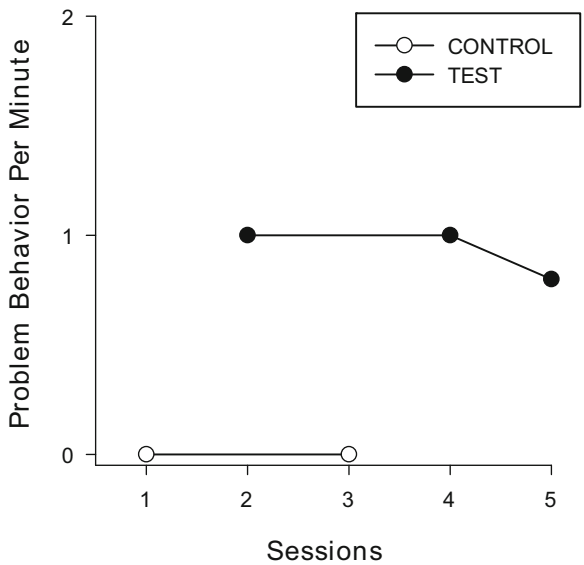

Fig. 1 Contingency analysis

During denial and delay tolerance sessions, Heather required more sessions to emit the tolerating response independently (see, panel 4 of Fig. 2). Complex FCRs and ideal FCRs continued to occur at similar frequencies (see, panel 3 of Fig. 2). During this phase, there was also an increase in the frequency of problem behavior. Similar to prior phases of treatment, this problem behavior consisted of non-dangerous precursor behavior with the exception of session 50, in which Heather engaged in two instances of aggression. Due to the consistent rates of problem behavior during the denial and delay tolerance training, an FDR was taught. Following teaching an FDR, the frequency of problem behavior decreased.

Following denial and delay tolerance training, the compliance chaining condition began (see Fig. 3). During phase 1, Heather complied with instructions but also engaged in variable rates of problem behavior. Following a spike in session 100, there was a gradual decline to zero for the remainder of phase 1. All instances of problem behavior consisted of precursor problem behavior (e.g., verbal threats or body tensing). During phase 2, Heather did not engage in any problem behavior, complied with all instructions, and continued to engage in ideal FCRs and tolerating responses independently. Throughout the remaining phases, Heather engaged in variable rates of problem behavior but consistently complied with instructions and engaged in ideal FCRs and tolerating responses independently. Similar to other phases of treatment, Heather's problem behavior

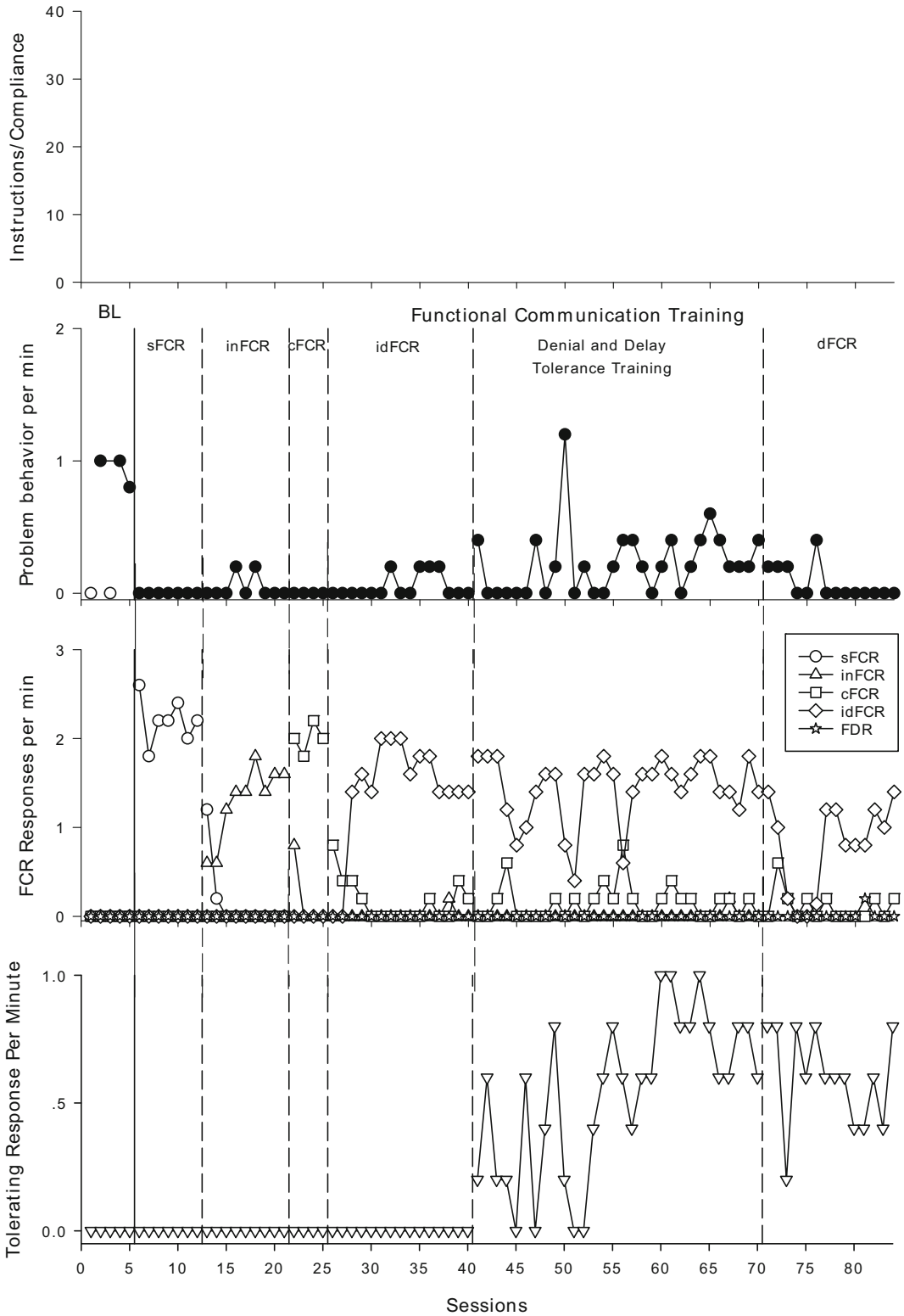

Fig. 2 Functional communication training and denial and delay tolerance training

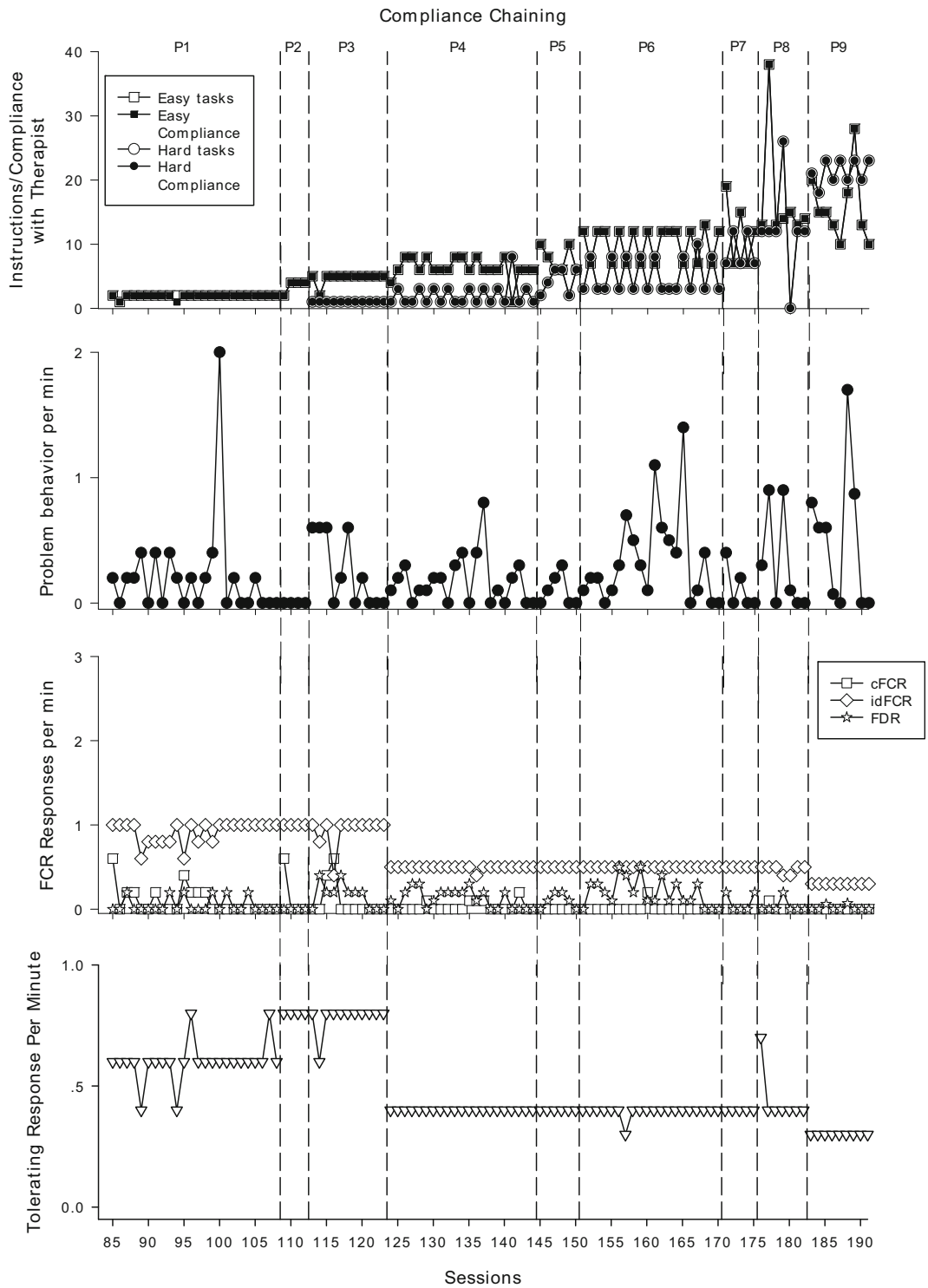

Fig. 3 Compliance chaining

during each phase primarily consisted of precursor problem behaviors (e.g., body tensing or verbal threats). Only nine sessions out of the 105 sessions during the compliance chaining condition included problem

behavior that was considered dangerous (e.g., aggression or property destruction).

Following the compliance chaining condition at the clinic, parent training began in which intervention was extended to Heather's parents at home (see Fig. 4). Once Heather's parents implemented the intervention at home, Heather complied with instructions, engaged in ideal FCRs and tolerating responses independently, and displayed minimal problem behavior during the first phase of the treatment extension. The next phase resulted in an increase in problem behavior with the highest frequency during session 202, which eventually decreased to a frequency of zero across two consecutive sessions. Following the introduction of the next phase, there was an immediate increase in the frequency of problem behavior (i.e., sessions 213–215). This was followed by a decrease in the frequency of problem behavior from session 216 to 221. During sessions 222–228 Heather engaged in variable frequencies of problem behavior, which were followed by a decrease in frequency in session 229. Throughout the treatment extension with Heather's parents, Heather consistently complied with instructions, continued to engage in ideal FCRs, and tolerating responses independently.

Social Validity

We first evaluated the social validity of the interview and contingency analysis using a 7-point Likert response scale. Heather's parents responded to five questions: (1) found the interview process to be acceptable; (2) comfortable during the interview process; (3) found the functional analysis of my child's problem behavior to be acceptable; (4) I consider the functional analysis to be safe for my child and the therapist; and (5) I was comfortable watching the functional analysis of my child's problem behavior. Heather's mother and father scored a 7 (e.g., very comfortable or very acceptable) on every single question.

Table 2 includes Heather's parents' responses to the assessment of the social validity of the intervention. The first four questions pertained to how satisfied Heather's parents were with her improvement, her ongoing problem behavior at home, how helpful they thought the treatment was at home, and how confident they felt implementing the treatment strategies. Overall, their responses were positive; however, both parents indicated they were still concerned about her problem behavior at home. Two questions on the social validity questionnaire asked how comfortable they felt taking away preferred activities or asking Heather to do something before and after the intervention. Heather's parents reported low comfortability ratings prior to intervention and much more comfortability taking away Heather's toys or asking her to do something following intervention. Two other questions asked Heather's parents how they felt taking her out in public before and after the intervention. Her parents reported low comfortability ratings prior to intervention and more comfortability following intervention. The final two questions on the social validity questionnaire asked how comfortable Heather's parents felt asking Heather to go to sleep before and after the intervention. Heather's parents reported that they felt very comfortable asking Heather to go to sleep before and after the intervention. In addition to filling out the social validity questionnaire, Heather's mother and father made additional comments such as, "This process has been fairly painless. Thank you so much. We are so happy that Heather buys in, which has never been the case before" and "Thrilled to have had the opportunity to learn this information!"

Parental Stress

Prior to treatment, Heather's mother had a parental distress score of 35 (78 percentile), a parent-child dysfunctional interaction score of 37 (92 percentile), difficult child score of 52 (>99 percentile), and a total stress score of 124 (98 percentile). All of these scores with the exception of the parental distress domain would be considered elevated (i.e., fall above the 86th percentile). Following intervention, Heather's mother had a parental distress score of 33 (72 percentile), a parent-child dysfunctional interaction score of 35 (86 percentile), difficult child score of 49 (>99 percentile), and a total stress score of 117 (92 percentile). Heather's mother still reported elevated stress on the difficult child and total stress domains; however, the results showed that parental stress decreased overall and across all domains following intervention.

Clinical Sessions

Prior to intervention, Heather was engaged in programming an average of 40% of the time, was out of programming an average of 50% of the time, and was in play/reinforcement an average of 10% of the time. Following intervention, Heather was engaged in programming an average of 60% of the time, out of

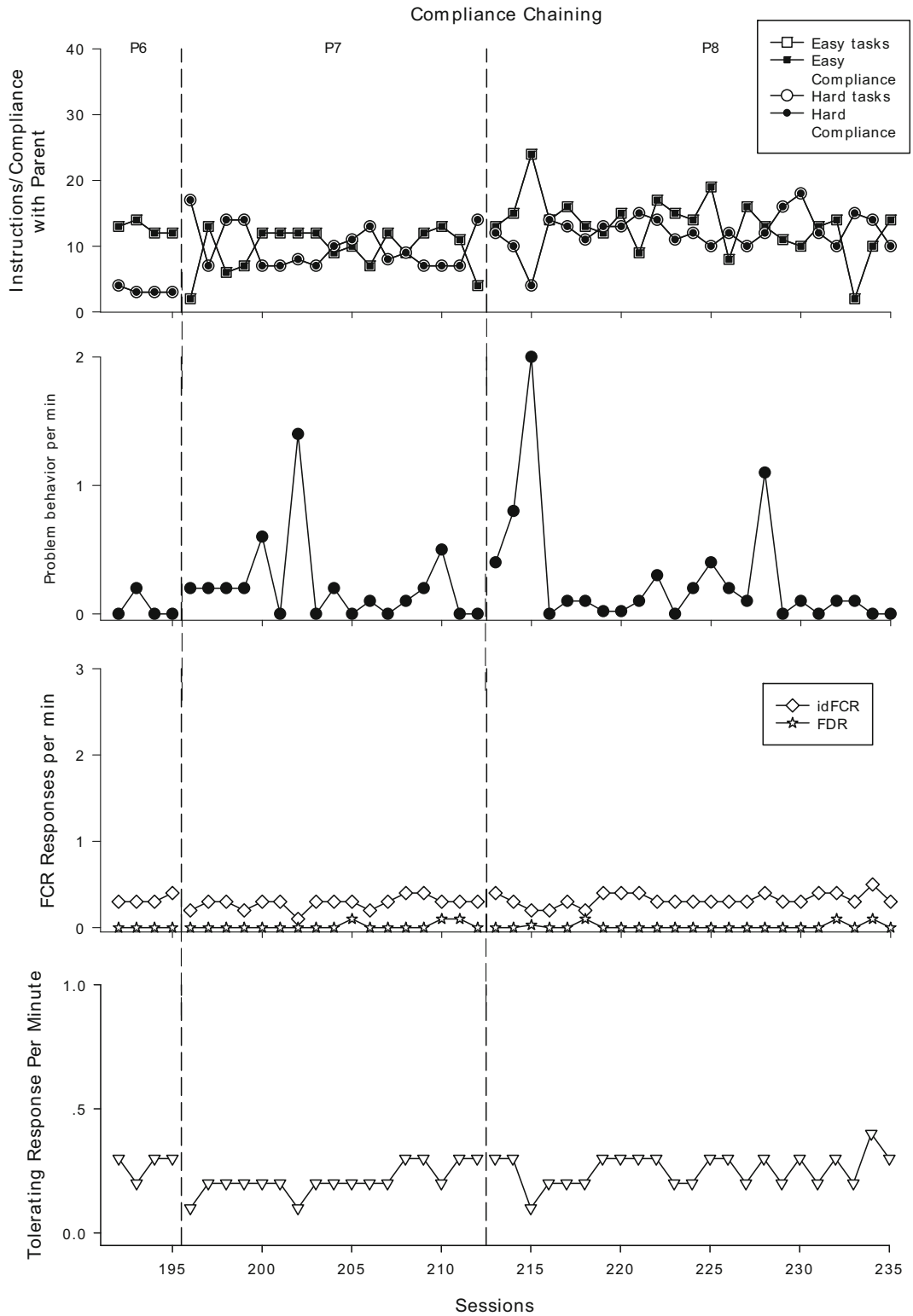

Fig. 4 Treatment extension with Heather's parents

Table 2 *Answers to questionnaire on assessment for the treatment process and outcomes*

Question	Mother's responses	Father's responses
Rate the extent to which you are satisfied with the amount of improvement seen in Heather's problem behavior during the practice sessions	6	6
Rate the extent to which you are concerned about Heather's ongoing problem behavior at home	6	6
Rate the extent to which you have found the assessment and treatment provided by our team helpful to your home situation up to this point	7	7
Rate the extent to which you feel confident applying the same strategies you have seen in the practice sessions, when addressing Heather's problem behavior at home	7	6
How comfortable were you taking away Heather's preferred activities and asking her to do something else BEFORE you were trained on the intervention?	3	2
How comfortable are you taking away Heather's preferred activities and asking her to do something else now AFTER you have been trained on the intervention?	6	5
How comfortable were you taking Heather to public places BEFORE you were trained on the intervention?	1	3
How comfortable are you taking Heather to public places now AFTER you have been trained on the intervention?	4	6
How comfortable were you asking Heather to go to sleep BEFORE you were trained on the intervention?	7	7
How comfortable were you asking Heather to go to sleep AFTER you were trained on the intervention?	7	7

programming an average of 10% of the time, and in play/reinforcement and average of 40% of the time.

Discussion

This study demonstrated the successful replication of the practical functional assessment and treatment described previously in several studies by a limited number of researchers within an early intensive behavior intervention (EIBI) program in a clinical setting. Following the contingency analysis and treatment, decreases in the frequency of problem behavior and increases in the frequency of desirable behavior were observed. Anecdotally, it should also be noted that after intervention Heather was able to work in a variety of rooms in the clinic, with regular furnishings, unlike prior to intervention. Results of the assessment of social validity also indicated that Heather's parents were comfortable with the interview and functional analysis and found the treatment to be acceptable and easy to implement at home. Additionally, Heather's mother's parental stress index scores decreased with the exception of the difficult child subscale.

Similar to Strand and Eldevik (2018), this study replicated the IISCA and subsequent treatment within an EIBI program and did not require any additional resources or cost of the program. Differences in the implementation of treatment included several sessions per day (i.e., up to 28), sessions conducted as many days of the week as possible (i.e., up to 5 days a week), and multiple measures of social validity.

Although this study replicated the results of previous studies (e.g., Strand and Eldevik 2018) limitations can be noted. Perhaps the main limitation is the inclusion of only one participant. Future studies should include replications across multiple participants in an EIBI clinic. Additionally, all sessions in the clinic were conducted by a BCBA®. Although this did not increase the cost of services for Heather's family at this clinic, it may be costly and time-consuming for other BCBAs® with larger caseloads at other behavior analytic clinics. Future research may wish to look at a model of treatment in which a BCBA® is supervising and overseeing treatment but not implementing treatment similar to Santiago et al. (2016).

Another limitation was that although we did see an overall decrease in the frequency of problem behavior, variable frequencies of problem behavior continued to occur throughout treatment. Some of the problem behavior included aggression, property destruction, and throwing, but the majority was non-dangerous, precursor behavior (e.g., yelling or body tensing). Specifically, body tensing occurred most frequently throughout treatment sessions. Although Heather's parents reported in the open-ended interview that tensing was part of the response class comprising problem behavior and was a signal that more dangerous problem behavior was likely to occur, it may be the case that tensing was not actually

a precursor to problem behavior and outside of the problem behavior response class. That is, tensing occurred throughout treatment in isolation without leading to more dangerous problem behavior and other problem behavior occurred in the absence of tensing; thus, it is unlikely that tensing was a part of the problem behavior response class.

Another limitation of this study is that the variable frequencies in problem behavior also contributed to the length of the intervention. It took over 200 sessions to complete the function-based treatment in the clinic and extend the treatment to Heather's parents. When looking at how long treatment took in the clinic in terms of days, it took 21 days, and parent training took 61 days due to the constraints Heather's parents had of just running one session per day. Future researchers may wish to compare this treatment to other function-based treatments in order to look at the efficiency of the procedures. It could be that other treatments might be more efficient than the one implemented in this study.

Additionally, measures of treatment integrity were not collected across therapists or Heather's parents. Taking measures of treatment integrity should be done in future replications of the IISCA function-based treatment. If interventionists and parents' implementation of treatment varies from person to person this could lead to treatment taking longer to be successful and effective. Since measures of treatment integrity were not collected in this study, it is unclear how this could have affected Heather's progress through treatment.

Within this study we presented data on Heather's treatment extending to her parents at home, but treatment was also extended to all of Heather's staff within the clinic and Heather's classroom at school. Unfortunately, data were not collected on the treatment extension to school or to additional staff within the clinic. Although data were not collected on Heather's treatment extension at school, anecdotally, the extension was reported as successful and resulted in an increase in the number of days spent at school (i.e., 5 days a week as opposed to 1 day a week prior to the intervention) and hours spent in a general education classroom with same aged-peers. Future researchers may wish to collect data on treatment extension or generalization to all relevant persons and environments in the client's life.

While this study was not without its limitations, its contributions to clinical practice and research literature should not be discounted. To our knowledge, this study represents only the second successful replication of the practical functional assessment and IISCA-informed treatment within a different research lab. The practical functional assessment offers several advantages over the conventional approach to problem behavior such as highlighting the importance of synthesized contingencies, ability to move quickly to treatment, and arranging the environment to resemble the criterion environment in order to teach the functional skills to replace problem behavior. However, to be considered evidenced based by several entities (e.g., Horner et al. 2005; National Autism Center (NAC) 2015; What Works Clearinghouse 2014), it requires replication across several different variables, including research labs. It is our hope that this study helps to contribute to this body of literature and inspires other research labs to replicate and extend the findings of this and other studies.

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