

BRIEF REPORT

Improvements in problem behavior in a child with autism spectrum diagnosis through synthesized analysis and treatment: A replication in an EIBI home program

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A recent study described a synthesized treatment where a functional analysis was based on an open-ended interview and combined with functional communication and delay-tolerance training. The treatment resulted in a reduction in problem behaviors and an increase in appropriate requests. Most of the analysis and intervention were done in a clinic setting, and required weekly visits by the family. This present study is a systematic replication, where we conducted the same synthesized treatments, with a young child with Autism Spectrum Disorder (ASD) enrolled in a home-based Early Intensive Behavior Intervention program, EIBI. Outcomes were similar with a marked reduction in problem behaviors and an increase in appropriate requests. These findings suggest that it is possible to conduct this intervention in a home setting, with weekly consultations with parents. Our study show the utility of the synthesized treatment in an EIBI program in a home setting and how this can contribute to client time and costs.

1 | INTRODUCTION

Autism spectrum disorder (ASD) is associated with problem behaviors. Problem behaviors include self-injury, aggression, stereotypy, disruption, sleep-deprivation, and extreme emotional outbursts (Didden et al., 2012; Dominick, Davis, Lainhart, Tager-Flusberg, & Folstein, 2007; Murphy, Healy, & Leader, 2009). Such behaviors often put serious strain on the families of children with ASD. Several studies have shown that identifying the function of problem behavior is important for deciding on the treatment procedures and for outcomes of treatment (Beavers, Iwata, & Lerman, 2013). One of the most common procedures used is the functional assessment (Hanley, 2012). It usually includes a combination of indirect assessment, descriptive assessment, and functional analysis (Iwata & Dozier, 2008). Descriptive assessment entails observations and measurements of problem behavior as they occur in context. A functional analysis consists of experimental observation and measurement of problem behavior in at least two contexts where the variables suspected of controlling problem behavior are present in a test condition but absent in a control condition (Hanley, Iwata, & McCord, 2003).

A well-documented procedure for reducing problem behaviors is functional communication training (FCT) by Carr and Durand (1985); (Heath, Ganz, Parker, Burke, & Ninci, 2015). FCT is a procedure that teaches specific communicative responses as an alternative to problem behavior by providing the reinforcers that originally controlled the problem behavior contingent on a more appropriate communicative response. Several studies have shown that problem behavior will lose its function when you combine extinction and contingent reinforcement (Lalli, Casey, & Kates, 1995). FCT has not only shown to reduce problem behavior but also to increase language acquisition in children with a low rate of independent language and/or echolalia (Wasson, McLaughlin, Derby, & Clark, 2013). FCT has been widely used in programs for children with ASD (Lovaas, 2003). The results of FCT in a home setting have been proven to endure and be resistant to extinction, which makes it socially valid for the individual and the family (Derby et al., 1997).

Hanley et al. (2003) conducted a study where they first did a functional assessment with an open-ended interview and then based the functional analysis on the results. Subsequently, they added FCT, delay, and tolerance training. This study was conducted in a university clinic, and the clients and their parents had sessions over a period of 6 to 8 weeks. One of the unique ingredients of this model was the use of an open-ended interview to inform the synthesized functional analysis and treatment. The results of the interview were used to match and individualize the test and control conditions in the functional analysis. The test condition included the putative reinforcement contingency whereas the control conditions did not. The functional assessment was also the basis for the FCT and delay-tolerance training.

The results of this synthesized analysis and treatment were that problem behavior decreased to near zero levels in all three participants and appropriate functional communicative responses increased to a functional level (Hanley, Jin, Vanselow, & Hanratty, 2014). The treatment sessions were done three to four times a week for 1 hr in clinic rooms at a university. After this, training for generalization was done by gradually changing settings from the clinic room to the home and involving parents directly in the treatment. This model is presented as a briefer, more cost-effective, and socially valid alternative to a traditional experimental functional analysis (Hanley et al., 2014). Although the synthesized treatment described may be more cost-effective than an experimental functional analysis, it can be difficult for many families to visit a university clinic.

Santiago, Hanley, Moore, and Jin (2015) did a systematic replication with two children with ASD ages 11 and 14 years. They replicated the treatment but changed the setting to be set in a regular classroom. Also, the personnel, who were familiar with applied behavior analysis, conducted the treatment instead of the experimenter. They had the same result in reduction of problem behavior and increase in appropriate requests. Similar method was used by Ghaemmaghami, Hanley, Jin, and Vanselow (2016) after this study and showed similar results. This also resulted in being more cost-effective than the preceding treatment in Hanley et al. (2014).

However, frequent visits to a clinic and treatment in the classroom may not be needed if the child is already enrolled in an Early Intensive Behavior Intervention (EIBI) program. In such cases, considerable expertise in behavior analysis, such as a board certified behavior analyst (BCBA), will usually visit the child's home on a regular basis. An alternative to conducting the synthesized analysis and treatment in a clinic may be to conduct it as part of the child's EIBI program. This can reduce the need for extra resources and travel time on part of the family. Family stress may also be reduced if a professional whom they already know directs the intervention. It also is preventive towards problem behavior with older children with ASD. The purpose of this study was to try to replicate the functional assessment and synthesized treatment methods described in Hanley et al. (2014) in a home setting with a child with ASD enrolled in an EIBI program, utilizing the resources already present.

2 | METHOD

2.1 | Participant

John was a 4-year-old boy diagnosed with ASD. He had been receiving EIBI for almost 1 year prior to this study. He received EIBI at home for an average of 60.5 hr a month. He could follow two-step vocal instructions (e.g., go to the living room and get the book), request, label, and imitate two to three word sentences.

His problem behaviors included crying, screaming, and throwing objects. The parents also reported that he emitted vocalizations (e.g., “bots,” “mine,” and “my turn”), which they interpreted as requests but not able to understand what he asked for. This resulted in frustration and escalation in problematic behaviors such as yelling and crying. The parents requested help to reduce problem behavior and increase proper requesting and general compliance.

2.2 | Setting

All sessions were conducted in John's home. We did one or two sessions a day, three to four times a week, after he came home from school (i.e., between 4:00 pm and 6:00 pm). The sessions were introduced as part of his established intervention program. His parents were separated; therefore, the sessions were held at his mother's house once a week and at his father's house the remainder of the week. In both homes, the sessions were conducted in the living room where John had his own chair and table, a television, and the same selection of food and toys. Every second week, a clinic meeting was held at his mother's house. Materials that were used were registration forms on paper, John's toys that were available and seen as reinforcing, and a general iPhone timer.

His EIBI intervention team consisted of three instructors. They had a training course from the Lovaas Institute and between 1 and 6 years of experience. Each of them conducted about 18 hr per week of early intervention. The EIBI program was supervised by a BCBA every 2 weeks and a psychologist (BCBA-D) who visited once a month. His mother and father participated in the biweekly clinic meetings. During this study, a student doing her practicum (the first author) was present at all times on top of the regular staff to help implement the functional assessment and communication training.

2.3 | Definition of problem behaviors and dependent variables

The dependent variables were the frequency of problem behavior, functional communication responses (FCR), tolerance responses, the duration of reinforcement during sessions, and request variety throughout the treatment hours. Problem behavior was defined as any instance of loud vocalization, screaming or crying, disruption, and throwing objects. This definition was already well-established within the home program, and frequency was therefore deemed as an appropriate measure. Data were collected on two different functional communication responses, simple FCR and complex FCR. Simple FCR was defined as saying, “I want x please.” Complex FCR was defined as saying, “Excuse me, I want x please,” slowly and softly while being oriented toward the adult. Softly defined as a low volume but hearable by more than one person. Tolerance responses were defined as stopping whatever he was doing, orienting towards the adult and saying, “Okay.” Tolerance responses and FCRs were only scored as correct if they had correct phrasing and appropriate tone and volume. A response was scored as prompted if an adult provided a vocal model for any part of the response. Tolerance responses were only scored as correct if it was emitted independently and within 10 s of a denial (The adult saying “No”) on a complex FCR.

Reinforcement duration was calculated by dividing the duration of reinforcement by the duration of the session. Reinforcement duration included the session time for which John had access to a reinforcer identified in the functional assessment. The functional assessment identified these as pizza, juice, Oreo cookies, television, transformer toys, and attention.

Request variety was measured based on all requests emitted with no prompt at any time during EIBI hours. They were scored with four levels of complexity. One word requests, such as “mine” and “bots.” Two word requests, such as “my turn,” “my bot,” and “want TV.” Three to four word requests, such as “I want bot,” “my turn car,” and “I want TV please.” Five and more worded requests, such as “Excuse me, I want shoe please” and “Daddy I want more ice cream please.”

2.4 | Measurement and reliability

A smartphone was used to time the duration of sessions, and all scoring was done using paper and pencil. Data were collected in continuous 10-s intervals and expressed as number of responses per minute (PB and FCR) or percentage of session (reinforcement time). Each session lasted for 5 min and was repeated after a 5-min break when possible. Request variety is expressed as the number of requests at each of the four levels of complexity.

For the purpose of measuring interobserver agreement, a trained instructor employed by the agency scored about 40% of the sessions in each condition. The request variety interobserver agreement was scored outside of the intervention time. Observer records were compared after each session, and agreement percentages were calculated by dividing the number of agreements by the number of agreements and disagreements and then multiplying by 100. All dependent variables were scored each time, through the same scoring sheet as used in collecting data throughout the study. If both observers scored zero the interval would be counted as 100% agreement. Interobserver agreement was 85% (range of 70–100%). Interobserver agreement on request variety was scored across 10% of all EIBI hours. Interobserver agreement was 90% (75–95%).

2.5 | Design

A reversal design was used for the functional analysis comparing parent- and therapist-implementation. The design for the treatment analysis followed the logic of a changing criterion design. Experimental control was demonstrated by the level of problem behavior and alternative responses that corresponded, in the predicted direction, over four successive changes, where reinforcement was contingent on the condition set for each phase. The design for request variety was an AB design with one baseline condition and one treatment condition.

2.6 | Functional assessment procedure

2.6.1 | Open-ended interview

An open-ended functional assessment interview was conducted before the functional analysis. The parents were asked multiple questions separately based on the interview described in Hanley et al. (2014) followed by a brief observation of the child to determine potential functions of the problem behavior. The interview was split into two sessions of 15 min because the time with the parents was limited during home sessions. During the interviews, the instructor noted any problem behavior that John was showing. In addition, the team working with John was interviewed about his language level and other skills.

2.6.2 | Functional analysis

A brief functional analysis based on the results of the open-ended interview was designed to test the hypothesized function(s) of the problem behavior. Based on the interviews, it seemed that problem behavior was related to access being restricted and/or denied to attention or tangible items, especially his transformer robots and favorite television show. Instructor 2 also reported that she experienced problem behavior in demanding situations, suggesting escape as a function. As a result, we also included escape in our analysis. In the functional analysis, we tested this systematically applying a control- and test-condition. In the control condition, all presumed reinforcers were freely accessible. In the test condition, the putative reinforcer(s) were removed every 30 s and returned contingent upon problem behavior.

Each conditions lasted 5 min, and the frequency of problem behavior and functional communication was recorded. The open-ended interview suggested that problem behavior only occurred with certain instructors and the father. We therefore alternated between who was conducting the removal of the items in the test condition.

2.6.3 | Functional communication training

FCT was introduced after the functional analysis was finished. The FCT was done in two different stages. The first stage was simple FCT and the second step was complex FCT.

2.6.4 | Simple functional communication responses

The simple FCR was aimed at replacing problem behavior with an appropriate request: "I want x please." All problem behaviors were placed on extinction. During the 5-min training sessions, the instructor removed the preferred stimuli every 30 s (similar as the test condition in the functional analysis and the following phases). Whenever John emitted the problem behavior after the removal of preferred stimuli, a full vocal prompt for a proper request was given and the stimuli were returned. Two stimuli were used in each session. These were chosen from the array of stimuli, selected based on the initial functional analysis, and included pizza, juice, Oreo cookies, transformer robots, and television. When he could make correct prompted requests following 80% of the removals, the prompt was faded from a full vocal prompt to the instructor just saying "I." When no prompts were needed for an entire 5-min session, only correct responses were reinforced (e.g., stimuli returned to John). When John had correctly emitted simple FCRs following at least 80% of the removals over three consecutive sessions with two different instructors, we moved to complex FCRs.

2.6.5 | Complex FCR

When the complex FCR was introduced, simple FCRs were no longer reinforced. Complex FCR was defined as saying "Excuse me" slowly and softly, then waiting for the adult to acknowledge him before emitting the simple FCR. The complex FCR was not reinforced unless it was uttered with the right tone of voice and with appropriate volume. Saying "Excuse me," was practiced independently before the intervention started. Because of his young age and the fact that he struggled with pronouncing "Excuse" correctly, an approximation of "Excuse me" was accepted as correct. When the time interval was less than 3 s between the removal of stimuli and the response "Excuse me" plus the simple FCR with an appropriate tone of voice and orientation towards an adult, over three sessions and two instructors, we moved to the next phase.

2.6.6 | Denial and delay tolerance training

Before starting on the delay and denial-tolerance training, baseline data were collected on problem behavior following two denials across five trials, within the 5-min sessions. Three of the five trials were still reinforced as in the complex FCR training. A denial was defined as an adult saying "No" to the complex FCR. In baseline, the removed preferred stimuli were given back contingent on problem behavior occurring after a denial. In the treatment phase, John was taught to say "Okay" as a tolerance response while orienting towards an adult. In this phase, the requested reinforcer was delivered contingent upon the tolerance response after a denial. Delay between the tolerance response and reinforcer was introduced, when the tolerance response occurred for 80% over all session over 3 days with training and across two different instructors.

2.6.7 | Social validity

To assess whether the functional assessment and treatment process was received as functional and positive for the family, a questionnaire was sent to both parents. It included four questions that were scored in a scale from 1 to 10, where 10 was the *most favorable* score and 1 the *least favorable*. The parents rated to which extent they (a) felt comfortable about John eliciting problem behavior, (b) reacted well to the problem behavior, (c) saw a decrease in problem behavior, and (d) felt satisfied with the treatment.

3 | RESULTS

The outcome of the open-ended interview suggested that the problem behavior occurred when access to preferred items was restricted or denied. The father reported more problem behavior than the mother. The instructors also reported that John usually showed problem behavior when preferred items were removed or denied. One of the instructors also reported that demands sometimes would lead to problem behaviors.

The functional analysis was adapted to the results of the open-ended interview and conducted across parents and instructors for the following conditions: attention, tangible, and escape. Automatic reinforcement was not included in the functional analysis as no instances was observed or reported in the open-ended interview. The functional analysis confirmed the findings from the open-ended interview, see Figure 1. Problem behavior occurred mostly when the father took items from him, such as (pizza, juice, Oreo cookies, television, and transformer toys). Problem behavior was also observed with one of the instructors when she removed attention. No problem behavior was observed with the mother on any of the suspected functions.

The parent's involvement in the sessions was around 10% of every treatment session for the father and 2% of the entire study for the mother.

Figure 2 shows the instances of the dependent variables per minute and percentage of reinforcement per session across all conditions in the full treatment procedure. The test conditions in the functional analysis served as the first point in the three point baseline. No simple FCR, complex FCR, or tolerance responses were observed during baseline. Problem behavior occurred on a mean of 2.5 instances per minute. During the first treatment condition, problem behavior was reduced and replaced by simple FCR. Across the simple FCR phase, problem behavior was reduced to a mean of 0.7 instances per minute and simple FCR was increased from zero instances to a mean of 1.5 instances per minute. No complex FCR or tolerance responses were observed during this phase. The percentage of reinforcement during this phase was at a mean of 83% (range of 60–90%). John was able to say the simple FCR “I want x please” independently after three sessions. Only independent responses are plotted on the graph.

In the second treatment condition, problem behavior was reduced from a mean of 0.7 to zero instances per minute. Simple FCR was no longer reinforced and decreased from a mean of 1.5 to 0.5 instances per minute. Complex FCR replaced simple FCR in Session 22. Complex FCR increased from a mean of 0 to 1.1 instances per minute. Tolerance responses were not observed during this condition. The percentage of reinforcement in this phase was at a mean of 79% (65–90%). John was able to say “Excuse me, I want x please” independently after eight sessions. In the third condition, tolerance response baseline, problem behavior on the denial “no” was reinforced and problem behavior increased from a mean of 0 to 2.1 instances per minute.

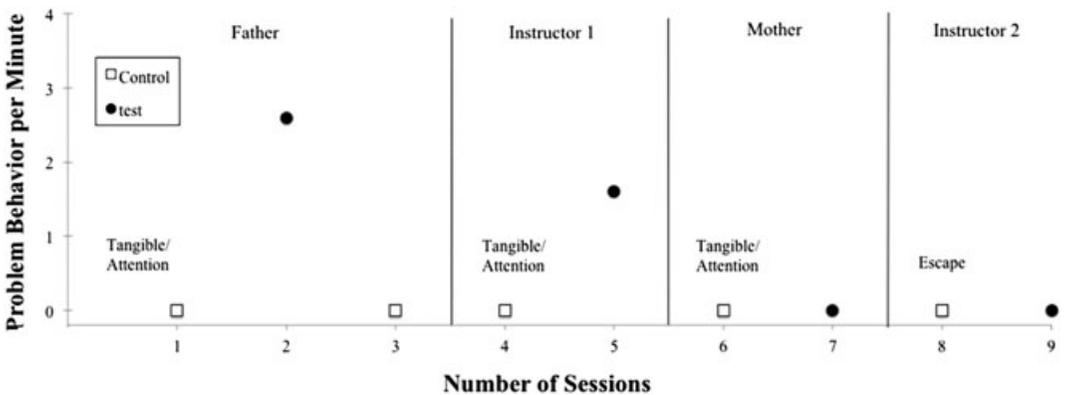


FIGURE 1 Interview-informed functional analysis across instructors. The x-axis shows number of sessions; the y-axis shows the number of problem behaviors per minute. The black circles represent the test condition, and the white square represents the control condition. The black condition lines separate sessions across instructors and parents. Two suspected functions of behavior were tested, tangible/attention and escape

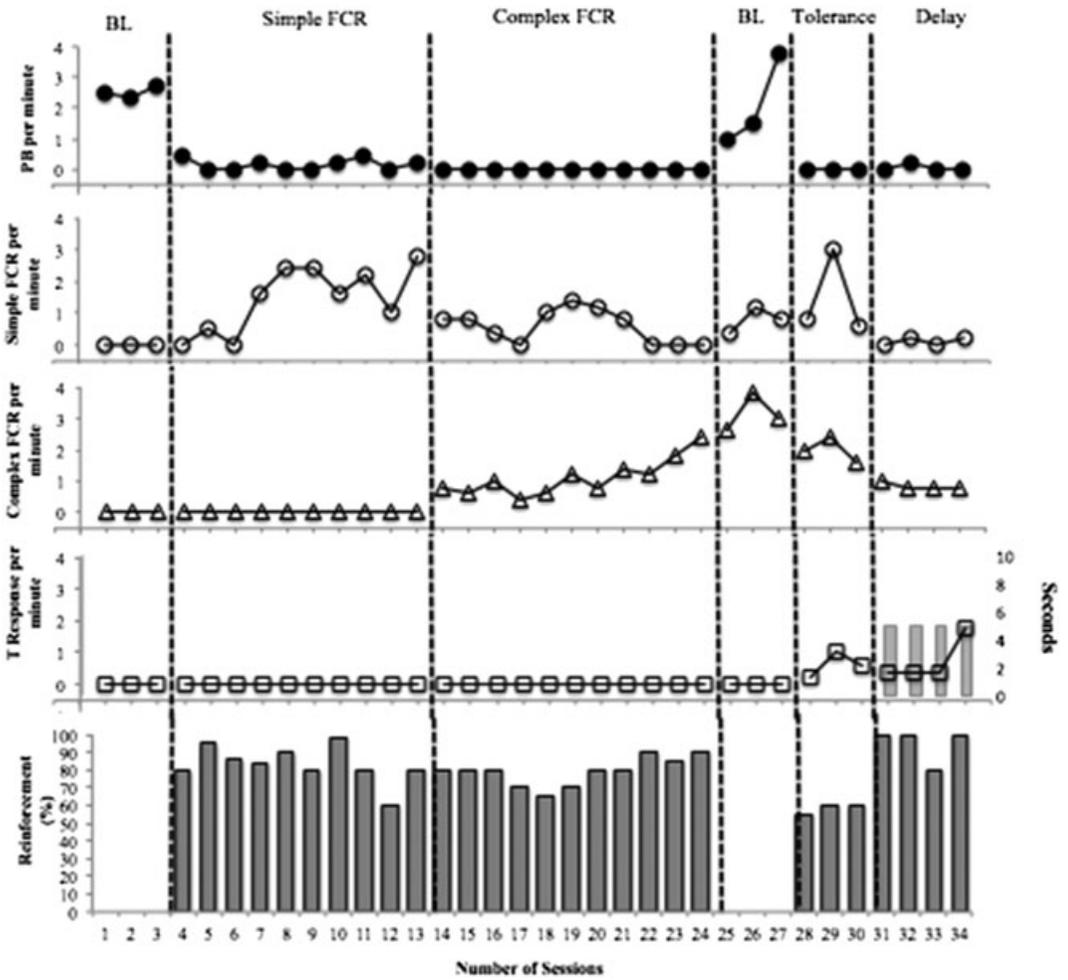


FIGURE 2 The number of sessions across the different conditions are shown on the x-axis. The rate of problem behaviors, simple FCRs and complex FCR per minute, are plotted against the y-axis along with the percentage of reinforcement across sessions. The delay in reinforcement is shown as bars against the y-axis on the right side. The dotted lines divide the conditions. The arrow indicates at which session the probe sessions for maintenance are done 2 months following treatment start. FCR = functional communication responses

In the next condition, denial and delay tolerance response training, problem behavior was not reinforced and it decreased to near zero, whereas tolerance responses increased from zero to a mean of 0.7 instances per minute. Functional communicative responses persisted throughout the tolerance response condition. Simple FCR had a mean of 0.7 instances per minute and complex FCR had a mean of 1.3 per minute. Reinforcement in this condition was at a mean of 79% (40–100%). Simple and complex FCR were now on a frequency that was deemed appropriate. John rarely emitted problem behavior and was able to say “Excuse me, I want x please” and when denied access he would say “Okay.” Also, the time with reinforcement gradually decreased as denial-tolerance training was introduced. As can be seen in Figure 2, the different contingencies of reinforcement varied with the rate of problem behavior and appropriate requests.

Figure 3 shows the total variety in requests scored across all EIBI treatment hours. In the 3 weeks prior to this study was started, we observed a high but decreasing frequency of one-word requests and a low frequency of three word requests. No two- or five or more word requests were observed before treatment. There was a marked increase in requesting the second week after treatment was introduced, this was at about the same time when simple FCR had

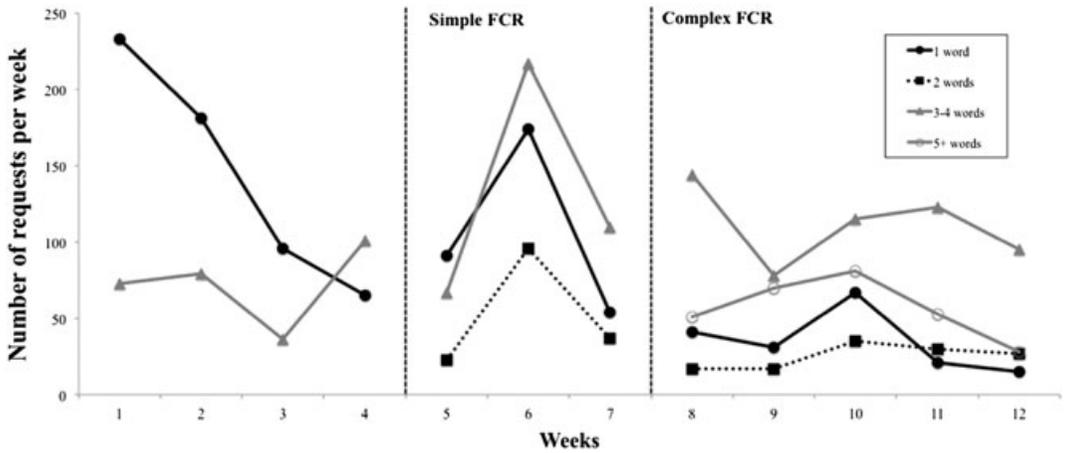


FIGURE 3 The total number of independent requests per week outside of this study across all Early Intensive Behavior Intervention treatment hours. The dotted line represents the start of treatment. The lines represent the number of words in the requests used. The number of requests per week are plotted against the y-axis, and time is shown on the x-axis. FCR = functional communication responses

become independent during sessions. Figure 3 also shows that 3–4 and 5 and more word requests started to replace one- and two-word request in the third and fourth week after the treatment was introduced.

The social validity questionnaires were sent by e-mail to both parents after treatment was finished. The mother reported that she found the assessment package and treatment overall positive to a general degree. The father found the treatment more effective than the mother as can be seen in Table 1.

4 | DISCUSSION

This study suggests that the procedures described by Hanley et al. (2014) consisting of an open-ended interview, an abbreviated functional analysis, and synthesized treatment may have similar results when conducted in a home setting through EIBI as in a clinic. Following treatment, John no longer showed any problem behavior, and appropriate requests were observed regularly at home. The increase in appropriate and more varied requests generalized to outside of the training situation.

In this study, we replicated both the functional assessment and the synthesized treatment procedure described in Hanley et al. (2014). Hanley et al. conducted the assessment and most of the treatment at a university clinic and in the replication in a school setting, whereas this study was conducted entirely at home. Adaptations were made to fit the procedure to the new setting. The adaptations consisted of fewer sessions per visit and less parent participation. This

TABLE 1 The mean of scores on a social validity questionnaire given to the mother and father following treatment. Every question could be rated on a scale from 1 to 10, where 10 was the *best* score and 1 was the *worst* score (adapted from Hanley et al., 2014)

Questions	Mother	Father
How comfortable do you feel when your child elicits problem behavior?	4	6
How well do you feel you react to the problem behavior when it occur?	5	8
Did you see a decrease in John's problem behavior after the student project?	5	7
How much did you get out of the students project?	4	9
Average	4.5	7.5

study employed the same functional assessment and treatment as described by Hanley et al. (2014) as part of an already established EIBI program and did not require any additional resources or increase the cost of the program.

Even if the results of this study are promising, we ran into some procedural problems that may be addressed in future studies. One of these was the lack of replication in the functional analysis conducted with mum and dad. The reason for this was mostly time constraints, the fact that the father got sick when these sessions were scheduled and that very few sessions were conducted at the mother's home. Furthermore, the open-ended interview had to be administered over several days because of time and logistical constraints in the home setting. Both of these weaknesses were potential threats to the internal validity of the functional analysis. However, the results of John's treatment suggest that the functional assessment was accurate enough.

Even though problem behavior was reduced to zero, we were not able to increase the delays as part of the tolerance training because of time constraints. The long-term effects of FCR and denial-tolerance training are not known. However, his EIBI team continued the intervention in a less formal way and conducted probes with 5 s delay 2 months later. The results of these probes showed that treatment gains were maintained and even somewhat extended given that John handled the brief delay very well.

John's requests increased during training and more varied multiword requests increased outside of training. This suggests that generalization occurred across settings and individuals. Simple FCR was not reduced to zero levels following training of complex FCR. This was most likely because simple FCR was still reinforced by his parents. This could perhaps have been prevented if we had been able to provide better parent training and supervision. We could also have asked for more involvement from the parents. This could have made generalization to daily life easier and increase their understanding of the logic behind the FCR training. The parent's low involvement in this study may have been a result of the procedure being conducted in their home, where there are more distractions and competing contingences, as compared to a clinic.

The requesting changed throughout the treatment from none, to a high level and a short sentence, to a high level and longer sentences, and then again back to a lower level longer sentences. This is important as the lower level was considered more appropriate and socially valid.

Hanley et al. (2014) reported very favorable social validity scores. We used a similar questionnaire following treatment. Between the parents, the social validity scores were almost as favorable as in Hanley et al. (2014). The mother did not experience many problem behaviors from John before treatment; there was therefore not much room for improvement and this likely affected the social validity scores. Problem behaviors like described are not socially acceptable in most social contexts. Incidentally, the family reported that following treatment, there was a reduction in problem behaviors and increase in appropriate communication; they were able to go shopping without embarrassing incidents.

Future research on conducting synthesized treatments in EIBI home settings should look at ways parental involvement could be increased. Ideally, this should include conducting a more comprehensive baseline, with parents and staff participating in reversals. This will likely increase the validity of conducting a functional assessment and synthesized treatment in a home setting. In the future, more systematic replications should be conducted across settings, cultures, and costs. It should be conducted with more participants in home settings. This will contribute to finding the most efficient way of treating excessive problem behaviors, potentially reduce cost, and increase more parent involvement.

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