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ASSESSING THE GENERALITY AND DURABILITY OF INTERVIEW-INFORMED FUNCTIONAL ANALYSES AND TREATMENT

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Due to the limited research demonstrating socially valid outcomes of function-based treatments in ecologically relevant environments (Santiago, Hanley, Moore, & Jin, 2016), we replicated and extended the effects of the interview-informed functional analysis and skill-based treatment procedure described by Hanley, Jin, Vanselow, and Hanratty (2014) with two children diagnosed with autism in a home setting. The assessment and treatment was implemented by a home-based service provider and treatment was extended to the participants' parents. Following the interview-informed functional analyses, we taught the participants functional communication responses and to engage in less-preferred activities when functional communication outcomes were delayed. We observed large reductions in problem behavior following the introduction of the function-based treatment. The effects extended to novel settings, stimuli, and caregivers and the results maintained at 6-week follow-ups.

Key words: delay tolerance, functional analysis, functional communication, reinforcement thinning, tolerance responses

Autism spectrum disorder (ASD) is characterized by deficits in social communication and restrictive or repetitive movements that are present from an early age and result in significant impairment in functioning (American Psychiatric Association, 2013). Although problem behavior is not one of the diagnostic features of ASD, studies have demonstrated that more than 50% of individuals diagnosed with ASD exhibit challenging behavior (Baghdadli, Pascal, Grisi, & Aussilloux, 2003; Murphy, Healy, & Leader, 2009). Due to the deficits in communication and the high prevalence of problem behavior exhibited by individuals diagnosed with ASD, more research is needed on assessments and treatments that produce significant and socially valid changes in communication and problem behavior.

Hanley, Jin, Vanselow, and Hanratty (2014) demonstrated the effectiveness of a comprehensive treatment for problem behavior of children diagnosed with ASD. The authors first conducted an interview-informed synthesized contingency analysis to identify the function of problem behavior. They subsequently taught the children to appropriately request the synthesized reinforcers maintaining problem behavior (i.e., emit a functional communication response [FCR]) and then to tolerate delays to the synthesized reinforcer. The use of synthesized contingencies in functional analysis and treatment of problem behavior has occurred for quite some time, especially following inconclusive results of analysis or ineffective treatment relying on isolated reinforcers (Slaton & Hanley, in press); however, Hanley et al. explicitly highlighted the utility of personalized and synthesized reinforcement contingencies in the absence of a failed standard analysis. Results of Hanley et al. demonstrated improvements in FCRs, tolerance responses, and compliance; problem behaviors were also significantly reduced for all three participants. The treatment was extended to multiple settings and

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caregivers. Caregivers reported high satisfaction with the assessment, treatment procedures, and effects. The results were promising but were limited to initial implementation in a highly controlled clinic setting with the process being initially implemented by highly trained behavior analysts (with the exception of one participant whose mother implemented the FA and treatment). Therefore, questions remained as to whether similar effects would be obtained if the entire process was conducted in more relevant environments (outside of the clinic) and with less trained individuals administering the assessment and treatment process.

Santiago et al. (2016) addressed the limitations and extended the generality of the findings of Hanley et al. (2014) in two ways. First, the authors completed the assessment and treatment procedures described in Hanley et al., but in the relevant environments in which the participants engaged in their problem behavior (i.e., home and school). Second, the individuals who implemented the procedures with one of the participants in the Santiago et al. study were not Board Certified Behavior Analysts (BCBAs). The purpose of this was to evaluate the effectiveness of the process when implemented by nonexperts and when implemented in relevant settings. Santiago et al. observed significant reductions in problem behavior and improvements in communication, caregivers were satisfied with the assessment and treatment process, and the process required slighltly less time than the clinic model described in Hanley et al. More recently, Strand and Eldevik (2017), Herman, Healy, and Lydon (2018), and Taylor, Phillips, and Gertzog (2018) also replicated and extended Hanley et al. in more ecologically valid environments (homes and schools) and observed marked reductions in problem behavior and increases in communication, toleration, and contextually appropriate behavior.

Single-case replications are essential to the field of behavior analysis; however, large-scale evaluations that report the results of all applications further extend the generality of assessment and treatment processes while conveying the probability a particular process will be effective (a consideration important to administrators responsible for supporting the adoption of assessment and treatment procedures). Jessel, Ingvarsson, Metras, Kirk, and Whipple (2018) extended previous research by conducting a consecutive controlled case series evaluation of the assessment and treatment process with 25 outpatient cases. Jessel et al. replicated the procedures described in Hanley et al. (2014) within a 2-week, full-day outpatient program and effectively reduced problem behavior by at least 90% across all 25 children and obtained high social validity ratings for the acceptability of the procedures and meaningfulness of the treatment outcomes.

Although the results of the assessment and treatment model employed by Hanley et al. (2014) are promising and there have been numerous replications of the assessment process and initial stages of treatment (e.g., Ghaemmaghami, Hanley, & Jessel, 2016; Ghaemmaghami, Hanley, Jessel, & Landa, 2018; Ghaemmaghami, Hanley, Jin, & Vanselow, 2015; Jessel et al., 2016; Slaton, Hanley, & Raftery, 2017), there are fewer replications of the entire assessment and treatment process with evaluations of the social validity of the outcomes (Herman et al., 2018; Jessel et al., 2018; Santiago et al., 2016; Strand & Eldevik, 2017; Taylor et al., 2018), and there are limited data on the maintenance of effects. In addition, only three replications were published by authors who did not train with Dr. Hanley at the Life Skills Clinic at Western New England University (Herman et al., 2018; Strand & Eldevik, 2017; Taylor et al., 2018). Replications from different researchers are critical for understanding the utility, generality, and limits of the procedures. The primary merit of an assessment is its ability to produce an effective and socially validated treatment outcome

(Hayes, Nelson, & Jarrett, 1987; Wolf, 1978); therefore, more social validity evaluations from different researchers are also needed. Therefore, the purpose of the present study was to replicate the assessment and treatment process described in Hanley et al. (2014) and assess the social validity of the procedures and its effects. In addition, we extended the treatment across settings, caregivers, stimuli, reported treatment integrity data, and briefly assessed maintenance of the effects.

METHOD

Participants and Setting

Anna was a 3-year-10-month old girl diagnosed with an ASD. Anna was referred for behavior analytic services due to the high frequency and intensity of her problem behavior. Her mother reported that she routinely engaged in whining and screaming (vocal protesting) that was extremely disruptive to those around her and interfered with the ability to complete typical daily activities. For example, when leaving a children's gym class (i.e., preferred activity), Anna screamed repeatedly and drew a significant amount of attention to herself and disrupted the environment for the other patrons. She followed multistep instructions, initiated conversation, spoke in full sentences, and requested a few preferred items. Despite Anna speaking in full sentences, she did not communicate effectively when she was delayed or denied access to preferred activities. Anna received approximately 8 hr of applied behavior analysis (ABA) services each week through a local agency and received private speech classes once per week.

Owen was a 5-year-11-month old boy diagnosed with an ASD who received 15 hr of ABA services a week in his home. He spoke in two-to-three word sentences. His problem behaviors included vocal protesting, aggression, and environmental destruction. Owen engaged in aggressive behaviors towards adults and same-age peers both at school and with his sister at home. Owen independently requested items vocally or through gestures (e.g., pointing), labeled items, and followed two-step instructions.

All functional analysis and treatment sessions took place in the child's home during home-based therapy sessions. Within the child's home, there was a designated work area at a table. We consulted with the children's parents to determine in which room of their house they thought it would be best for us to work. With Anna, we worked in her basement at a small table with two chairs or on the floor. This was where Anna worked during all of her home-based therapy sessions. We also worked in Owen's basement at a small table with two chairs or on the floor. In both of the participants' finished basements, there were a variety of toys and games. The individuals conducting the sessions held a bachelor's degree in psychology and were enrolled in a master's in applied behavior analysis program.

Materials

The materials included two timers, a video camera, datasheet, and a pen. For both participants, preferred and less-preferred tangible items were present. The items were identified based on the parent interview and requests from the participants. Preferred tangible items for Anna included the game Zingo®, figurines, Feed the Woozle® game, a matching game, Hungry Hippo® game, Guess Who® game, and Headbanz® game. Less-preferred tangible items included Tangrams®, new puzzles, Legos®, and books. Preferred tangible items for Owen included dry-erase letters to trace, marbles, a wooden letter book, and animal Legos®. Less-preferred tangible items included a letter flip book, Elmo Legos®, and puzzles.

Response Definitions and Measurement

Data were collected while watching videotaped sessions and recorded using computer software. The target behaviors were problem behaviors, simple FCRs, complex FCRs, tolerance responses, duration of delay, and independent engagement with an alternative activity during the delay. The specific FCRs that Anna and Owen emitted were different because different materials were used.

We measured the rate of simple and complex FCRs and tolerance responses. *Simple FCRs* were defined as the child independently asking for an item and attention using the sentence frame "______, please" (e.g., "Board, please," "Headband, please," "Block structures, please," etc.). *Complex FCRs* were defined as the child independently saying "Excuse me," waiting for the therapist to acknowledge him or her, and emitting the complex communication response (e.g., "May I have ___, please?"). *Tolerance responses* were defined as the child independently saying "Okay" within 5 s of the therapist delaying access or denying access to a preferred item. The response, "Okay" was selected as the tolerance response because it is a socially appropriate form of communication when presented with a denial or delay to a preferred item (e.g., the therapist saying "no" *or* removing the item). We considered removing an item from the participant as a delay or denial because the item was no longer available which occasioned the opportunity for the participant to say "Okay" and do something else. We also recorded when an independent simple FCR, independent complex FCR, and independent tolerance response occurred during the first trial with a novel stimulus. We recorded this to assess whether direct teaching procedures were needed for each stimulus or if teaching could be applied to some stimuli and then extend to novel stimuli. *Engagement* was defined as independently engaging with an alternative activity after the requested item was delayed and was measured using duration but depicted as a percentage because session time varied.

Anna's problem behaviors were *vocal protests*; these were defined as any instance of Anna emitting an inappropriate vocalization above conversational level, which typically involved shrieking or yelling "No." Each instance of a vocal protest was separated by 2 s.

Owen's problem behaviors included vocal protests, environmental destruction, and aggression. *Vocal protests* were defined as any instance of Owen emitting an inappropriate vocalization above conversational level (i.e., yelling). Each instance of a vocal protest was separated by 2 s. *Aggression* was defined as any instance of Owen making forceful physical contact with another person, often in the form of kicking, hitting, biting, pinching, slapping, or grabbing. *Environmental destruction* was defined as any instance in which Owen throws, sweeps, or kicks items off of the table or across the floor after he is denied access to a preferred tangible item. Rates of problem behavior were calculated by dividing the number of instances these behaviors occurred by the total session duration.

Interobserver Agreement and Treatment Fidelity

Interobserver agreement (IOA) was obtained by having two observers independently collect data during at least 30% of the sessions across all conditions, measures, and participants and comparing observer records. Mean duration-per-occurrence IOA was calculated for independent engagement and was calculated by dividing the smaller duration by the larger duration for each response, adding these numbers together, dividing that sum by the total number of responses and then multiplying by 100. For problem behavior, tolerance responses, simple FCRs, and complex FCRs, we used mean-count-per-interval IOA within 10-s intervals. Mean count-per-interval IOA was calculated by dividing the smaller count by the larger count per interval, adding those numbers together and dividing that sum by the total number of intervals and multiplying by 100. For Anna, the mean IOA for all target behaviors was 98% (range, 85%-100%). For Owen, the mean IOA for all target behaviors was 98% (range, 83%-100%).

Treatment integrity was collected during 30% of sessions across conditions and participants. Treatment integrity was collected by an observer watching the video of the session and recording whether the experimenter implemented the procedures as prescribed. The procedural components being measured included experimenter responses to problem behavior, FCRs, and tolerance responses. For example, the experimenter's response would be scored correct if the experimenter delivered the reinforcers when the participant said, "board, please" during simple FCT. Treatment integrity was a mean of 98% (range, 71-100%) for Anna and a mean of 99% (range, 83-100%) for Owen.

Experimental Design

We used a multielement design during the functional analysis. With the treatment evaluation, we demonstrated experimental control through a changing criterion design with an initial baseline. As Hartmann and Hall (1976) assert, changing criterion designs are ideal for evaluations involving the gradual change of a target behavior or procedures that involve modifying a target behavior in a stepwise manner. Control is demonstrated with changing criterion designs when behavior conforms to the set criterion and is strengthened when there are varying phase lengths at each criterion shift. Our evaluation involved modifying the target behavior in a stepwise manner until it reached a terminal response. In other words, the first criterion was "______, please," the second criterion was "Excuse me, may I have _____ please," the third criterion was ""Excuse me, may I have _____ please," and saying "Okay" after a delay or denial, and the final criterion involved saying "Excuse me, may I have _____ please," saying "Okay" after a delay and denial, and engaging in another activity while waiting for the reinforcer for increasing amounts of time. We observed changes in behavior that met each criterion when and only when we implemented the contingencies to support the behavior.

Procedures

Functional assessment. The functional assessment consisted of an indirect assessment and a brief observation. The indirect assessment included conducting an open-ended interview (Hanley, 2012) with the caregiver. In addition to the questions in the interview, we also asked the parents how long they would like their child to be able to wait for an item or activity, which allowed the experimenters to identify a goal regarding the duration of the delay to the requested item, and we asked the parents what they typically said when an activity or item was not immediately available.

For the brief observation, we observed Owen for 15 to 30 min. The observation differed from Hanley et al. (2014) as we did not manipulate consequences during the observation. The purpose of our observation was for the experimenter to build rapport with the child, observe language abilities, and assess factors that may evoke problem behavior. A brief observation was not conducted with Anna because the experimenter had previously worked with Anna for an extended period of time and had already established a relationship with her and was aware of her language abilities.

After the open-ended interview and brief observation, we conducted a functional analysis. The purpose of the functional analysis was to identify the reinforcing contingencies of the problem behaviors. We followed the same process as described in Hanley et al. (2014). Because the open-ended interview suggested that problem behavior occurred when access to preferred tangible items and attention were delayed, denied, or terminated we conducted a synthesized functional analysis using a single test condition with a matched control condition for each participant. In the control condition, which was always conducted first, the child had continuous access to his or her preferred items and undivided attention. The items and interactions were chosen based on information from the parent interview.

During the control condition for Anna, Anna and her mom played together with preferred toys. Preferred toys included a picture card game, figurines, and magnets. No demands were placed on Anna during this condition. The synthesized attention and tangible test condition was conducted immediately following the control condition. At the beginning of the synthesized test condition following 30 s of engagement with her mother and preferred toys, Anna's mom picked up the toys and walked down the hall. While removing the items, the mother said "Game is all over. I have to go upstairs" or a similar statement (we asked her to say statements that she typically stated when removing/denying access to activities). Contingent on problem behavior, attention from mom and preferred toys were returned for 30 s.

For Owen, the test condition began when Owen asked for a preferred item that was within sight, but out of reach. Asking for the item included pointing, physically moving towards the item, or grabbing for the item. Contingent on any of those behaviors, the therapist said, "No, you can't have it." Contingent on problem behavior, Owen received access to the preferred item and attention for 30 s. At the end of the 30 s, the therapist removed the item by saying, "My turn," "No, you can't play with that," or "First (experimenter's name), then Owen's turn." During the control condition, Owen was given access to requested preferred tangibles and therapist attention throughout the sessions.

Treatment evaluation. The data from the test condition of the functional analysis were used as the baseline for the treatment evaluation.

We replicated the procedures in Hanley et al. (2014) when teaching the simple FCRs, complex FCRs, and tolerance responses. We used behavior skills training (BST), which involved the experimenter describing the expected target behavior, modeling the expected target behavior, role playing, and then in the session providing differential outcomes with least-to-most prompting to teach simple FCRs, complex FCRs, and tolerance responses. During the session, least-to-most prompting involved waiting 5 s for the child to emit the response independently. If the child did not emit the response independently within 5 s, a partial vocal prompt was provided. If the participant did not emit the FCR within 5 s, a full vocal prompt was then provided. We placed problem behavior on extinction, meaning attention and tangible items were withheld following any instance of problem behavior.

Treatment was implemented in a stepwise fashion following the logic of the changing criterion design (Hartmann & Hall, 1976) across simple FCRs, complex FCRs, and tolerance responses. For Anna, we introduced teaching of a new skill after she exhibited the FCR independently in 90% of the opportunities presented and problem behaviors were at a 90% decrease from baseline levels for three consecutive sessions. After delay tolerance training, Anna was also required to emit the tolerance response independently in 90% of the opportunities presented. For Owen, we introduced teaching of a new skill after he exhibited a 90% decrease in problem behaviors from baseline levels and he emitted the simple FCR during 85% of the opportunities presented for three consecutive sessions. After delay tolerance training, Owen was also required to emit the tolerance response independently during 85% of the opportunities presented.

The experimenter provided the child with the opportunity to choose the activity before each session began. Sessions began when the experimenter and child were sitting together at a table or on the floor. Consistent with BST, the experimenter described the desired target behavior at the start of the condition, modeled the target simple FCR, and then conducted a practice roleplay with the participant. Teaching trials began immediately after the instructions, modeling, and roleplay and as described above, least-to-most prompting was provided throughout the session. The experimenter held the preferred item in the child's sight but out of reach. If the child emitted an independent communication response (e.g., said, "______, please"), he or she received 30 s access to the preferred item or activity and the experimenter played with the participant with the item. After 30 s elapsed, the experimenter said, "My turn," or something similar (e.g., "Game over."), and quickly took away the preferred item and placed it out of reach. If the child did not emit the communication response, the experimenter used least-to-most prompting as mentioned previously. Multiple FCRs were taught across sessions and varied depending on which item the child chose prior to the start of session. If the participant had emitted a simple FCR of an item that was not used in session, the request would have been granted (given it was a reasonable request); however, this did not occur with either participant. Each participant requested the item that they had preselected at the start of the session. Before the start of each session, the participants were given the opportunity to select a new activity or item.

Sessions were structured similar to simple FCT during the teaching of complex FCRs. The only difference during complex FCT was that Anna and Owen were taught to make eye contact with an adult, say, "Excuse me," slowly and quietly, wait for the adult to acknowledge him or her (i.e., adult said, "Yes"), and then ask for the item in a complete sentence (e.g., "May I have the ______, please). After the child emitted the complex FCR and problem behaviors were absent, he or she received a preferred item and attention (i.e., experimenter played with the participant) for 30 s. If the child emitted the simple FCR in this phase, the experimenter vocally prompted the child to say the complex FCR.

Delay tolerance training. During delay tolerance training, the child was required to emit the complex FCR and then a tolerance response following a delay or denial (e.g., "Not right now") emitted by the experimenter. Identical to Hanley et al. (2014), three of every five complex FCRs produced a delay to reinforcement and two produced immediate reinforcement. If the child emitted the simple FCR, the experimenter prompted the complex FCR. During the delay trials, upon the child emitting a complex FCR, the experimenter said, "In a little bit," "Wait," or a similar phrase, and the child was taught to say, "Okay," while looking at the adult and then engage in a less-preferred activity. The experimenter said multiple phrases (e.g., "Wait," "No," "In a little bit," "I'm using it," "It's not available") to indicate a delay. Some of the phrases that the experimenters used were phrases that the parents reported during the caregiver interview that they used. One procedural variation was implemented for Owen. After Owen emitted the tolerance response the experimenter said, "You can play with this or this instead," and provided Owen with the choice between two less-preferred tangible items. This was done because Owen's mom reported that she preferred to give him this choice rather than have him wait without items.

Initially, the requested reinforcer was given immediately after the child emitted an appropriate tolerance response and problem behaviors were absent. The duration of the delay in which the child engaged with the less-preferred activity was then variable and quasirandom. We preselected delays that averaged a particular mean and selected them out of a hat prior to a session. Once a delay was selected, it could not be selected again until all other delays were selected. Similar to Hanley et al. (2014), the delay to reinforcement was terminated based on performance criteria (i.e., contingency-based delay; Ghaemmaghami et al., 2016) applied to engagegment, which was increased as this phase progressed. For engagement to be scored, the participants had to interact independently with the less-preferred activity during the delay without problem behavior. Problem behavior was ignored, and if it occurred during the delay, engagement was not scored. The timer was not reset, but the the delay was extended as needed. For example, if the delay was 15 s and problem behavior occurred at 7 s, the experimenter paused the timer at 7 s and resumed the timer once the child independently engaged with the item without engaging in problem behavior. Once the timer reached 15 s, the delay was ended and the reinforcer was delivered. The variable schedule ensured that the duration of the delay was unpredictable to the child. The duration of time that the child had access to the reinforcer was also quasirandom and independent of the duration of the delay (see Table 1). The randomization was determined prior to session. The less-preferred alternative activities and the maximum duration the child was required to wait and engage independently were selected through the parent interview. Less-preferred activities were selected by asking the participant's parents what toys the child did not like and by the experimenter observing what toys the participant did not select when playing. Less-preferred activities for Anna included play-dough, letter games, and magnet dolls. Less-preferred activities for Owen included certain puzzles, building Elmo® out of Legos® and animal figurines.

Delay tolerance training was divided into six levels for Anna and five levels for Owen (see Table 1). The purpose of this was to systematically increase the average duration of time the child engaged in the less-preferred activity and accessed the reinforcer. Anna's sessions were systematically increased to 20 min and Owen's sessions were systematically increased to 10 min. The terminal duration of the sessions was selected based on how long the parents reported they wanted their child to wait during the parent interview. In the first level, the preferred item was given to the child immediately after the child emitted an independent tolerance response. In the second level, the duration of the delay increased to an average of 30 s (range, 0 s-45 s). After this, the average total duration of the delay increased by 50% and the range was plus or minus 50% of the average duration (e.g., if the average duration was 30 s, in the next level the average duration was 45 s but unpredictably ranged from 30 s to 1 min 30 s). With respect to reinforcer access, the

Table 1
Tolerance Training Levels

	Anna			Owen		
Level	Mean delay (s)	Reinforcer range (s)	Session duration (min)	Mean delay (s)	Reinforcer range (s)	Session duration (min)
1	0	30	10	0	30	5
2	30 (0-45)	30	10	30 (0-45)	30	5
3	60 (30-90)	30	10	60 (30-90)	30	5/7
4	120 (60-180)	30-60	10	120 (60-180)	30-60	7
5	240 (120-360)	30-120	15	240 (120-360)	30-120	10
6	480 (240-720)	30-240	20	--	--	--

Note. Numbers in the parentheses represent the delay range.

minimum reinforcer duration was always 30 s and the maximum reinforcer duration was 50% of the average duration of the delay (e.g., if the delay was 3 min, the reinforcer duration unpredictably ranged from 30 s-1.5 min).

We increased the delay to the reinforcer for Anna when problem behaviors were at a 90% decrease from baseline level, she emitted the complex FCR and tolerance response independently in 90% of the opportunities presented, and she engaged in a less-preferred activity for 90% of the delay for one session. The criterion to revert to the previous delay schedule for Anna was if problem behaviors were greater than baseline levels for two consecutive sessions. For Owen, we increased the delay to the reinforcer when problem behaviors were at a 90% decrease from baseline level, he emitted the FCR and tolerance response independently in 85% of the opportunities presented, and he engaged in the less-preferred activity for 90% of the delay for one session. The criterion to revert to a previous delay schedule for Owen was problem behaviors greater than baseline levels (five or greater) for two consecutive sessions.

Denial probes (Anna). Two 20-min denial probes were conducted with Anna after she reached mastery criteria for delay tolerance training. At the start of the session, she received access to a preferred item for 1 min. After the minute elapsed, the experimenter took the preferred item, said, "The game is over," or a similar statement, and turned away from Anna. After Anna emitted the tolerance response, the experimenter gave Anna a less-preferred activity to play with for the remainder of the session. There were no prompts provided to Anna during the denial probes. She did not receive access to the requested item at any point during the session or after the session. We conducted these sessions to assess whether problem behavior would remain low if an item was completely unavailable, to mimic times when parents may have to deny items (as opposed to *delaying* access).

Treatment extensions. We conducted two treatment extension sessions in different settings with Anna. The sessions were conducted by the experimenter in a different room in her house (a room where no teaching occurred). No prompts were provided. Sessions were the same as those at the last delay level.

In addition, we conducted treatment extensions with the parents implementing the treatment. The experimenter used BST to teach the parents to implement the program in his or her home where the sessions were typically conducted with the child. Next, the parent implemented the program with their child in a different room of the home from where teaching occurred.

The sessions were structured to resemble each of the participant's typical interactions with his or her caregivers. Sessions were 10 min and began with the child and caregiver playing with a preferred tangible item that the child chose. After a varied amount of time, the caregiver said that she was all done playing with the preferred tangible item. The caregiver then did one of two things: (a) the caregiver asked the child what he or she wanted to play with next or (b) the caregiver gave the child an option of two less-preferred activities the child could choose from. If the caregiver implemented the first option, sometimes the caregiver would allow the child to play with the new activity he or she requested, and sometimes the caregiver would deny access to the new activity if it was not available. The caregivers were told to do what felt natural to them to ensure that the sessions resembled the families' daily lives.

Maintenance probe. We conducted a 6-week maintenance probe with both Anna and Owen. No prompts were provided. Anna's session was 20 min and was the same as the last delay level of tolerance training. Anna's maintenance probe occurred prior to the treatment extension because before we could conduct the treatment extension, her family left for a 6-week vacation. Therefore, we conducted a maintenance probe upon return from her vacation to ensure the effects maintained and then conducted the treatment extension. Owen's session was 10 min and the conditions were the same as the last delay level of tolerance training.

Social Validity

At the end of the study, the children's caregivers were given a social validity questionnaire. A 7-point Likert scale was used. We asked the caregivers if they (a) thought accepting being told "wait" or "no" was an important skill for their child to learn, (b) were satisfied with the amount of time that their child waited for an item that they requested, (c) were satisfied with the communication responses their child learned, and (d) were satisfied in the amount of improvement observed in their child's problem behaviors.

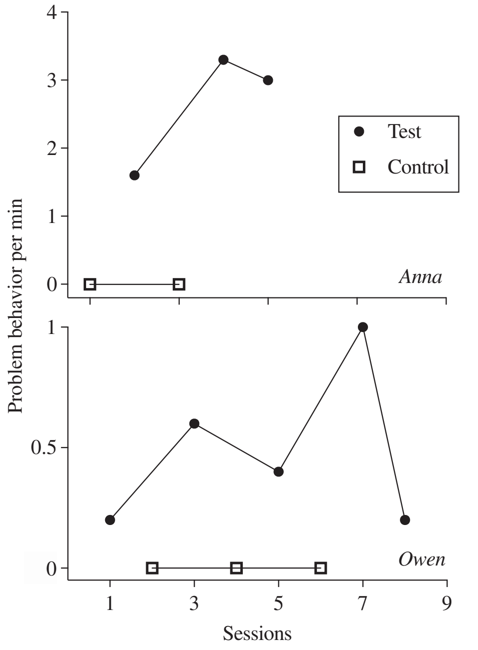

Figure 1. Problem behavior per minute in the test and control condition of the functional analysis for Anna (top panel) and Owen (bottom panel).

RESULTS

Figure 1 depicts the results from the functional analysis for Anna and Owen. For both participants, problem behaviors were at zero during the control condition, and problem behaviors were at high levels with some variability during the test condition. The results showed that both participants' problem behavior was sensitive to the synthesis of tangibles and attention as reinforcement.

Figures 2 and 3 depict Anna and Owen's problem behavior, simple FCRs, complex FCRs, tolerance responses, and engagement across all conditions. The test condition of the functional analysis served as the baseline for our treatment evaluation. There was a rapid (Anna) or immediate (Owen) decrease in problem behavior once we began teaching simple FCRs, and problem behavior remained at a low level with some variability during all teaching conditions. As noted, we used a changing criterion design to evaluate functional control of behavior by the treatment process. We taught the participants the terminal response in four steps or four criteria shifts (simple FCR, complex FCR, complex FCR + tolerance response, complex FCR + tolerance response + waiting/engagement) and we observed changes (improvements) in each target step upon implementation of the teaching procedures, which was staggered across panels.

It is important to note that over time, with both participants, the duration of the delay increased and there were fewer opportunities to emit the complex FCR and tolerance response during sessions. Due to this, there was a decreasing trend in complex FCRs and tolerance responses during the latter part of tolerance training and during denial probes, treatment extension, and the maintenance probe. However, although there were a decreased number of opportunities to emit the complex FCR and tolerance response, there was an increase in the opportunities to emit engagement during the delay (while waiting for the

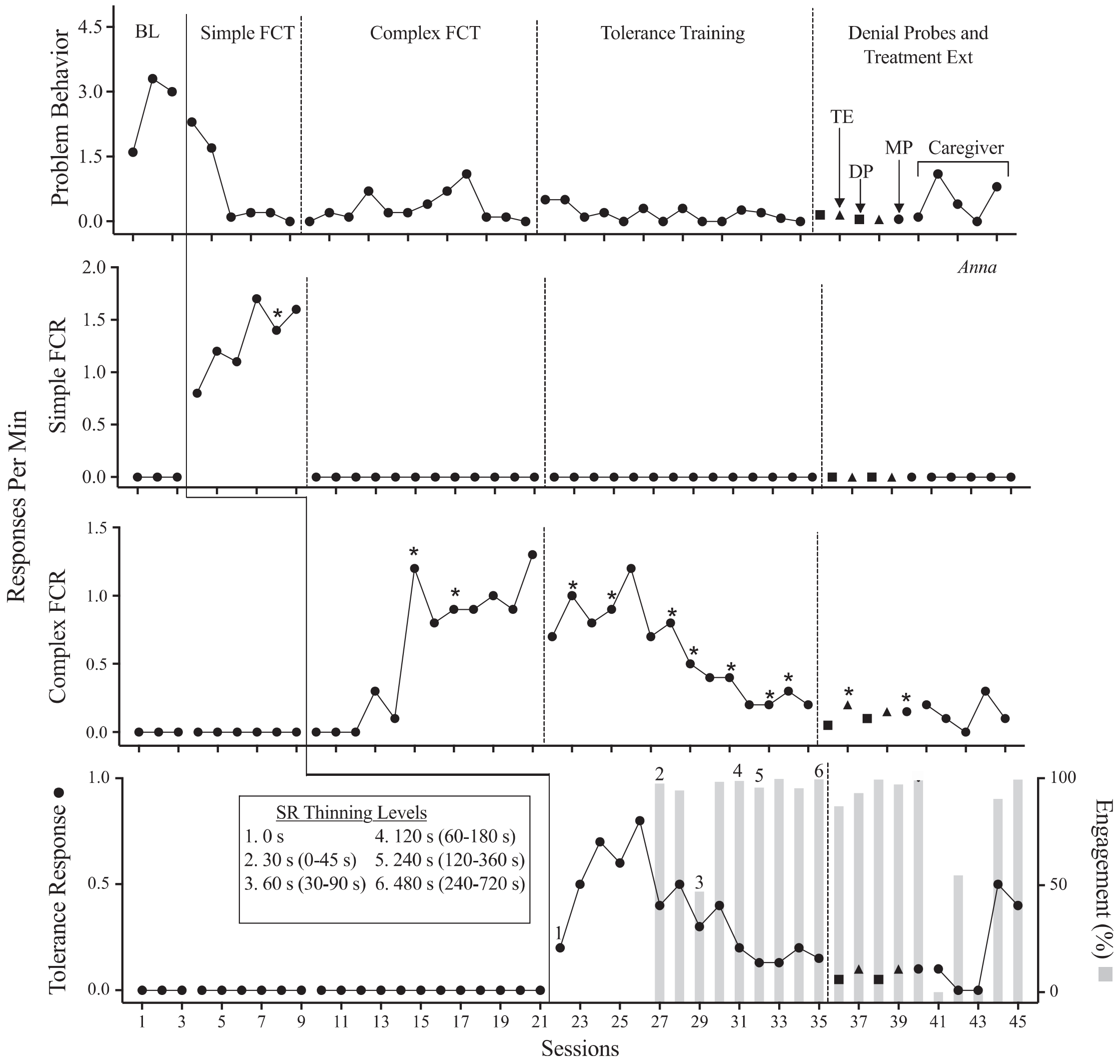

Figure 2. Treatment evaluation for Anna. The asterisk (*) denotes when a novel toy was introduced and an independent FCR was observed. The values of the thinning levels refer to mean length of the delay in seconds. TE = Treatment Extension; DP = Denial Probe; MP = Maintenance Probe.

reinforcer), and we observed increases in engagement as the delay increased.

The asterisks on panel 3 and panel 4 of Figures 2 and 3 denote when Anna and Owen emitted independent complex FCRs and tolerance responses, respectively, on the first trial with a novel stimulus. During these sessions, the experimenter introduced a novel toy (i.e., not used in teaching) and recorded a first trial probe of whether the child independently requested the item during the first opportunity of the session and whether they tolerated the delay. During the evaluation, Anna emitted an independent complex FCR and tolerance response with all 11 novel stimuli, and Owen emitted an independent complex FCR and tolerance response with all 14 novel stimuli. This means that on the first trial that an untrained item was presented, the participants always independently emitted a FCR and/or tolerance

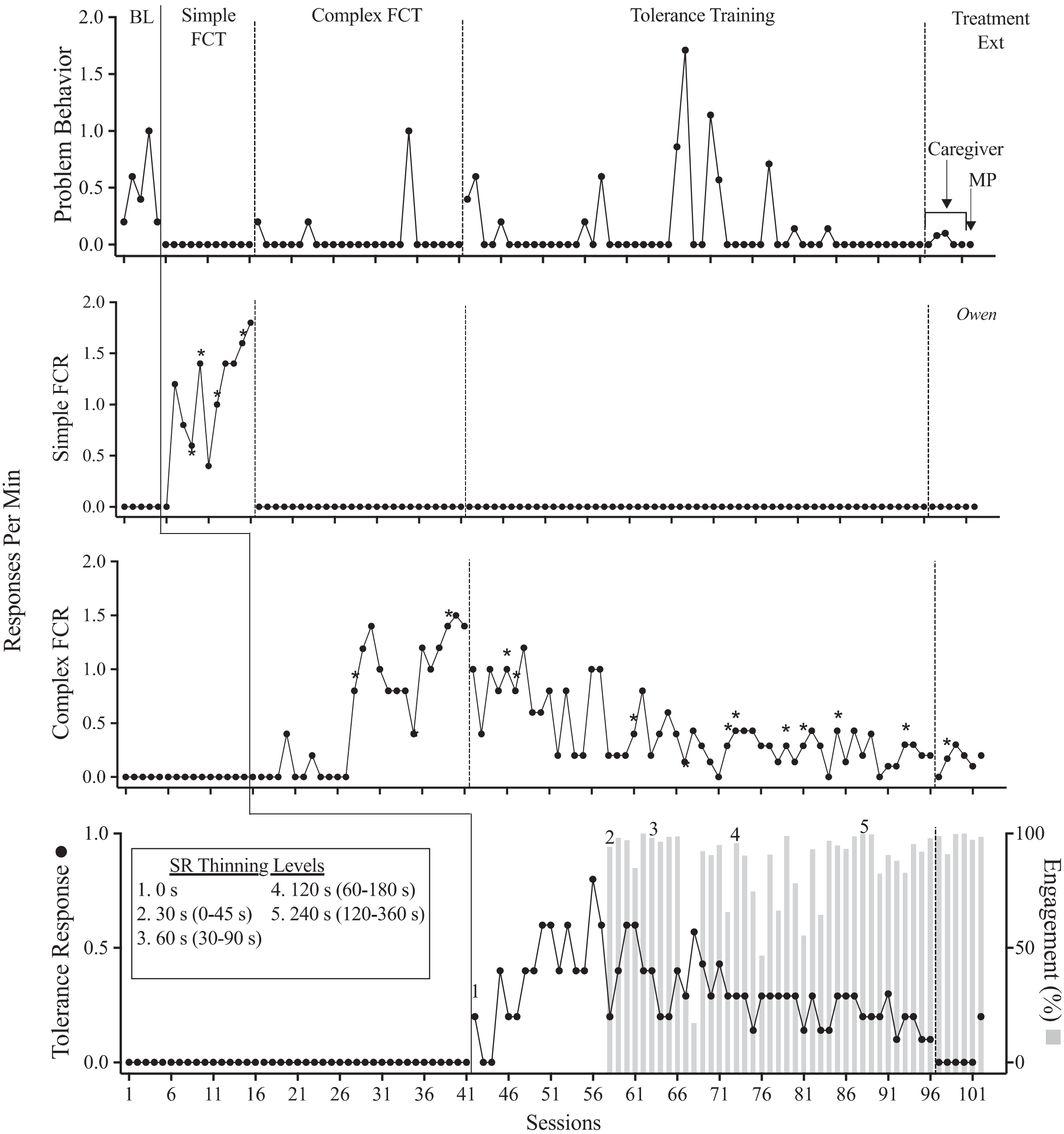

Figure 3. Treatment evaluation for Owen. The asterisk (*) denotes that when a novel toy was introduced an independent FCR was observed. The values of the thinning levels refer to the mean length of the delay in seconds. MP = Maintenance Probe (6 weeks).

response that was specific to that item (e.g., "May I have the hungry caterpillar book, please?" and if a delay was programmed, responded with a tolerance response).

Both Anna and Owen did not engage in problem behavior during the maintenance probe and they both emitted the complex FCR and tolerance response. Anna's problem behavior increased to a level similar to the complex FCT phase when her mother was implementing the procedures with her during the treatment extension phase. Despite this, Anna still emitted the complex FCR during four of the five sessions with her mother and the tolerance response for three of the five sessions with her mother. Owen's problem behavior remained at low levels during the sessions that a parent was implementing the procedure. Owen emitted the complex FCR for four of the five sessions and tolerance responses were zero during treatment extension with the Owen's caregiver. However, Owen was emitting a socially acceptable waiting response. Upon being told "No" by his caregiver, Owen sat or stood with a calm body without emitting problem behavior after the item requested was delayed or denied and engaged in an alternative activity. This was deemed socially acceptable because both of Owen's parents stated that as long as Owen was not engaging in problem behavior when a preferred item was removed or denied, the parent found the response acceptable. Although the parent accepted this as an appropriate response, it did not meet the definition of the tolerance response; hence, measured tolerance responses are zero during the treatment extension.

Table 2
Social Validity Responses by Anna's and Owen's Parents

Question	Anna	Owen
My child learned to accept being told "no" or "wait" from an adult.	6	5
Teaching children to accept "no" or "wait" is an important skill for a child.	7	7
I thought the methods (instructions, modeling, role play, and feedback) that were used to teach my child appropriate communication responses were acceptable.	7	7
I am satisfied with how I was taught to implement the procedures with my child.	6	6
I feel comfortable implementing the procedures on my own.	7	6
I am satisfied with the amount of improvement observed in my child's problem behavior.	6	5
I am satisfied with the length of time that my child will wait for an item or activity that they requested.	6	7
I am satisfied with the communication responses that my child learned to use to request an item or activity.	6	6

Note. 1: strongly disagree, 4. No opinion, 7: strongly agree

Table 2 depicts the results from the social validity assessment. The social validity assessment indicated that the parents of both participants strongly agreed that (a) teaching children "no" or "wait" is an important skill, and that (b) the methods (instructions, modeling, role play and feedback) that were used to teach the child an appropriate communication response were acceptable. Both parents reported that the results were socially meaningful; however, Anna's parents strongly agreed that the outcomes were socially meaningful whereas results were more tempered with Owen's parents.

DISCUSSION

We replicated and extended Hanley et al. (2014) and Santiago et al. (2016). We demonstrated the positive effects of stregthening FCRs, tolerance responses, and engagement with reinforcers identified via interview and analysis on problem behaviors with two young children diagnosed with ASD. During the delay tolerance training sessions, both Owen and Anna were taught to engage in other activities while they waited for increased amounts of time before they received access to their requested reinforcers. We also extended the treatment across settings, people, and toys and demonstrated the maintenance of the skills at a 6-week follow-up. Caregivers agreed that the target behaviors were important, the treatment was appropriate, and the effects acceptable. This study adds to the growing literature base (Hanley et al., 2014; Herman et al., 2018; Jessel et al., 2018; Santiago et al., 2016; Strand & Eldevik, 2017; Taylor et al., 2018) showing that socially meaningful reductions in problem behavior may be achieved when interview-informed and synthesized reinforcers are used to strengthen the skills of communication, toleration, and contextually appropriate behavior.

We conducted a synthesized functional analysis similar to Hanley et al. (2014) because our open-ended interview with the caregivers suggested that there were two contingencies simultaneously controlling the participants' problem behavior and multiple toys/activity terminations that occasioned the problem behavior. Had the interview suggested separate controlling variables operating under different conditions, we may have conducted additional test and control conditions. Nevertheless, as mentioned, the merit of an assessment is found in the ability to design an effective treatment (Hayes et al., 1987), and the interview, brief observation (Owen only), and synthesized contingency analysis led to an effective treatment.

Like Ghaemmaghami et al. (2015), we taught specific FCRs for various activities as opposed to a an omnibus "My way" request (Hanley et al., 2014; Ghaemmaghami et al., 2018; Jessel et al., 2018). Unlike Ghaemmaghami et al. (2015), we did not see persistence of problem behavior while we taught precise mands which may be because we taught mands for different toys whereas Ghaemmaghami et al. (2015) taught precise mands for different functional classes of reinforcement (i.e., escape, tangibles, and attention).

We extended previous research by assessing maintenance of effects after 6 weeks without programmed treatment and observed positive effects with both participants. During the maintenance probe, Anna and Owen's problem behaviors were at a zero, and they independently emitted a complex FCR and tolerance response while engagement in the alternative activity occurred at a high level. We extended Hanley et al. (2014) by showing the durable effects of the treatment. In addition, we extended Hanley et al. by including denial probes (sessions in which the requested item was denied, not delayed); more systematic evaluation of the functional differences between delay and denials are now needed. We also showed the generality of the procedures by conducting sessions with the participants in the basement (Anna and Owen), an upstairs room (Anna), and on the main floor (Owen). Both participants demonstrated the skills with the experimenter and the participant's parents. We also observed some novel responding during the treatment extension with Anna's caregiver and Owen's caregiver. For example, when the parents served as the implementer, the preferred activity that Owen requested was interactive play with an activity that was never used during teaching (being squished into a bean bag chair). Future research should more systematically evaluate the extent to which the treatment process evokes existing mands or generates the development of novel mands.

The current study had some limitations. The procedures were implemented with only individuals who were language-abled (similar to Strand & Eldevik, 2017); therefore, it is unknown whether these procedures will be effective in homes when teaching individuals without well-developed vocal–verbal behavior. The positive outcomes reported by Jessel et al. (2018) and Ghaemmaghammi et al. (2016) from outpatient clinic processes with learners of various language abilities suggest that these procedures would be effective, but more replications in the home with learners of different language abilities is needed. A second limitation was that although we worked in the children's homes and included parents at the end of the process, we did not evaluate whether the treatment effects generalized to community settings when implemented by parents. Thus an important area of future research is to evaluate the effects of the assessment and treatment process over longer observational periods when implemented by parents in home and community settings. Last, we observed an increase in Anna's problem behavior when her mother began implementing the procedure. This increase may have been a demonstration of limited generalization and resurgence of the problem behavior. Previous research has demonstrated resurgence effects with the implementation FCT on an intermittent schedule (Volkert, Lerman, Call, & Trosclair-Lasserre, 2009). Future research should evaluate methods to minimize resurgence when transferring the effects of FCT to relevant people in relevant contexts.

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