Received: 4 December 2024 | Accepted: 16 June 2025

DOI: 10.1002/jaba.70023

RESEARCH ARTICLE

Journal of Applied Behavior Analysis SEAB

Skill-based treatment of interfering stereotypy

Jessica D. Slaton[1] | Gregory P. Hanley[2,5] | Ellen E. Gage[2,3] | Kelsey W. Ruppel[2,5] | Katherine J. Rafftery[1] | M. Kimball Clark[4] | Christina M. Caruso[1]

[1]Nashoba Learning Group, Bedford, MA, USA
[2]Psychology Department, Western New England University, Springfield, MA, USA
[3]New England Center for Children, Southborough, MA, USA
[4]Ivymount School, Rockville, MD, USA
[5]FTF Behavioral Consulting, Worcester, MA, USA

Correspondence
Jessica D. Slaton, Nashoba Learning Group, 10 Oak Park Drive, Bedford, MA 01730, USA.
Email: jessica.slaton@nashobalearninggroup.org

Editor-in-Chief: John Borrero
Handling Editor: Jennifer Austin

Abstract

To address the high-rate, interfering stereotypy of three autistic students, a chained schedule for treating stereotypy was combined with skill-based treatment for challenging behavior. Treatment consisted of progressively widening contingencies to differentially reinforce functional communication, toleration, and accurate task completion with escape from instruction to engage in stereotypy. Stimuli were correlated with periods during which instructions were presented and motor stereotypy was redirected (S-) and periods during which escape was provided and motor stereotypy was not redirected (S+). Skills were maintained via intermittent, unpredictable reinforcement schedules. Functional communication and tolerance responses were acquired, discriminative control over both motor stereotypy and vocal stereotypy was established, and task accuracy increased to >80% for all participants. The goals, procedures, and outcomes of the intervention were also socially validated by the participants' teachers.

KEYWORDS
autism, chained schedule, skill-based treatment, stereotypy, stimulus control

Stereotypy can be described as a restricted and repetitive pattern of behavior, which is one of the criteria used to diagnose autism (American Psychiatric Association, 2013). Examples of stereotypy include motor behavior such as body rocking or hand flapping or vocal behavior such as echolalia (repeating the last spoken phrase) and repeating syllables (Bodfish et al., 2000; Goldman et al., 2008; MacDonald et al., 2007). Stereotypy has been reported to serve important functions for autistic individuals, such as calming, self-soothing, or expressing specific emotions (e.g., Charlton et al., 2021; Kapp et al., 2019; Morris et al., 2025) and therefore does not necessarily need to be reduced or eliminated in all cases. However, high-rate stereotypy has also been reported to interfere with instructional activities (e.g., Cook & Rapp, 2018; Coon & Rapp, 2020; Cunningham & Schreibman, 2008; Dunlap et al., 1983; Lanovaz et al., 2013), and some topographies of stereotypy may be physically harmful or distressing to the individual and those around them (Kapp et al., 2019). When stereotypy is harmful or interferes with daily life, intervention may be warranted. Addressing stereotypy can be difficult because stereotypy is usually automatically reinforced (Hanley et al., 2003; Melanson & Fahmie, 2023; Vollmer, 1994), and interventions such as function-based differential reinforcement are more often applied to socially mediated challenging behavior (e.g., Carr & Durand, 1985; Tiger et al., 2008).

Treatment of stereotypy has often involved environmental enrichment in which alternative stimuli are provided noncontingently (e.g., Horner, 1980; see also Gover et al., 2019, for a review). Environmental enrichment has been shown to reduce motor stereotypy (e.g., Higbee et al., 2005) and vocal stereotypy (e.g., Enloe & Rapp, 2014) during brief (e.g., Britton et al., 2002) and extended (e.g., Lindberg et al., 2003) sessions for some participants. However, literature reviews have shown that environmental enrichment alone has limited efficacy (e.g., DiGennaro Reed et al., 2012; Gover et al., 2019) but could serve as the baseline for other interventions (e.g., Hanley et al., 2000; Potter et al., 2013).

Environmental enrichment can be supplemented with other treatment components like redirecting stereotypy and prompting alternative responses (e.g., Giles et al., 2012; Langone et al., 2013; Reid et al., 1993; Roscoe et al., 2013). These components might increase overall treatment efficacy in some cases (Gover et al., 2019), but they have also had a negative effect on stereotypy (e.g., Hanley et al., 2000; Potter et al., 2013) or have increased other responses (e.g., Hagopian & Toole, 2009; Lerman et al., 2003). Furthermore, Lang et al. (2010) suggest that motivation to engage in stereotypy strengthens with redirection.

When scientists and practitioners arrange environmental enrichment, redirecting, and prompting alternative responses, the goal is often to eliminate or substantially reduce stereotypy. However, this is not necessary when the topography of stereotypy is not physically harmful. An alternative goal of intervention could be to establish stimulus control over stereotypy so that response allocation is shifted to create periods with and without stereotypy. Establishing stimulus control over stereotypy has a number of potential benefits. First, individuals with disabilities have the right to choose how to spend their time and the types of activities in which they engage (Bannerman et al., 1990). This includes the choice to engage in nonharmful stereotypy. Establishing stimulus control over stereotypy can help achieve a balance between an individual's right to habilitation (i.e., to experience educational, social, and other opportunities that are impeded by stereotypy) with their right to choose how to spend their time. Second, by providing periods for stereotypy, there is less risk of redirection-induced aggression (e.g., Hagopian & Toole, 2009; Lerman et al., 2003) or that the intervention will fail as deprivation from stereotypy increases (Lang et al., 2010). Third, establishing stimulus control could also allow for reduced caregiver monitoring that would not be possible with an intervention that relied on frequent redirection.

One possible way to establish stimulus control over stereotypy is to use multiple or chained schedules (e.g., Doughty et al., 2007; Slaton & Hanley, 2016). Multiple and chained schedules can establish stimulus control over stereotypy by alternating between signaled periods when stereotypy is redirected (S- component) and signaled periods with free access to stereotypy (S+ component). In a multiple schedule, the alternation between these components is noncontingent (i.e., time-based; Tiger et al., 2017). In a chained schedule, alternation from the S- to the S+ component is contingent on meeting specific criteria (i.e., access to stereotypy is provided as a reinforcer). Slaton and Hanley (2016) directly compared multiple and chained schedules with two autistic participants and found that both schedules shifted allocation of stereotypy but that the chained schedule produced a greater reduction in stereotypy during the S- component as well as a greater increase in functional engagement. Furthermore, they found that stimulus control was established only with the chained schedule in which access to stereotypy was provided as a reinforcer for task engagement. Several other authors have also reported the efficacy of contingent access to stereotypy as a reinforcer for correct responding or engagement with leisure items (e.g., Charlop et al., 1990; Hanley et al., 2000; Potter et al., 2013). However, there are few published examples of treating stereotypy within chained schedules.

Another possible way to establish stimulus control over stereotypy is by teaching individuals to mand for periods to engage in stereotypy (i.e., functional communication training [FCT]). Treating stereotypy with FCT has the unique advantage of teaching the individual to solicit their own reinforcement rather than waiting for a caregiver to provide it. During the initial stages of FCT, the functional communication response (FCR) is reinforced on a continuous schedule; however, it is important that this schedule be thinned to practical levels that can be supported within the individual's natural environment. Schedule thinning must be done systematically to avoid extinction of the FCR and to mitigate possible resurgence (Briggs et al., 2018; Greer et al., 2016; Hagopian et al., 2011). Several authors have reported successfully establishing a mand for stereotypy during FCT (e.g., Falcomata et al., 2010; Hausman et al., 2009) but without the inclusion of schedule thinning to practical levels. There is a similar concern with chained schedules: As the response requirement in the S- interval of the chained schedule increases, a decline in task engagement can occur.

There are several ways to mitigate potential negative side effects during reinforcement thinning. For example, a multiple schedule can be applied to establish periods in which the FCR will not produce reinforcement (e.g., Hagopian et al., 2004; Hanley et al., 2001), a time-based delay can be inserted following the FCR (e.g., Hagopian et al., 1998; Muething et al., 2018), or a gradually increasing number of responses can be inserted following the FCR (i.e., demand fading; Falcomata et al., 2012; Lalli et al., 1995; Zangrillo et al., 2016).

Another way to avoid extinction of the FCR or other appropriate responses and mitigate potential resurgence during schedule thinning is to apply an unpredictable schedule of reinforcement such that some (but not all) instances of these responses are immediately reinforced. An example of this type of unpredictable schedule was reported by Hanley et al. (2014). These researchers applied a variable, unsignaled schedule of reinforcement during schedule thinning for three autistic children who engaged in socially mediated challenging behavior. During the first phase of treatment, each instance of the FCR was immediately reinforced with access to the reinforcers maintaining challenging behavior. During the second phase of treatment, some instances of the FCR continued to be immediately reinforced but some instances were denied. Participants were taught to engage in an appropriate tolerance response to this denial, which then produced reinforcement. During the final phase of treatment, the schedule was further thinned to create an arrangement in which the FCR and tolerance response were reinforced on variable schedules and varying amounts of cooperation with adult-directed tasks were also reinforced.

The skill-based treatment model reported by Hanley et al. (2014) has been replicated several times with similar outcomes (e.g., Beaulieu et al., 2018; Fiani & Jessel, 2022; Ghaemmaghami et al., 2016; Herman, et al., 2018; Jessel et al., 2018; Metras et al., 2023; Slaton et al., 2024; Staubitz et al., 2022). Broadly, the skills acquired by these participants fall into the categories of communication (e.g., manding), social skills (e.g., waiting, accepting "no"), and language skills (e.g., listening to and following increasingly complex directions). This is important to note for several reasons. The first is that deficits in communication, social skills, and language are among the core features of autism, and therefore a treatment package that teaches some of these skills would be beneficial for autistic learners for whom skill acquisition may be impaired by high-rate, interfering stereotypy. The second is that there are very few examples of stereotypy treatments that directly measure increases in specific skills. Gover et al. (2019) found that only 26% of the stereotypy studies that they reviewed included interventions to increase play skills and only four studies demonstrated functional control over an increase in alternative behavior. In addition, among the few stereotypy studies that have reported increases in alternative behavior, most have limited their measures to a few responses in a single skill (e.g., math work in Conroy et al., 2005; simple vocational or leisure tasks in Slaton & Hanley, 2016; engagement with specific toy sets in Edwards et al., 2018, and Potter et al., 2013). Establishing effective treatments for stereotypy that reliably increase skills in multiple domains is therefore an important line of continued research.

The purpose of the current study was to evaluate a treatment package for stereotypy that combined the chained schedule described by Slaton and Hanley (2016) with FCT to teach a mand for stereotypy and thus bring stereotypy under stimulus control of a naturally occurring interaction. To avoid extinction of the FCR, we applied the schedule thinning methods reported in the skill-based treatment described by Hanley et al. (2014). We taught participants to mand for stereotypy (i.e., mand for access to the S+ component) when the S- component was implemented, refrain from stereotypy until the mand was granted, and engage in an appropriate tolerance response if the mand was denied. We then provided contingent access to stereotypy as a reinforcer to teach early language skills (e.g., matching, identifying objects), academic skills (e.g., reading sight words, identifying numbers), leisure skills (e.g., playing iPad games), and daily living skills (e.g., dressing).

METHOD

Participants and settings

The participants were three autistic individuals (two children and one young adult). All participants were White males and were referred because they engaged in high-rate stereotypy that interfered with their educational curriculum. Grant's teachers reported that he engaged in vocal and motor stereotypy, including stereotypy with objects (e.g., flapping objects), that interfered with his academic curriculum (e.g., reading, identifying numbers) and that redirecting alone had not yielded sufficient reductions in stereotypy. They also reported that Grant tended to require many trials before acquiring new responses due to his stereotypy and that the time it took him to demonstrate independence with new tasks was considered excessive. In addition, Grant's parents reported that stereotypy interfered with his participation in family activities.

Milo engaged in vocal stereotypy as well as motor stereotypy with and without objects, including engaging in stereotypy with any instructional materials presented to him. Milo's teachers reported that they could not interrupt or redirect his stereotypy consistently enough to complete most instructional tasks and that several of his Individualized Education Plan objectives had been discontinued over the past year due to lack of progress. Milo's parents reported that his motor stereotypy at home with cups and bowls was so excessive and disruptive that they had to lock away the dishes in their house.

Ben's teacher reported that he engaged in motor stereotypy that was disruptive to the environment (e.g., galloping across the room) and interfered with independent leisure activities. Ben's teachers usually had to interrupt teaching sessions multiple times to wait for his stereotypy to subside so that they could begin teaching again; they often had to wait for several minutes, as redirecting the stereotypy was not successful. It was also reported that the disruptive nature of Ben's stereotypy sometimes evoked aggressive responses from other students (e.g., another student in the classroom engaging in aggression toward Ben when Ben's vocal stereotypy was loud and ongoing or when motor stereotypy resulted in Ben moving into the personal space of another student).

Sessions took place in a separate, private classroom at a day school (Milo, Grant) or residential school (Ben) for autistic children and young adults. The instructional tasks presented to all participants were tasks from their current Individualized Education Plan, and sessions were conducted by people that the participants regularly interacted with and received instruction from at school. Grant's sessions were conducted by his special education teacher and Board Certified Behavior Analyst (BCBA) who had approximately 20 years of experience working with children with developmental disabilities. His sessions were overseen via live teleconferencing by the fourth author who collected data, provided coaching to implement the procedures, and collaborated with the sixth author to make treatment decisions. Milo's sessions were conducted by his 1:1 therapist, who had a bachelor's degree in an unrelated field and approximately three years of experience working with autistic children. His sessions were overseen by the first and fifth authors, one of whom was present at each session to collect data and provide coaching and immediate feedback to the 1:1 therapist. Ben's sessions were conducted by the third author who worked as a 1:1 therapist and had several years of experience in the field. These sessions were completed as part of the coursework for their master's degree in applied behavior analysis under the supervision of the second author. Ben's sessions were overseen by the second author via weekly meetings to review data, review videos of sessions, provide feedback regarding implementation, and discuss next phases of treatment.

We invited relevant stakeholders for each participant to collaborate with the study authors to define some of our dependent variables and make some decisions about how our independent variable was implemented. These stakeholders included parents, the BCBA supervising the participant's educational program, and direct care therapists who provided 1:1 instruction during the school day. The first, second, and fourth authors selected the experimental design and general phases of intervention (described below) as well as the mastery criteria for each phase and the general dependent variables to be measured (e.g., percentage of time spent engaging in stereotypy). However, we relied on relevant stakeholders to identify topographies of stereotypy to address versus topographies of stereotypy that would not be addressed, how often instruction should be paused for the participant to engage in stereotypy and for how long, what signals to correlate with instructional periods versus stereotypy periods, what FCR and tolerance response to teach, what instructional tasks to present, what sequence to follow in building from easy to difficult instructional tasks, and the total amount of instructional tasks that should be presented during each session. These conversations occurred with stakeholders at the beginning of the study and throughout as participants moved on to next phases of intervention. Participant input was considered by observing the specific toys or items with which they often chose to engage in stereotypy (if applicable) and ensuring that those toys or items were provided during sessions. Participant input was also considered by observing the topographies of stereotypy and ensuring that there was adequate space in the room to safely engage in these topographies (e.g., space to gallop or jump).

We shared this decision-making responsibility with relevant stakeholders as part of our commitment to an inclusive and socially validated research process that balanced the participants' preferences for stereotypy with the educational goals that were important to their parents and teachers. Institutional review board approval was obtained through Western New England University prior to beginning the study, and written consent for each participant was obtained from a parent. Assent from participants was obtained prior to each session by inviting them to sit down at a table in the session room or area and observing whether they chose to do so. Participants could leave the session room or area at any time by requesting to do so or by getting up and walking away.

Response definitions, measurement, and interobserver agreement

Together with each participant's parents and educational team, we selected topographies of motor stereotypy that the team reported to be most interfering and that could easily be defined, observed, and redirected. We excluded topographies that we could not redirect (e.g., eye movements) or topographies that the team reported were not of concern. *Motor stereotypy* for Grant included hand flapping, finger wiggling, object flapping, clapping, and holding objects to his eyes while rotating them. *Motor stereotypy* for Milo included hand flapping, tapping his fingers on his teeth, rubbing or poking his face, twisting or waving fingers in front of his face, shaking objects, tapping objects on other objects, and tapping objects on his teeth. *Motor stereotypy* for Ben included pacing or galloping around the room, jumping, tapping his body, tapping furniture, hair twirling, and knuckle cracking. The onset of each instance of stereotypy was scored as soon as the participant emitted one of the topographies above; the offset was scored when no stereotypy had occurred for 3 s. Contingencies during treatment were applied only to motor stereotypy, but vocal stereotypy was also measured for all participants. *Vocal stereotypy* for all participants was defined as audible humming or nonword vocalizations (e.g., shrieking, saying "la la la"). The onset of each instance of vocal stereotypy was scored as soon as the participant began emitting an audible hum or nonword vocalization; the offset was scored when no vocal stereotypy was audible for 3 s.

The topography of each participant's FCR and tolerance response was selected by a member of their educational team. The team also determined whether the initial FCR would be expanded to include longer or more complex phrasing. Grant's FCR was defined as a vocal approximation of the word "play." Beginning with Session 16, the definition of his FCR was expanded to include orienting toward the teacher as well. Two FCRs were measured for Milo: a simple FCR ("play please") and a complex FCR ("Can I play please?"). These were both produced vocally. Ben's FCR was the phrase "hang out," produced vocally. An independent FCR was scored each time the participant emitted the phrase without any prompts from the teacher. The tolerance response for each participant was the vocal response "okay." An independent tolerance response was scored each time a participant said "okay" without any prompts from the teacher (regardless of whether a denial had just occurred).

Instructions presented during the S- interval varied for each participant and were nominated by the participant's educational team. Grant's language tasks were matching pictures and labeling pictures; his academic tasks were labeling numbers, labeling letters, and vocally reading sight words. Milo's language tasks were sorting nonidentical objects, matching pictures, and identifying pictures. His academic tasks were matching letters and numbers, and his daily living tasks were putting on a shirt and unpacking his backpack. Ben's leisure tasks were playing games on his iPad, doing puzzles on his iPad, and completing a visual schedule of exercises. His academic task was typing words, and his daily living tasks were adding events to his calendar and setting an alarm on his iPad.

For all participants, a *correct response* to a teacher-delivered instruction was defined as an accurate answer without stereotypy (e.g., for a labeling task, saying the correct name of the picture, letter, or number presented while refraining from stereotypy). For tasks that involved multiple steps (e.g., putting on a shirt), a task analysis was created and a correct response was scored for each step in the task analysis performed correctly and without stereotypy. Table 1 provides a summary of participant characteristics and the instructional tasks included for each participant.

The following measures were scored in each session for each participant: duration of motor stereotypy during S- and S+ intervals; duration of vocal stereotypy during S- and S+ intervals; duration of each S- and S+ interval; number of independent FCRs; number of independent tolerance responses; number of instructions delivered by the teacher; and number of correct language, academic, leisure, or daily living responses to teacher instructions without stereotypy. From these measures, we calculated the percentage of S- and S+ component time during which motor and vocal stereotypy occurred; independent FCRs and tolerance responses per minute; optimal rates of FCRs and tolerance responses; and the percentage of accuracy with teacher-delivered language, academic, leisure, or daily living skill instructions. The optimal FCR rate for each session was determined by dividing the number of S- intervals by total duration of S-intervals; the optimal tolerance response rate for each session was determined by dividing the number of times the FCR was denied by the total duration of S- intervals. Thus, the optimal rates each session indicated the rate that would have been obtained if one independent response occurred each time the S- interval was presented (FCR) or each time the FCR was denied (tolerance response). As free-operant responses, the FCR or tolerance response could occur at any time; all instances were scored to determine the extent to which responding was allocated to the S- component (to evaluate stimulus control over these responses) and to ensure responding was not occurring above or below the optimal rate. Responding below the optimal rate would indicate that the response was not being emitted independently in all opportunities; responding above the optimal rate (e.g., continuing to emit the tolerance response while instructional tasks were being presented) would be undesirable because it could interrupt instruction.

Each session was video recorded, and data were collected using laptops equipped with data collection software. Interobserver agreement (IOA) was assessed by having a second observer review session videos for at least 20% of sessions in each phase for each participant. Agreement was calculated by dividing sessions into 10-s intervals and dividing the number of agreements per interval by the number of disagreements plus agreements per interval and multiplying by 100. Mean IOA for all measures for Grant was 90.53% (session range: 75.93%–100%). Mean IOA for all measures for Milo was 94.82% (session range: 74.64%–100%). Mean IOA for all measures for Ben was 93.92% (session range: 69.73%–100%).

Experimental design

Several experimental designs were used to evaluate the effects of the treatment package across dependent variables. We used a nonconcurrent multiple-baseline-across-participants design to evaluate the initial effects on stereotypy; we used a multiple-baseline-across-responses design for each participant to evaluate the acquisition of FCRs, tolerance responses, and language, academic, leisure, or daily living tasks. In addition, by measuring all free-operant responses separately during S- versus S+ intervals, we continually evaluated control by correlated stimuli in a chained schedule. Because we were closely collaborating with each participant's educational team, decisions such as the duration of sessions in baseline, the number of S- and S+ changeovers during each session in treatment, and the number and type of response-chaining levels were individualized to each participant based on the input from their team.

TABLE 1 Participant characteristics and instructional tasks.

Participant	Age	Diagnosis	Communication	Instructional tasks
Grant	7	Autism	Regular use of 1–2 word phrases	Matching pictures; identifying numbers, letters, pictures, sight words
Milo	12	Autism	Highly infrequent 1–3 word phrases	Matching pictures, letters, numbers; sorting objects; ADLs; identifying pictures
Ben	21	Autism	Regular use of 1–3 word phrases	Typing, puzzles, iPad games, exercise schedule, calendar skills, setting an alarm

Note: ADLs = activities of daily living.

Procedure

Baseline

Each participant experienced two baseline phases, with implementation of the independent variable staggered across baselines for each participant. Each baseline phase continued until the participant experienced at least the prescribed number of sessions necessary for the multiple-baseline design (three for Grant; five for Milo; seven for Ben) and stereotypy was stable or increasing during the S- component.

Alone baseline
The purpose of the alone baseline was to measure stereotypy in the absence of social consequences (e.g., Querim et al., 2013). The teacher told the participant she would be back soon and left the room. Thus, each session consisted of a single uninterrupted S+ interval. For participants who engaged in motor stereotypy with objects (Grant, Milo), a set of objects was provided within arm's reach. This included small plastic toys for Grant and plastic cups, marbles, small plastic animals, and beads for Milo. These were selected because they were objects with which Grant and Milo frequently engaged in stereotypy. Ben was not provided with any objects because his stereotypy did not include objects. Sessions were 5 min (Grant, Milo) or 10 min (Ben) in duration.

Instructional baseline
The purpose of the instructional baseline was to measure stereotypy during the tasks nominated by each participant's team and under the terminal schedules that each team designated as the desired endpoint for treatment. Table 2 includes a description of the treatment endpoints. The amount and type of instructions presented during each S- interval, the duration of the S+ interval, and the session duration were thus selected individually by each participant's team. The S- interval was implemented at the start of each session, and instructional tasks were presented to the participant. As in the alone baseline, no consequences were provided for stereotypy. Correct responses to instructions with or without stereotypy received brief praise. After the maximum number of instructions identified as the desired treatment endpoint had been presented (e.g., 10 discrete trial instructions for Milo), the participant was provided with access to the S+ interval.

Grant and Ben's intervals were signaled with a colored card (red during S-; green during S+). Grant's S+ interval included access to the same items provided during his alone baseline; these items were kept within arm's reach during his S- interval. For Milo, the items with which he engaged in stereotypy were placed on a red tray and his S- and S+ intervals were signaled by the distance of the tray from him. During S+ intervals, the tray was placed on the table directly next to him; during S- intervals, the tray was moved to the top of the table (but still easily within arm's reach). The items on the tray were identical to those provided within arm's reach during the alone baseline. Vocal instructions were also presented at the start of each interval (e.g., instructing the participant to complete a task at the beginning of the S- interval or telling the participant that he may play now at the beginning of the S+ interval).

Treatment

Stereotypy was redirected during the S- interval for all treatment sessions. Redirecting consisted of the teacher gently placing her hands on the participant's body where stereotypy was occurring and directing them to complete the current task that had been presented. For example, if Milo began shaking a picture card during a matching task, the teacher gently placed her hand on his and gestured to the array of stimuli on the table to indicate that he should match the card instead of shaking it. Each instance of redirecting lasted 3 s. Treatment sessions for Milo and Grant consisted of 10 changeovers between the S- and S+ interval (i.e., 10 trials). Treatment sessions for Ben were 10 min during FCT and five changeovers between the S- and S+ interval (i.e., five trials) during tolerance response teaching and response chaining. Mastery criteria during FCT and tolerance response teaching for all participants involved three consecutive sessions with stereotypy occurring in less than 5% of the S- component and FCRs and tolerance responses occurring at near-optimal rates (defined as falling within .10 responses above or below the optimal rate). The mastery criteria for each level of response chaining included all previous criteria as well as 80% or greater accuracy for three consecutive sessions; for Milo we also applied the criteria of 100% accuracy for two consecutive sessions (whichever occurred first).

Functional communication training
These sessions were identical to the instructional baseline except that stereotypy was now redirected to the task being presented during the S- component and access to the S+ component was contingent on emitting the FCR. Each session began with implementation of the S- component (i.e., presenting the correlated stimulus and instructing the participant that it is time to work). The FCR was established for all participants by providing a vocal model immediately after changeover to the S-. This model was faded within sessions for Grant and Milo and across sessions for Ben. Within-session fading for Grant and Milo consisted of inserting a progressive time delay (1, 2, 3 s) between the onset of the S- interval and the vocal model. Fading across sessions for Ben included inserting a progressive time delay of up to 7 s between the onset of the S- interval and the vocal model as well as systematically decreasing the vocal model. Each

TABLE 2 Response-chaining levels for Grant, Milo, and Ben.

Level	Grant	Milo	Ben
1	Complete 1–3 trials of mastered DTT tasks; 12 total instructions	Complete 1–3 trials of matching pictures; 12 total instructions	Typing: 1 word Puzzles: 5 pieces iPad game: 1 round Exercise: 1 step Calendar: open calendar Set alarm: 1–2 trials
2	Complete 1–3 trials of **acquisition DTT tasks**; 12 total instructions	Complete 1–3 trials of matching pictures, **letters, or numbers**; 12 total instructions	Typing: 1–**4 words** Puzzle: 5–**12 pieces** iPad game: 1–**3 rounds** Exercise: 1–**3 steps** Calendar: **set event** Set alarm: 1–**8 trials**
3	Complete 1–**6 trials** of acquisition DTT tasks; **20 total instructions**	Complete 1–**6 trials** of matching pictures, letters, or numbers; **18 total instructions**	Typing: 1–**5 words** Puzzles: 5–**24 pieces** iPad game: 1–**5 rounds** Exercise: **full schedule** Calendar: set event Set alarm: 1–**10 trials**
4	Complete 1–**10 trials** of acquisition DTT tasks; **30 total instructions**	Complete 1–**10 trials** of matching pictures, letters, or numbers; **27 total instructions**	
5	Complete 1–10 trials of acquisition DTT tasks; **40 total instructions**	Same as above, but increase **field size from 3 to 4.**	
6		Increase **field size to 5**	
7		Increase **field size to 6**	
8		Add task: **sort objects**	
9		Add task: **ADLs**	
10		Add task: **identify nouns**	

Note: New components of each level are indicated in **bold**. DTT = discrete trial training; ADLs = activities of daily living. Field size refers to the number of stimuli in the array for match-to-sample tasks. Levels 8–10 for Milo included up to 10 trials and 27 total instructions of all tasks from previous levels as well as the new task.

occurrence of the FCR (independent or prompted) during the S- interval produced immediate access to the S+ interval for 15–30 s, after which changeover back to the S- interval occurred. For example, Milo's teacher would begin an S- interval by removing Milo's toys, placing them on the red tray, pushing the tray away from him (but within arm's reach), and saying something like "We need to do some work now." When Milo said, "play please," the teacher granted his request (i.e., implemented the S+ interval) by moving the red tray closer to him and telling him that he may play now. FCRs that occurred during the S+ interval were measured but resulted in no programmed consequences. The session continued until 10 component changeovers had been experienced (Grant, Milo) or 10 min had elapsed (Ben).

Milo was the only participant who experienced a second FCT phase in which a more complex FCR was established. During this phase for Milo, the complex FCR "Can I play please?" produced access to the S+; the simple FCR "play please" no longer produced this access. The complex FCR was established using the same prompting method described above. This phase was included for Milo because his team indicated that they preferred his FCR to be a longer utterance. This phase was not included for Grant and Ben because their teams did not indicate that this was a desired goal.

Tolerance response teaching

These sessions were identical to FCT except that only 40% of FCRs produced access to the S+ interval. The remaining 60% of FCRs were denied using various phrases (e.g., "No, you can't play right now," or "No, let's do some work first.") Participants were taught to emit the tolerance response of saying, "okay" following this denial. The tolerance response was then reinforced with access to the S+ interval. For example, if the teacher denied Milo's FCR by saying, "No, let's do some work first," once Milo responded, "okay," the teacher said something like "Thanks for being so flexible about that! You can play now" and provided access to the S+ component. The tolerance response was established for each participant using the same prompting methods described above for establishing the FCR. Each occurrence of the tolerance response (independent or prompted) during the S- interval produced immediate access to the S+ interval for 15–30 s. Tolerance responses that occurred during the S+ interval were measured but resulted in no programmed consequences. The order of trials on which the FCR was granted versus denied was randomized each session, but the ratio of 40% granted and 60% denied remained the same. As with FCT, each session continued until the required number of changeovers was experienced.

Response chaining

These sessions were identical to those in the previous phase except that 60% of S- intervals required that the participant complete some amount of teacher-directed language, academic, leisure, or daily living instructions before accessing the S+ interval. Twenty percent of FCRs continued to produce immediate access to the S+; the remaining 20% of FCRs were denied, and access to the S+ was provided following the tolerance response. We continued to immediately reinforce both the FCR and tolerance response in 20% of trials to ensure that these responses did not contact extinction. For the 60% of trials in which instructions were presented, completion of these instructions then produced access to the S+. For example, when changeover to the S- occurred and Milo said, "Can I play please?" the teacher said something like "Not right now." Milo would then say, "Okay," and the teacher might have then presented a picture matching task. After a certain number of correct responses without stereotypy (e.g., one to three responses), access to the S+ was provided. Trials in which the FCR was granted versus denied were randomized each session, as were trials on which the tolerance response was reinforced or teacher-directed instructions were presented.

The response-chaining phase was divided into levels for each participant, with the amount and complexity of teacher-directed instructions increasing across levels. Table 2 describes these levels for each participant. Each level specified a range of instructions to be completed. The number of instructions presented during any given S- interval was randomized across trials and was never signaled to participants. For example, one S- interval might include three instructions; the next might include 10 instructions. If an inaccurate response occurred (e.g., touching a picture of a cat when asked to identify a fish), the correct response was modeled and the participant was required to perform the correct response before the next instruction was presented. In other words, inaccurate responses were not directly reinforced, even if they occurred without stereotypy. The response-chaining phase continued until the participant met mastery criteria at the terminal level designated by his educational team. Discussions regarding type and number of tasks in each level occurred with relevant stakeholders for each participant at the start of the study, but they were also revisited throughout the study as participants experienced this phase.

Grant's response-chaining levels included moving from mastered tasks to acquisition tasks, increasing the longest consecutive chain of instructions from three to 10, and increasing the total number of instructions presented across the entire session from 12 to 40. Milo's response-chaining levels included increasing the difficulty of tasks from matching pictures to identifying pictures, adding some daily living tasks, increasing the longest consecutive chain of instructions from three to 10, increasing the total number of instructions presented across the entire session from 12 to 27, and systematically increasing the field size of his stimulus array from three to six. After the first four levels of response chaining, Milo's team asked whether all the remaining planned levels were necessary or whether he could skip ahead to Level 7, which involved increasing his stimulus array from three to six. We thus conducted a probe at Level 7. After observing that Milo's accuracy immediately dropped for several sessions, we terminated this probe, returned to Level 4 (a stimulus array of three), and proceeded with the previously planned levels. Ben's response-chaining levels included increasing the amount of each type of task he performed, such as increasing from a five-piece puzzle to a 24-piece puzzle or increasing from typing one word to typing five words. This arrangement was selected based on the preferences of his team to target these specific skills across all response-chaining levels.

Discrimination index

Following the completion of the response-chaining phase, we calculated a discrimination index for motor and vocal stereotypy for each participant to determine the extent to which discriminated responding was occurring. We used the procedures described by Luczynski and Hanley (2014) except that we calculated a conditional duration rather than a conditional rate for stereotypy during each component because we measured stereotypy using duration, not frequency. The discrimination index for each session is expressed as a decimal ranging from 0 to 1, with 0 meaning that all responding was allocated to the S- component, .50 indicating indiscriminate responding (i.e., responding is allocated equally between S- and S+ components), and 1 indicating that all responding was allocated to the S+ component (i.e., perfect discriminated responding). Values of .70 or higher (or .30 or lower) have been used to indicate discriminated responding (e.g., Luczynski & Hanley, 2014).

Social validity survey

Following the completion of the response-chaining phase, a social validity survey was provided to each participant's teachers and to the BCBA supervising Milo's educational program. The survey consisted of a 7-point Likert-type scale with 1 indicating "*strongly disagree*" and 7 indicating "*strongly agree*." Respondents circled a number on the scale to indicate the extent to which they agreed or disagreed with statements about the treatment goals, treatment procedures, and treatment outcomes (e.g., Wolf, 1978). The four statements can be paraphrased as follows: the treatment was acceptable, the amount of behavior change was acceptable, the overall goals of the treatment were acceptable, and I would recommend this treatment to others.

RESULTS

Baseline

Figure 1 depicts the results for Grant, Figure 2 depicts the results for Milo, and Figure 3 depicts the results for Ben. The top panel of each figure depicts stereotypy per minute during the S- and S+ components and indicates for each participant that their stereotypy persisted in the absence of social consequences. The instructional baseline for all participants, denoted by the phase line within the baseline condition, indicated that high levels of stereotypy occurred during both the S- and S+ component. For Grant and Ben, there was no differentiation in stereotypy between S- and S+ components. For Milo, stereotypy during the S- component initially occurred at lower levels than during the S+ component (although still high enough to be interfering) but then increased to near 100% for the final two sessions of his instructional baseline. For all participants, no appropriate mands for stereotypy occurred during the instructional baseline and accuracy with teacher-directed instructions was consistently below the desired minimum of 80%.

Treatment

Stereotypy during the S- interval decreased substantially for all participants across each phase of treatment (FCT, tolerance response teaching, and response chaining). Across the final phase of treatment, stereotypy during the S- interval averaged 3.44% for Grant, .58% for Milo, and

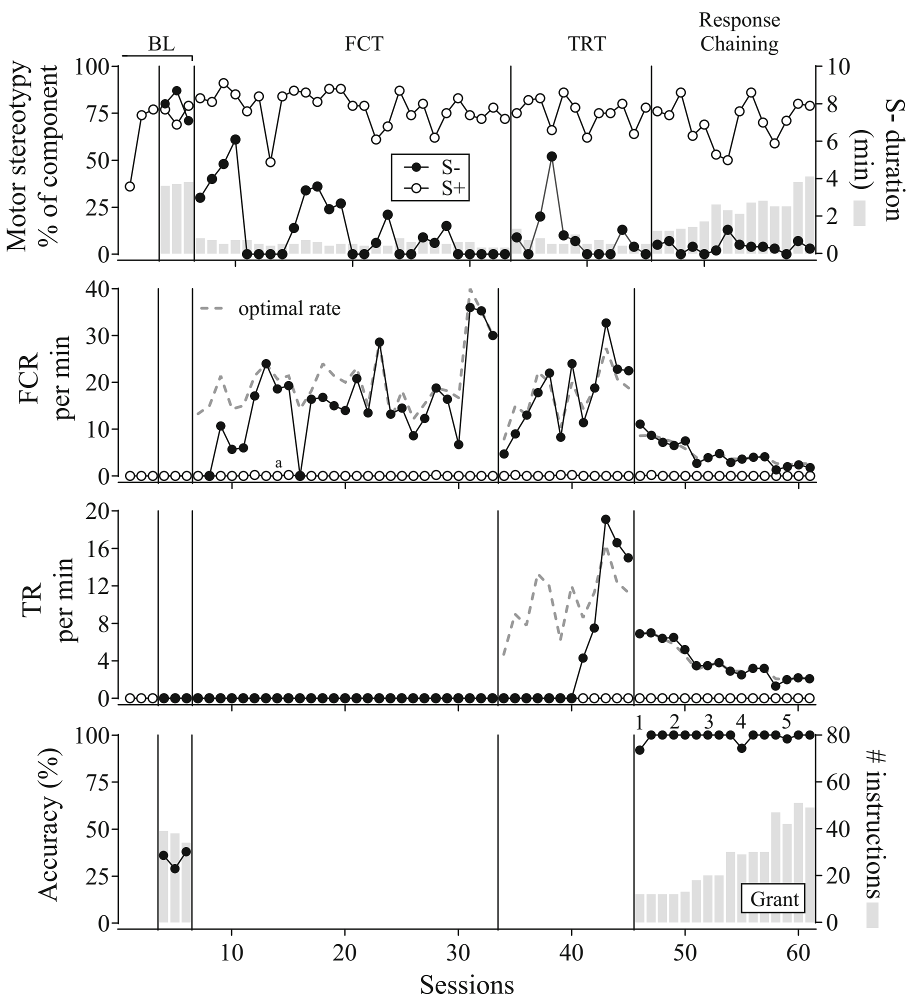

FIGURE 1 Stereotypy, FCR, TR, and percentage accuracy for Grant. The lowercase letter "a" denotes the session at which the FCR definition expanded to include orienting to the teacher. Numbers above data points on the bottom panel indicate response-chaining levels. FCR = functional communication response; TR = tolerance response; BL = baseline; FCT = functional communication training; TRT = tolerance response training; S- = stereotypy is redirected; S+ = stereotypy is permitted.

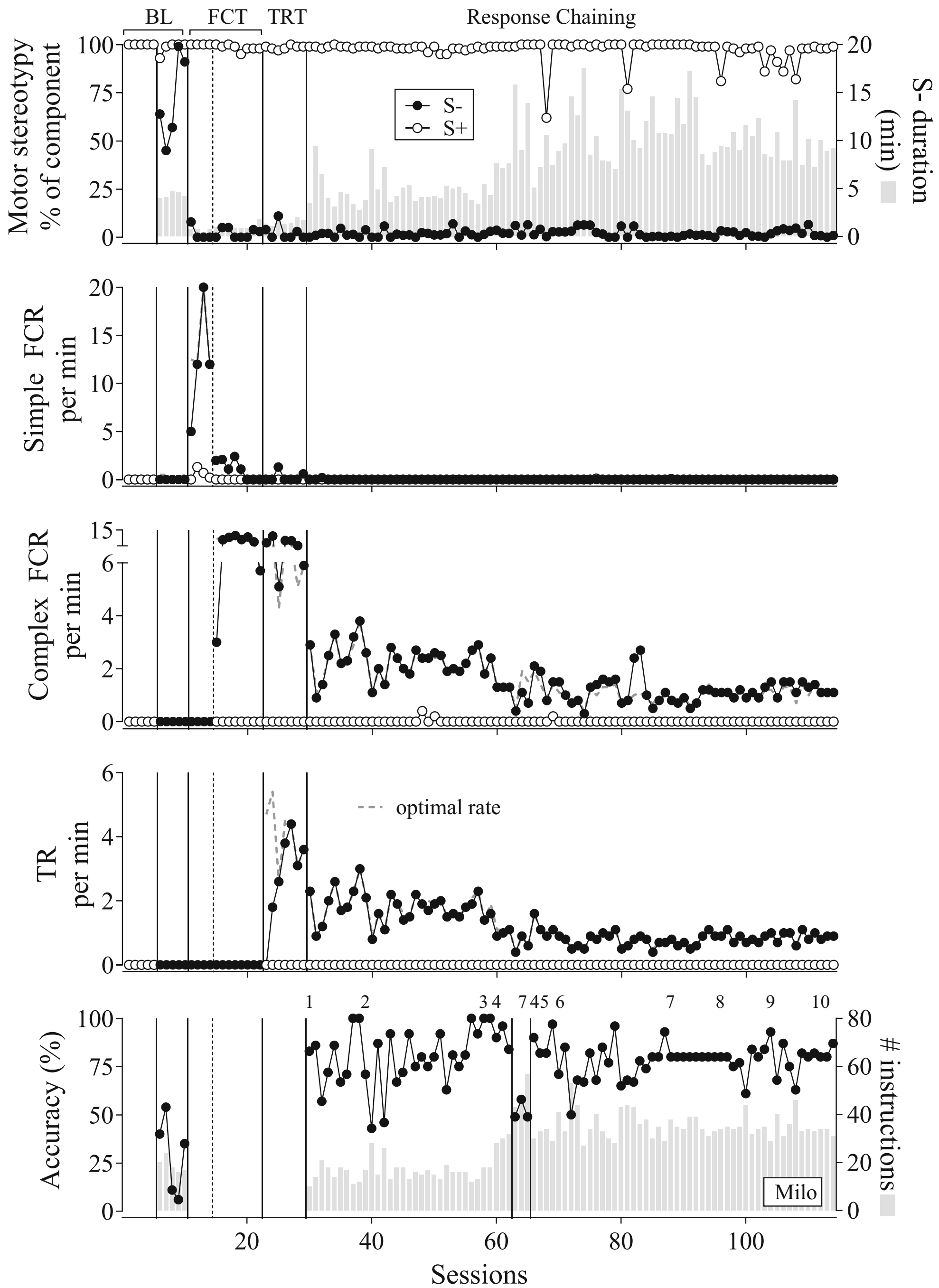

FIGURE 2 Stereotypy, FCR, TR, and percentage accuracy for Milo. Numbers above data points on the bottom panel indicate response chaining levels. The dashed phase line during FCT indicates the introduction of the complex FCR. FCR = functional communication response; TR = tolerance response; BL = baseline; FCT = functional communication training; TRT = tolerance response training; S- = stereotypy is redirected; S+ = stereotypy is permitted.

0% for Ben. When compared with mean levels of stereotypy during the S- interval of the instructional baseline, this represents a decrease of 95.66% for Grant, 99.12% for Milo, and 100% for Ben. In contrast, stereotypy continued to occur and was differentiated during the S+ interval across all treatment phases for each participant.

Figures 1, 2, and 3 show independent FCRs per minute in the second (Grant, Ben) or second and third panels (Milo). All participants acquired the FCR upon the introduction of FCT, and this response persisted at optimal rates during the S- interval across subsequent phases of treatment. During complex FCT for Milo, denoted by the dashed phase line during his FCT condition, the complex FCR was acquired within three sessions. The simple FCR continued to occur initially but eventually dropped to zero rates. FCRs did not occur

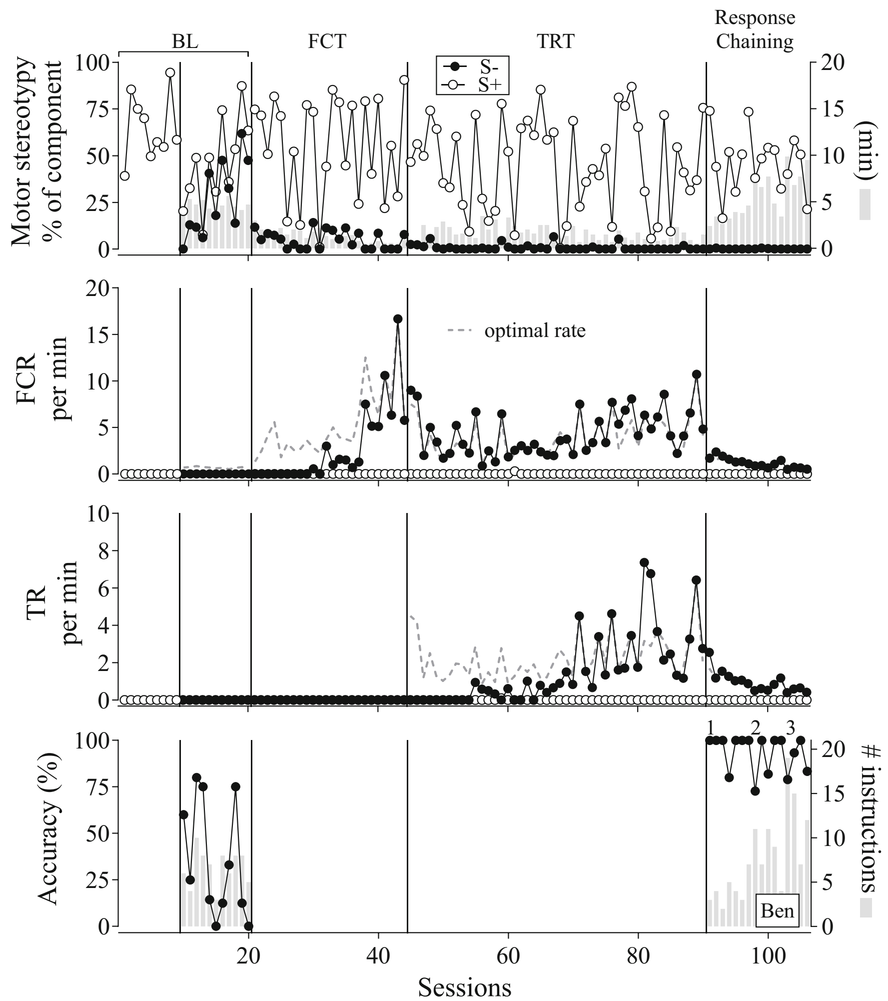

FIGURE 3 Stereotypy, FCR, TR, and percentage of accuracy for Ben. Numbers above data points on the bottom panel indicate response-chaining levels. FCR = functional communication response; TR = tolerance response; BL = baseline; FCT = functional communication training; TRT = tolerance response training; S- = stereotypy is redirected; S+ = stereotypy is permitted.

during any S+ intervals for Grant or Ben; the complex FCR occurred during the S+ interval one time each in three out of 114 sessions for Milo (i.e., a total of three times). This indicates that not only was the FCR acquired for each participant but also stimulus control over it was established such that the response occurred only in the presence of the relevant establishing operation.

Figures 1, 2, and 3 show independent tolerance responses per minute in the third (Grant, Ben) or fourth panel (Milo). All participants acquired the tolerance response upon introduction of tolerance response teaching, and this response persisted at optimal rates during the S- interval across the response-chaining phase. The tolerance response did not occur during any S+ interval for any participant, indicating stimulus control over this response as well. As the number of instructions presented during the response-chaining phase increased, the rate of FCRs and tolerance responses decreased as an artifact of longer S- durations. The average S- duration across the final level of response chaining was 3.83 min for Grant (increased from 0.67 min during FCT), 9.35 min for Milo (increased from 0.72 min during FCT), and 8.48 min for Ben (increased from 1.29 min during FCT).

Accuracy with teacher-directed instructions increased to consistently high levels during response chaining, indicating that participants acquired new skills that they had not demonstrated during their instructional baseline and that their teachers had reported they had difficulty acquiring. Grant experienced five response-chaining levels, and his accuracy increased from an average of 29.80% during baseline to 98.46% across response chaining. Milo experienced 10 response-chaining levels, and his accuracy increased from an average of 29.36% during baseline to 82.37% across the final response-chaining level. Ben experienced three response-chaining levels, and his accuracy increased from an average of 35.21% during baseline to 93.13% across response chaining.

Discrimination index

Figure 4 displays the discrimination index for motor stereotypy for each session for each participant. For all three participants, the discrimination indices during baseline indicated indiscriminate responding: Grant's average was .45, Milo's average was .58, and Ben's average was .67, with a decreasing trend. Upon the introduction of FCT, each participant's discrimination index increased to consistently higher levels, indicating that responding had become discriminated. The average discrimination index across the final level of response chaining was .97 for Grant, 1 for Milo, and 1 for Ben. Figure 5 displays the discrimination index for vocal stereotypy for each participant. Although there were no programmed contingencies for vocal stereotypy, we observed an increase in the mean discrimination index for each participant, consistent with discriminative control. Grant's mean discrimination index for vocal stereotypy increased from .34 in baseline to .99 across all treatment phases; Milo's mean increased from .39 in baseline to .74 across all phases of treatment; Ben's mean increased from .50 in baseline to .91 across all treatment phases.

Social validity survey

Table 3 depicts the results of each participants' social validity questionnaire. The respondents endorsed scores of 6 or 7 ($M = 6.75$) for the acceptability of the treatment goals, indicating that they agreed or strongly agreed that the goals were acceptable and appropriate for the individual. For the acceptability of the treatment, all respondents endorsed scores of seven, indicating that they strongly agreed that the treatment was acceptable and they would recommend it to other therapists or providers. For amount of behavior change, the respondents endorsed scores of 6 or 7 ($M = 6.50$), indicating that they agreed or strongly agreed that the amount of behavior change was acceptable. The mean score across all items was 6.81.

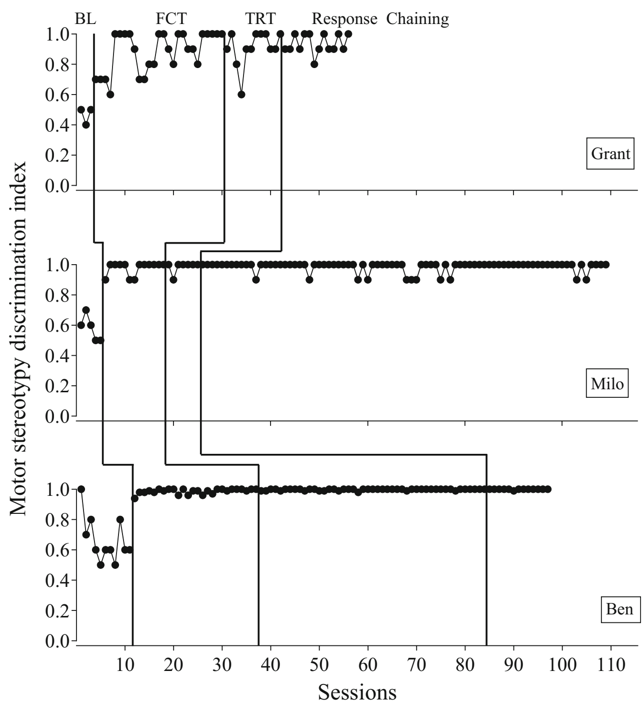

FIGURE 4 Motor stereotypy discrimination index for Grant, Milo, and Ben. A discrimination index of .70–1.0 indicates discriminated responding. BL = baseline; FCT = functional communication training; TRT = tolerance response training.

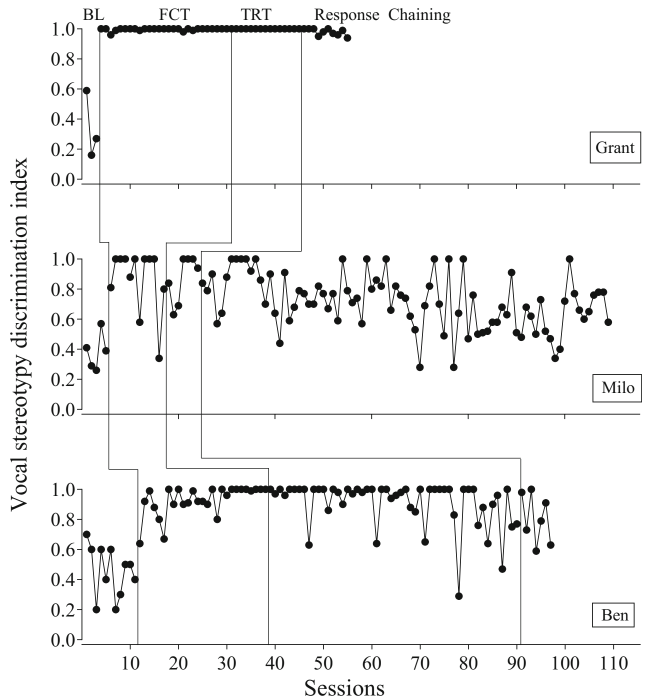

FIGURE 5 Vocal stereotypy discrimination index for Grant, Milo, and Ben. A discrimination index of .70–1.0 indicates discriminated responding. BL = baseline; FCT = functional communication training; TRT = tolerance response training.

DISCUSSION

Motor and vocal stereotypy were reduced during instructional periods while establishing mands for stereotypy, tolerating denials of this mand, and increasing accurate responding to teacher-directed instructions. Prior to intervention, participants did not demonstrate the targeted communication skills or accurately perform the language, academic, leisure, and daily living skills selected by their educational teams. Their high-rate stereotypy interfered with their education, and discrimination indices showed that all participants were engaging in indiscriminate responding during baseline. By the end of treatment, each participant had acquired new skills, was experiencing the amount of instructional time nominated by his educational

TABLE 3 Social validity results.

Question	Score			
	Grant	Milo R1	Milo R2	Ben
1. The treatment that involved teaching a request for stereotypy, teaching an appropriate response to the denial of that request, and teaching the individual to complete an increasing number of demands before accessing stereotypy was acceptable.	7	7	7	7
2. The amount of behavior change (i.e., the effects of the treatment) was acceptable.	6	7	7	6
3. The overall goals of this treatment were acceptable, appropriate, and important for the individual.	7	7	7	6
4. I would recommend this treatment package to other therapists or providers who are attempting to decrease stereotypy and increase appropriate engagement.	7	7	7	7

Note: The scale was 1 to 7 (1 = *strongly disagree*; 7 = *strongly agree*). R1 = Rater 1 and refers to Milo's 1:1 therapist; R2 = Rater 2 and refers to Milo's Board Certified Behavior Analyst.

team as the terminal goal, and was reliably allocating stereotypy to S+ intervals (i.e., discriminative control was established). The intervention and its outcomes were also socially validated by relevant stakeholders. In summary, we shifted response allocation of stereotypy such that it no longer interfered with instruction and we used contingent access to stereotypy to teach skills across a variety of domains including communication, language, and social skills.

The intervention described here combines the treatment package for socially mediated challenging behavior reported by Hanley et al. (2014) with the chained schedule treatment for stereotypy described by Slaton and Hanley (2016). These results demonstrate the efficacy of FCT as a function-based treatment for noninjurious stereotypy. However, these results also have important implications for the broader autism treatment literature: Conditional high-rate stereotypy need not interfere with skill acquisition. It is possible to design interventions that incorporate contingent time for stereotypy while teaching skills across multiple domains. This is not to suggest that this treatment package can or should eliminate features of autism or change the functional skill profile of any autistic person—but these outcomes do suggest that instead of viewing high-rate stereotypy as an undesirable response to be eliminated, contingent application of access to stereotypy can instead be a treatment component that produces meaningful skill acquisition where other reinforcers have failed. Our participants acquired one or two skills each in multiple domains. By the end of treatment, they were consistently responding with a high percentage of accuracy to tasks that they did not perform accurately in baseline. However, the extent to which this treatment package can produce more comprehensive acquisition of skills within each domain remains an empirical question.

Establishing discriminative control over stereotypy is an important outcome because it can make intervention more feasible in less controlled environments and with less intensive monitoring (see Kliebert et al., 2011). Slaton and Hanley (2016) found that stimulus control over stereotypy was established when contingent access was provided (a chained schedule) but not when noncontingent access was provided (a multiple schedule). The current study provides another example of stimulus control over stereotypy established with contingent access and correlated stimuli. There is evidence that individuals tend to prefer contingent reinforcement to noncontingent reinforcement (e.g., Hanley et al., 1997; Luczynski & Hanley, 2009, 2010, 2014; Potter et al., 2013; Slaton & Hanley, 2016). We did not evaluate participants' preference for treatment, but this is a potential area for future research.

It is interesting to note that discriminative control over vocal stereotypy was established without placing any direct contingencies on it. This suggests that it may be possible to shift allocation of vocal stereotypy by targeting motor stereotypy. There are several reasons why control over vocal stereotypy could have been established without direct intervention. One is that vocal stereotypy can co-occur with motor stereotypy. Rapp (2008) provided a review of studies evaluating conjugate reinforcement arrangements and suggested that some types of behavior–behavior relations are particularly relevant to stereotypy. The topographies of stereotypy potentially covary when they are physiologically related or when they are maintained by the same automatic reinforcers (see also Austin & Wilson, 2002). For example, the combined products of two topographies could produce higher quality reinforcement than each response alone (e.g., tapping an object in rhythm with a series of humming noises could be more enjoyable than tapping by itself and humming by itself). In cases where motor and vocal stereotypy covary as part of a behavior–behavior relation, it is likely that shifting response allocation of motor stereotypy would also shift response allocation of vocal stereotypy. It is also possible that the treatment package described here has generality to other topographies of stereotypy (regardless of whether they naturally covary). An important area of future research will be to replicate these findings with respect to vocal stereotypy and to investigate the mechanism by which treating motor stereotypy may also affect vocal stereotypy. Likewise, it will also be important to evaluate this treatment package when directly applied to vocal stereotypy in cases in which vocal stereotypy is the primary referring concern or when a change in response allocation of motor stereotypy does not produce satisfactory changes in vocal stereotypy.

Another area for future research would be to evaluate this treatment package with individuals for whom redirection to another activity is reported to evoke challenging behavior. A parametric analysis would be helpful as well to determine what "dosage" of redirection is necessary to achieve meaningful reductions in stereotypy and establish discriminative control. Kliebert et al. (2011) found that even short delays in redirecting produced deleterious treatment effects, although this was not evaluated within the context of correlated stimuli and contingent access. Future research should also examine the individual contributions of each of component of the current treatment package (i.e., a component analysis).

One limitation of the current study is that we did not measure topographies of motor stereotypy that were not specifically targeted (e.g., eye movements for Milo). It is possible that as targeted topographies were reduced, other topographies increased (see Rapp et al., 2013). The increase in accuracy with teacher-directed tasks, however, would suggest that even if nontargeted topographies increased, they did not interfere with skill acquisition. Grant and Milo's teams reported that after the conclusion of the study, the intervention was successfully transferred to their classrooms with their typical 1:1 therapists or paraprofessional staff. However, we did not directly measure this implementation to determine whether the treatment effects were maintained.

A second and important limitation of this study is that some topographies of stereotypy can be injurious (e.g., skin picking that produces abrasions), infringe on someone else's personal space or belongings (e.g., ritualistic arranging of other people's personal belongings), or be unsanitary (e.g., licking surfaces). The treatment package described here relies on participants engaging in stereotypy during certain periods and thus does not have generality to topographies that are injurious or contextually inappropriate. However, researchers and practitioners could apply this treatment to safe topographies of stereotypy while redirecting injurious, dangerous, or unsanitary topographies across both S- and S+ intervals; whether such an arrangement produces similar efficacy is an empirical question to be answered.

When determining whether to intervene on stereotypy, it is important to consider the values expressed in Bannerman et al. (1990) and Van Houten et al. (1988): Individuals have the right to effective treatment that teaches functional skills as well as the right to choose their reinforcers and how they spend their leisure time. This includes the right to engage in safe stereotypy. Sometimes, however, an individual's choices may be at odds with effective treatment (e.g., an individual may choose to engage in stereotypy to the exclusion of all other responses). By teaching individuals to engage in stereotypy during free time and refrain from it during instructional times, the intervention described here can balance the right to engage in stereotypy with the right to receive effective treatment.

AUTHOR CONTRIBUTIONS

The first author contributed to the conceptualization, methodology, and supervision of the study, collected data, prepared visual displays of data, and wrote most of the original draft manuscript and subsequent revisions. The second author served as the project administrator, was the primary contributor to the conceptualization, methodology, and supervision of the study, wrote portions of the original draft, and revised and edited the manuscript. The third author collected data and wrote portions of the original draft manuscript for one participant, in partial fulfilment of the requirements for a master's degree in applied behavior analysis under the supervision of the second author. The fourth author contributed to conceptualization, methodology, and supervision, collected data, and provided revisions and revisions to the manuscript. The fifth, sixth, and seventh authors conducted sessions and collected data.

ACKNOWLEDGMENTS

Dedicated to the memory of Marjorie Kimball "Kimmy" Clark (1977-2023), colleague, collaborator, and friend. Kimmy's care for those she served was unwavering.

CONFLICT OF INTEREST STATEMENT

The authors have no conflict of interest to declare.

The second and fourth authors are now affiliated with FTF Behavioral Consulting, which provides paid training in the approach described in this article. However, at the time the study was conducted, both authors were at Western New England University and were not affiliated with FTF.

DATA AVAILABILITY STATEMENT

Data are available upon reasonable request from the first author.

ETHICS APPROVAL

Approval for research with human participants was obtained from the Institutional Review Board at Western New England University prior to beginning the study. Informed consent was obtained from parents of each participant before they participated in the study.

ORCID

Jessica D. Slaton https://orcid.org/0000-0002-3416-2038

Kelsey W. Ruppel https://orcid.org/0000-0002-6800-8485

REFERENCES

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). American Psychiatric Association.

Austin, J., & Wilson, K. G. (2002). Response-response relationships in organizational behavior management. *Journal of Organizational Behavior Management*, *21*(4), 39–53. https://doi.org/10.1300/J075v21n04_04

Bannerman, D. J., Sheldon, J. B., Sherman, J. A., & Harchik, A. E. (1990). Balancing the right to habilitation with the right to personal liberties: The rights of people with developmental disabilities to eat too many doughnuts and take a nap. *Journal of Applied Behavior Analysis*, *23*(1), 79–89. https://doi.org/10.1901/jaba.1990.23-79

Beaulieu, L., Van Nostrand, M. E., Williams, A. L., & Herscovitch, B. (2018). Incorporating interview-informed functional analyses into practice. *Behavior Analysis in Practice*, *11*(4), 385–389. https://doi.org/10.1007/s40617-018-0247-7

Bodfish, J. W., Symans, F. J., Parker, D. E., & Lewis, M. H. (2000). Varieties of repetitive behavior in autism: Comparisons to mental retardation. *Journal of Autism and Developmental Disorders*, *30*(3), 237–243. https://doi.org/10.1023/A:1005596502855

Briggs, A. M., Fisher, W. W., Greer, B. D., Kimball, R. T. (2018). Prevalence of resurgence of destructive behavior when thinning reinforcement schedules during functional communication training. *Journal of Applied Behavior Analysis*, *51*(3), 620–633. https://doi.org/10.1002/jaba.472

Britton, L. N., Carr, J. E., Landaburu, H. J., & Romick, K. S. (2002). The efficacy of noncontingent reinforcement as treatment for automatically reinforced stereotypy. *Behavioral Interventions*, *17*(2), 93–103. https://doi.org/10.1002/bin.110

Carr, E. G., & Durand, V. M. (1985). Reducing behavior problems through functional communication training. *Journal of Applied Behavior Analysis*, *18*(2), 111–126. https://doi.org/10.1901/jaba.1985.18-111

Charlop, M. H., Kurtz, P. F., & Casey, F. G. (1990). Using aberrant behaviors as reinforcers for autistic children. *Journal of Applied Behavior Analysis*, *23*(2), 163–181. https://doi.org/10.1901/jaba.1990.23-163

Charlton, R. A., Entecott, T., Belova, E., & Nwaordu, G. (2021). 'It feels like holding back something you need to say': Autistic and non-autistic adults experiences of sensory experiences and stimming. *Research in Autism Spectrum Disorders*, *89*, Article 101864. https://doi.org/10.1016/j.rasd.2021.101864

Conroy, M. A., Asmus, J. M., Sellers, J. A., & Ladwig, C. N. (2005). The use of an antecedent-based intervention to decrease stereotypic behavior in a general education classroom: A case study. *Focus on Autism and Other Developmental Disabilities*, *20*(4), 223–230. https://doi.org/10.1177/10883576050200040401

Cook, J., & Rapp, J. (2018). To what extent do practitioners need to treat stereotypy during academic tasks? *Behavior Modification*, *44*(2), 228–264. https://doi.org/10.1177/0145445518808226

Coon, J. C., & Rapp, J. T. (2020). Brief report: Evaluating college students' perceptions of a child displaying stereotypic behaviors: Do changes in stereotypy levels affect ratings? *Journal of Autism and Developmental Disorders*, *50*(5), 1827–1833. https://doi.org/10.1007/s10803-019-03916-2

Cunningham, A. B., & Schreibman, L. (2008). Stereotypy in autism: The importance of function. *Research in Autism Spectrum Disorders*, *2*(3), 469–479. https://doi.org/10.1016/j.rasd.2007.09.006

DiGennaro Reed, F. D., Hirst, J. M., & Hyman, S. R. (2012). Assessment and treatment of stereotypic behavior in children with autism and other developmental disabilities: A thirty year review. *Research in Autism Spectrum Disorders*, *6*(1), 422–430. https://doi.org/10.1016/j.rasd.2011.07.003

Doughty, S. S., Anderson, C. M., Doughty, A. H., Williams, D. C., & Saunders, K. J. (2007). Discriminative control of punished stereotyped behavior in humans. *Journal of the Experimental Analysis of Behavior*, *87*(3), 325–336. https://doi.org/10.1901/jeab.2007.39-05

Dunlap, G., Dyer, K., & Koegel, R. L. (1983). Autistic self-stimulation and intertrial interval duration. *American Journal of Mental Deficiency*, *88*(2), 194–202. PMID: 6638081

Edwards, C. K., Landa, R. K., Frampton, S. E., & Shillingsburg, M. A. (2018). Increasing functional leisure engagement for children with autism using backward chaining. *Behavior Modification*, *42*(1), 9–33. https://doi.org/10.1177/0145445517699929

Enloe, K. A., & Rapp, J. T. (2014). Effects of noncontingent social interaction on immediate and subsequent engagement in vocal and motor stereotypy in children with autism. *Behavior Modification*, *38*(3), 374–391. https://doi.org/10.1177/0145445513514081

Falcomata, T. S., Roane, H. S., Feeney, B. J., & Stephenson, K. M. (2010). Assessment and treatment of elopement maintained by access to stereotypy. *Journal of Applied Behavior Analysis*, *43*(2), 513–517. https://doi.org/10.1901/jaba.2010.43-513

Falcomata, T. S., Roane, H. S., Muething, C. S., Stephenson, K. M., & Ing, A. D. (2012). Functional communication training and chained schedules of reinforcement to treat challenging behavior maintained by terminations of activity interruptions. *Behavior Modification*, *36*(5), 630–649. https://doi.org/10.1177/0145445511433821

Fiani, T., & Jessel, J. (2022). Practical functional assessment and behavioral treatment of challenging behavior for clinically based outpatient services: A consecutive case series evaluation. *Education and Treatment of Children*, *45*(2), 211–230. https://doi.org/10.1007/s43494-022-00071-9

Ghaemmaghami, M., Hanley, G. P., & Jessel, J. (2016). Contingencies promote delay tolerance. *Journal of Applied Behavior Analysis*, *49*(3), 548–575. https://doi.org/10.1002/jaba.333

Giles, A. F., Peter, C. C. S., Pence, S. T., & Gibson, A. B. (2012). Preference for blocking or response redirection during stereotypy treatment. *Research in Developmental Disabilities*, *33*(6), 1691–1700. https://doi.org/10.1016/j.ridd.2012.05.008

Goldman, S., Wang, C., Salgado, M. W., Greene, P. E., Kim, M., & Rapin, I. (2008). Motor stereotypies in children with autism and other developmental disorders. *Developmental Medicine & Child Neurology*, *51*(1), 30–38. https://doi.org/10.1111/j.1469-8749.2008.03178.x

Gover, H. C., Fahmie, T. A., & McKeown, C. A. (2019). A review of environmental enrichment as treatment for problem behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis*, *52*(1), 299–314. https://doi.org/10.1002/jaba.508

Greer, B. D., Fisher, W. W., Saini, V., Owen, T. M., & Jones, J. K. (2016). Functional communication training during reinforcement schedule thinning: An analysis of 25 applications. *Journal of Applied Behavior Analysis*, *49*(1), 105–121. https://doi.org/10.1002/jaba.265

Hagopian, L.P., Boelter, E. W., & Jarmolowicz, D. P. (2011). Reinforcement schedule thinning following functional communication training: Review and recommendations. *Behavior Analysis in Practice*, *4*(1), 4–16. https://doi.org/10.1007/BF03391770

Hagopian, L. P., Fisher, W. W., Sullivan, M. T., Acquisto, J., & LeBlanc, L. (1998). Effectiveness of functional communication training with and without extinction and punishment: A summary of 21 inpatient cases. *Journal of Applied Behavior Analysis*, *31*(2), 211–235. https://doi.org/10.1901/jaba.1998.31-211

Hagopian, L. P., & Toole, L. M. (2009). Effects of response blocking and competing stimuli on stereotypic behavior. *Behavioral Interventions*, *24*(2), 117–125. https://doi.org/10.1002/bin.278

Hagopian, L. P., Toole, L. M., Long, E. S., Bowman, L. G., & Lieving, G. A. (2004). A comparison of dense-to-lean and fixed lean schedules of alternative reinforcement and extinction. *Journal of Applied Behavior Analysis*, *37*(3), 323–337. https://doi.org/10.1901/jaba.2004.37-323

Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis*, *36*(2), 147–185. https://doi.org/10.1901/jaba.2003.36-147

Hanley, G. P., Iwata, B. A., & Thompson, R. H. (2001). Reinforcement schedule thinning following treatment with functional communication training. *Journal of Applied Behavior Analysis*, *34*(1), 17–38. https://doi.org/10.1901/jaba.2001.34-17

Hanley, G. P., Iwata, B. A., Thompson, R. H., & Lindberg, J. S. (2000). A component analysis of "stereotypy as reinforcement" for alternative behavior. *Journal of Applied Behavior Analysis*, *33*(3), 285–297. https://doi.org/10.1901/jaba.2000.33-285

Hanley, G. P., Jin, C. S., Vanselow, N. R., & Hanratty, L. A. (2014). Producing meaningful improvements in problem behavior of children with autism via synthesized analyses and treatments. *Journal of Applied Behavior Analysis*, *47*(1), 16–36. https://doi.org/10.1002/jaba.106

Hanley, G. P., Piazza, C. C., Fisher, W. W., Contrucci, S. A., & Maglieri, K. A. (1997). Evaluation of client preference for function-based treatment packages. *Journal of Applied Behavior Analysis*, *30*(3), 459–473. https://doi.org/10.1901/jaba.1997.30-459

Hausman, N., Kahng, S., Farrell, E., & Mongeon, C. (2009). Idiosyncratic functions: Severe problem behavior maintained by access to ritualistic behaviors. *Education and Treatment of Children*, *32*(1), 77–87. https://doi.org/10.1353/etc.0.0051

Herman, C., Healy, O., & Lydon, S. (2018). An interview-informed synthesized contingency analysis to inform the treatment of challenging behavior in a young child with autism. *Developmental Neurorehabilitation*, *21*(3), 202–207. https://doi.org/10.1080/17518423.2018.1437839

Higbee, T. S., Chang, S., & Endicott, K. (2005). Noncontingent access to preferred sensory stimuli as a treatment for automatically reinforced stereotypy. *Behavioral Interventions*, *20*(3), 177–184. https://doi.org/10.1002/bin.190

Horner, R. D. (1980). The effects of an environmental "enrichment" program on the behavior of institutionalized profoundly retarded children. *Journal of Applied Behavior Analysis*, *13*(3), 473–491. https://doi.org/10.1901/jaba.1980.13-473

Jessel, J., Ingvarsson, E. T., Metras, R., Kirk, H., & Whipple, R. (2018). Achieving socially significant reductions in problem behavior following the interview-informed synthesized contingency analysis: A summary of 25 outpatient applications. *Journal of Applied Behavior Analysis*, *51*(1), 130–157. https://doi.org/10.1002/jaba.436

Kapp, S. K., Steward, R., Crane, L., Elliot, D., Elphick, C., Pellicano, E., & Russell, G. (2019). 'People should be allowed to do what they like': Autistic adults' views and experiences of stimming. *Autism*, *23*(7), 1782–1792. https://doi.org/10.1177/1362361319829628

Kliebert, M. L., Tiger, J. H., & Toussaint, K. A. (2011). An approach to identifying the conditions under which response interruption will reduce automatically reinforced problem behavior. *Behavior Analysis in Practice*, *4*(2), 17–26. https://doi.org/10.1007/BF03391771

Lalli, J. S., Casey, S., & Kates, K. (1995). Reducing escape behavior and increasing task completion with functional communication training, extinction, and response chaining. *Journal of Applied Behavior Analysis*, *28*(3), 261–268. https://doi.org/10.1901/jaba.1995.28-261

Lang, R., O'Reilly, M., Sigafoos, J., Machalicek, W., Rispoli, M., Lancioni, G. E., Aguilar, J., & Fragale, C. (2010). The effects of an abolishing operation intervention component on play skills, challenging behavior, and stereotypy. *Behavior Modification*, *34*(4), 267–289. https://doi.org/10.1177/0145445510370713

Langone, S. R., Luiselli, J. K., & Hamill, J. (2013). Effects of response blocking and programmed stimulus control on motor stereotypy: A pilot study. *Child & Family Behavior Therapy*, *35*(3), 249–255. https://doi.org/10.1080/07317107.2013.818906

Lanovaz, M. J., Robertson, K. M., Soerono, K., & Watkins, N. (2013). Effects of reducing stereotypy on other behaviors: A systematic review. *Research in Autism Spectrum Disorders*, *7*(10), 1234–1243. https://doi.org/10.1016/j.rasd.2013.07.009

Lerman, D. C., Kelley, M. E., Vorndran, C. M., & Van Camp, C. M. (2003). Collateral effects of response blocking during the treatment of stereotypic behavior. *Journal of Applied Behavior Analysis*, *36*(1), 119–123. https://doi.org/10.1901/jaba.2003.36-119

Lindberg, J. S., Iwata, B. A., Roscoe, E. M., Worsdell, A. S., & Hanley, G. P. (2003). Treatment efficacy of noncontingent reinforcement during brief and extended application. *Journal of Applied Behavior Analysis*, *36*(1), 1–19. https://doi.org/10.1901/jaba.2003.36-1

Luczynski, K. C., & Hanley, G. P. (2009). Do children prefer contingencies? An evaluation of the efficacy of and preference for contingent versus noncontingent social reinforcement during play. *Journal of Applied Behavior Analysis*, *42*(3), 511–525. https://doi.org/10.1901/jaba.2009.42-511

Luczynski, K. C., & Hanley, G. P. (2010). Examining the generality of children's preferences for contingent reinforcement via extension to different responses, reinforcers, and schedules. *Journal of Applied Behavior Analysis*, *43*(3), 397–409. https://doi.org/10.1901/jaba.2010.43-397

Luczynski, K. C., & Hanley, G. P. (2014). How should periods without social interaction be scheduled? Children's preference for practical schedules of positive reinforcement. *Journal of Applied Behavior Analysis*, *47*(3), 500–522. https://doi.org/10.1002/jaba.140

MacDonald, R., Green, G., Mansfield, R., Geckeler, A., Gardenier, N., & Anderson, J. (2007). Stereotypy in young children with autism and typically developing children. *Research in Developmental Disabilities*, *28*(3), 266–277. https://doi.org/10.1016/j.ridd.2006.01.004

Metras, R. L., Hanley, G. P., & Carbone, M. J. (2023). Distance-based collaboration for assessing and treating challenging behavior. *Journal of Autism and Developmental Disorders*, *54*(10), 3587–3604. https://doi.org/10.1007/s10803-023-06085-5

Melanson, I. J., & Fahmie, T. A. (2023). Functional analysis of problem behavior: A 40-year review. *Journal of Applied Behavior Analysis*, *56*(1), 262–281. https://doi.org/10.1002/jaba.983

Morris, I. F., Sykes, J. R., Paulus, E. R., Dameh, A., Razzaque, A., Vander Esch, L., Gruenig, J., & Zelazo, P. D. (2025). Beyond self-regulation: Autistic experiences and perceptions of stimming. *Neurodiversity*, *3*. https://doi.org/10.1177/27546330241311096

Muething, C. S., Falcomata, T. S., Ferguson, R., Swinnea, S., & Shpall, C. (2018). An evaluation of delay to reinforcement and mand variability during functional communication training. *Journal of Applied Behavior Analysis*, *51*(2), 263–275. https://doi.org/10.1002/jaba.441

Potter, J. N., Hanley, G. P., Augustine, M., Clay, C. J., & Phelps, M. C. (2013). Treating stereotypy in adolescents diagnosed with autism by refining the tactic of "using stereotypy as reinforcement." *Journal of Applied Behavior Analysis*, *46*(2), 407–423. https://doi.org/10.1002/jaba.52

Querim, A. C., Iwata, B. A., Roscoe, E. M., Schlichenmeyer, K. J., Virués Ortega, J., & Hurl, K. E. (2013). Functional analysis screening for problem behavior maintained by automatic reinforcement. *Journal of Applied Behavior Analysis*, *46*(1), 47–60. https://doi.org/10.1002/jaba.26

Rapp, J. T. (2008). Conjugate reinforcement: A brief review and suggestions for applications to the assessment of automatically reinforced behavior. *Behavioral Interventions*, *23*(2), 113–136. https://doi.org/10.1002/bin.259

Rapp, J. T., Swanson, G., Sheridan, S. M., Enloe, K. A., Maltese, D., Sennott, L. A., Shrader, L., Carroll, R. A., Richling, S. M, Long, E. S., & Lanovaz, M. J. (2013). Immediate and subsequent effects of matched and unmatched stimuli on targeted vocal stereotypy and untargeted motor stereotypy. *Behavior Modification*, *37*(4), 543–567. https://doi.org/10.1177/0145445512461650

Reid, D. H., Parsons, M. B., Phillips, J. F., & Green, C. W. (1993). Reduction of self-injurious hand mouthing using response blocking. *Journal of Applied Behavior Analysis*, *26*(1), 139–140. https://doi.org/10.1901/jaba.1993.26-139

Roscoe, E. M., Iwata, B. A., & Zhou, L. (2013). Assessment and treatment of chronic hand mouthing. *Journal of Applied Behavior Analysis*, *46*(1), 181–198. https://doi.org/10.1002/jaba.14

Slaton, J. D., Davis, M., DePetris, D. A., Raftery, K. J., Daniele, S., & Caruso, C. M. (2024). Long-term effectiveness and generality of practical functional assessment and skill-based treatment. *Journal of Applied Behavior Analysis*, *57*(3), 635–656. https://doi.org/10.1002/jaba.1090

Slaton, J. D., & Hanley, G. P. (2016). Effects of multiple versus chained schedules on stereotypy and item engagement. *Journal of Applied Behavior Analysis*, *49*(4), 1–20. https://doi.org/10.1002/jaba.345

Staubitz, J. L., Staubitz, J. E., Pollack, M. S., Haws, R. A., & Hopton, M. (2022). Effects of an enhanced choice model of skill-based treatment for students with emotional/behavioral disorders. *Journal of Applied Behavior Analysis*, *55*(4), 1306–1341. https://doi.org/10.1002/jaba.952

Tiger, J. H., Hanley, G. P., & Bruzek, J. (2008). Functional communication training: A review and practical guide. *Behavior Analysis in Practice*, *1*(1), 16–23. https://doi.org/10.1007/BF03391716

Tiger, J. H., Wierzba, B. C., Fisher, W. W., & Benitez, B. B. (2017). Developing and demonstrating inhibitory stimulus control over repetitive behavior. *Behavioral Interventions*, *32*(2), 169–174. https://doi.org/10.1002/bin.1472

Van Houten, R., Axelrod, S., Bailey, J. S., Favell, J. E., Foxx, R. M., Iwata, B. A., & Lovaas, O. I. (1988). The right to effective behavioral treatment. *Journal of Applied Behavior Analysis*, *21*(4), 381–384. https://doi.org/10.1901/jaba.1988.21-381

Vollmer, T. R. (1994). The concept of automatic reinforcement: Implications for behavioral research in developmental disabilities. *Research in Developmental Disabilities*, *15*(3), 187–207. https://doi.org/10.1016/0891-4222(94)90011-6

Wolf, M. (1978). Social validity: The case for subjective measurement, or how applied behavior analysis is finding its heart. *Journal of Applied Behavior Analysis*, *11*(2), 203–214. https://doi.org/10.1901/jaba.1978.11-203

Zangrillo, A. N., Fisher, W. W., Greer, B. D., Owen, T. M., & DeSouza, A. A. (2016). Treatment of escape-maintained challenging behavior using chained schedules: An evaluation of the effectives of thinning positive plus negative reinforcement during functional communication training. *International Journal of Developmental Disabilities*, *62*(3), 147–156. https://doi.org/10.1080/20473869.2016.1176308

How to cite this article: Slaton, J. D., Hanley, G. P., Gage, E. E., Ruppel, K. W., Raftery, K. J., Clark, M. K., & Caruso, C. M. (2025). Skill-based treatment of interfering stereotypy. *Journal of Applied Behavior Analysis*, 1–17. https://doi.org/10.1002/jaba.70023