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Increasing behavior incompatible with catatonia in a young adolescent girl with autism spectrum disorder

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ABSTRACT

Catatonia is a syndrome of motor disturbances and is characterized as a cluster of abnormalities in speech, movement and overall behavior. A common treatment of catatonic symptoms is lorazepam and/or electroconvulsive therapy. Only three papers were found that reportedly used behavioral interventions. Nevertheless, treatment procedures were often partially described, and outcomes were often based on clinician impressions, as opposed to objective measures. The following is an experimental analysis of the effects of a prompt-fading behavioral treatment package on the daily living skills of an adolescent girl with autism spectrum disorder and catatonia. Data were collected on the completion of four activities: blow drying hair; using a hair barrette; vacuuming a rug; and using a paper shredder. Initially, following the verbal direction to engage in the target activity, the instructor provided full manual guidance to assist the participant to complete each component response in the task analysis. Over time, manual prompts were faded. A functional relation between prompt fading and the percentage of independent responses completed across four activities was demonstrated in this paper. As manual prompts were systematically faded, independent responding emerged. Future researchers will want to investigate the effectiveness of prompt fading across different educational settings and across different individuals with similar profiles or with more or less severe symptoms of catatonia.

1. Introduction

Catatonia is a syndrome of motor disturbances (Wilcox & Duffy, 2015) and is characterized as a cluster of abnormalities in speech, movement and overall behavior (DeJong, Bunton, & Hare, 2014; Kakooza-Mwesige, Wachtel, & Dhossche, 2008). Common features of the disorder include increased slowness in verbal and motor movements, difficulty in initiating actions, difficulty completing tasks, reliance on physical or verbal prompts to complete tasks, increase in passivity, lack of motivation (Wing & Shah, 2000), and deterioration in social-emotional behavior and adaptive functions (Bozhurt & Mukaddes, 2010). In its severe form, it is characterized by an absence of speech, absence of movement, and maintenance of rigid postures (Wing & Shah, 2000). Task engagement and task completion is severely impaired. Catatonia can coexist in individuals with autism spectrum disorder (DeJong et al., 2014; Bozhurt & Mukaddes, 2010). The prevalence of catatonic deterioration in autism spectrum disorder is estimated to be 4–17% in adolescents and adults (Dhossche, 2014).

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In an interesting study conducted by Breen and Hare (2017), the authors recognized the lack of commonly accepted diagnostic criteria for catatonia in the context of autism spectrum disorder. The number and severity of symptoms vary across individuals. In an effort to better assessment, the authors developed a 34-item questionnaire that allows for a measure of symptoms presented, a measure of severity, and a comparison of symptoms over time. By asking questions regarding current behavior compared with past presentation, the questionnaire can possibly be used to measure the effectiveness of interventions provided.

In the general psychiatric population, a common treatment of catatonic symptoms is lorazepam. Lorazepam belongs to a class of drugs known as benzodiazepines, and benzodiazepines are the most frequently used medications to treat catatonic symptoms (Mazzone, Postorino, Valeri, & Vicari, 2014).

When individuals are unresponsive, or insufficiently responsive, to lorazepam, electroconvulsive therapy (ECT) is often administered (Dhossche, 2014; Luchini et al., 2015; Wilcox & Duffy, 2015; Mazzone et al., 2014). The optimal length of ECT treatment to prevent relapse of catatonia is unknown (Dhossche, 2014). Nevertheless, it has been reported that the death toll from catatonia has decreased considerably since the introduction of ECT as a treatment (Luchini et al., 2015).

Dhossche and Wing (2006) and Dhossche (2014) stated that although many case studies report a successful reduction in catatonic symptoms following pharmacological and/or ECT treatment, there are a very small number of published cases and a lack of controlled studies. It is unclear from the available literature the extent to which pharmacological treatment and/or electroconvulsive therapy is successful in reducing catatonic features in all cases of autism in which catatonic features are present or only with those very severe forms or catatonia (Dhossche & Wing, 2006). According to DeJong et al. (2014), the published research provides poor outcome measures and incomplete descriptions of treatment procedures.

Dhossche (2014) also stated that only successful treatments, as opposed to unsuccessful examples of treatments, have been published. At this time, there are no systematic studies of the causes, nature, and treatment of catatonia-like conditions in autism.

In 2014, DeJong et al. reviewed 22 articles describing the treatment of 28 patients with catatonic features. The articles reviewed found limited evidence that the use of ECT, high doses of lorazepam and behavioral intervention may be beneficial. The quality of the existing literature was found to be generally poor. Treatment procedures were often partially described, and outcomes were often based on clinician impressions, as opposed to objective measures.

DeJong et al. (2014) reviewed only three papers that reportedly used behavioral interventions (Dhossche & Wing, 2006; Hare & Malone, 2004; Shah & Wing, 2006). A search was conducted, and no additional studies were identified. In 2006, Shah and Wing emphasized (a) the need for verbal and physical prompts to overcome movement challenges, and (b) the need to maintain a predictable structure and a daily routine. They stated that the amount, level, and type of prompts required varies across different people, situations, and actions for the same person. They also stated that light physical touches should be used initially. If minimal touch is not sufficient in affecting change, the authors suggest using a more intrusive prompt to assist in completing the response. As the person makes progress, it is suggested that the level and type of prompt be adjusted. Unfortunately, data were not presented to support these suggestions.

Dhossche and Wing (2006) reported on the treatment of a 15-year old boy who showed a decline in function across years. By the age of 17, he lost much language function, did not retain food in his mouth, required assistance washing and dressing, stopped using the toilet, and was often uncooperative and unresponsive. He was prescribed diazepam and fluoxetine. The authors stated that “an intensive behavioral intervention was started using the same framework set out by Shah and Wing (2006) for the treatment of catatonia in patients with autism. “In a nine-month follow-up, the authors reported an increase in language, independent walking, and a wider range of emotion. Nevertheless, no description of methodology was provided and data were not presented to support these observations.

Hare and Malone (2004) used verbal prompts and environmental changes to increase speed of stair use by an 18-year old man. The authors propped open the doors on the top and bottom of the stairs, placed mirrors to enable the young man to see around corners, and limited the use of the stairs by others. An instructor provided a verbal instruction prior to each step and used a verbal praise statement (e.g., “Well done!”) following a successful action. The investigation resulted in a reduction in time to ascend and descend stairs. In addition, the authors reported that the treatment gains generalized across locations and maintained 18 months after the completion of the study.

Hare and Malone (2004) reported that structured behavioral interventions appear to be the most appropriate forms of treatment for individuals with catatonic symptoms, and according to DeJong et al. (2014), may be associated with fewer risks than ECT. Although most studies did not report side effects of ECT treatment, one study did report an increase in symptoms following the initial treatment (Wachtel, Griffin, Dhossche, & Reti, 2010), and another a prolonged seizure during the initial ECT session (Zaw, Bates, Murali, & Benthan, 1999).

The following is an experimental analysis of the effects of a prompt-fading behavioral treatment package on the daily living skills of an adolescent girl with autism spectrum disorder and catatonia. The principles of applied behavior analysis were employed to ensure a measureable change in socially important behavior (Baer, Wolf, & Risley, 1968). Each of the skills taught was incompatible with catatonic behavior and was treated in a single-case reversal experimental design.

The behavioral treatment package involved the use of positive reinforcement and the careful fading of full manual guidance. Manual prompts have been used to teach many skills to children with autism. For example, MacDuff, Krantz, and McClannahan (1993), and McClannahan and Krantz (1999) used manual guidance to teach children with autism to follow photographic activity schedules. Across successive sessions, these authors systematically replaced manual prompts with graduated guidance, spatial fading, shadowing, and decreased adult proximity. The present study used a similar prompt-fading sequence. By changing the intensity and location of manual prompts, stimulus control was transferred from the “extra” stimuli to the relevant stimuli in the natural environment (MacDuff, Krantz, & McClannahan, 2001).

In the present study, the skills targeted were those normally taught to adolescents in this school setting, and for the purposes of this paper, included blow-drying hair and using a hair barrette in the bathroom, and pre-vocational vacuuming and using a paper shredder in the classroom. Graphic display of treatment results is presented.

2. Method

2.1. Participant

Blake, a fictitious name used to conceal the identity of the participant, is an 18-year-old girl who is enrolled at the New York Child Learning Institute where she receives ongoing science-based applied behavior analytic services. Blake's parent agreed to the publication of this report and to the inclusion of identifiable photographs, Blake received a diagnosis of autism when she was three and a comorbid diagnosis of catatonia when she was 15 from an adult and child psychiatrist from an outside agency. Blake underwent a comprehensive psychiatric and behavior evaluation. Information was obtained via Blake's mother as informant and via behavioral observation and impression.

At the age of 14, Blake began to show a decline in function. Skills that had previously been in her repertoire were no longer displayed. As reported by both the school and the parent, Blake stopped talking, stopped following verbal directions, stopped walking over thresholds, stopped eating independently, became immobile, became increasingly reliant on physical prompts to engage in daily functions, maintained rigid postures for extended periods of time, and stopped walking on her own.

Blake had received treatment at the New York Child Learning Institute for 15 years, beginning at age four. Prior to age 14, Blake had learned to follow an activity schedule, engage in a variety of self-care activities independently, engage in sight reading and simple math activities, respond to direction, initiate choice, engage in simple conversation with adult recipients, make her own lunch, engage in cleaning tasks, eat independently, and engage in leisure activities without adult assistance. Many of these responses were first acquired using manual prompts. As soon as possible, manual prompts were replaced by graduated guidance, spatial fading, shadowing and decreased adult proximity. The rate at which prompts were faded and responses acquired varied across activities. At no point in time can the primary investigator remember Blake resisting manual prompts when delivered. At the age of 15, these skills were no longer displayed.

At age 16, Blake began taking Fluoxetine 10 mg, Trazodone 50 mg and Vitamin B12 injections daily. At age17, she did receive 0.5 mg of Lorazepam twice a day for a two-week period with no clear change in behavior. From age 16–19, the combination of Fluoxetine, Trazodone, Vitamin B12 injections and our usual applied behavior analytic intervention strategies resulted in minimal improvements in Blake's level of functioning.

2.2. Setting

The study was conducted in one classroom and one bathroom at the New York Child Learning Institute. The Institute uses an applied behavior analytic approach to produce socially significant measureable changes in children with autism. The classroom measured 4.0 m x 7.5 m and included desks, tables, chairs, computers, file cabinets, a rug and a television. The bathroom included a shower, two sinks, three bathroom stalls, shelving for toiletries and hooks for towels.

To assess transfer-of-treatment effects to different settings, transfer-of-training probe trials were conducted in a separate bathroom at the Institute that included one toilet, a sink and a mirror, and in a separate office that included a rug, desks, tables, chairs, file cabinets, and computers.

2.3. Stimuli

At the beginning of the study, Blake's day at the Institute consisted of activities that involved long chains of motor responses (e.g., showering; washing hands; brushing teeth; eating lunch). Activities that required verbal exchanges, verbal imitation, motor imitation, and/or responsiveness to verbal direction were temporarily suspended. During each activity throughout her day, the environmental arrangement was such that all relevant stimuli were within Blake's reach. For example, the hair dryer and the hairbrush were well within Blake's reach where she was to blow-dry her hair. The hair barrette was on the counter in front of a mirror where Blake was to style her hair. The vacuum cleaner was placed near the rug to be vacuumed. The paper shredder and the papers to be shredded were easily accessible when preparing to complete office work.

Initially, secondary motivational systems that had been previously used (e.g., token motivational systems) were suspended. Activities/items that had been previously identified as reinforcers (e.g., snacks; a drink of water; an iPad; magazines) were placed within Blake's reach throughout her day. At no point during the study did Blake initiate toward any previously preferred stimulus or activity.

2.4. Dependent variable

Data were collected on the completion of components of four activities: blow drying hair; using a hair barrette; vacuuming a rug; and using a paper shredder. Prior to beginning this study, Blake did not display these skills. As will be described below, the experimental design, at times, required the removal of intervention. Due to the novelty of the procedure employed with this population, and the uncertainty of whether responding would reemerge following the removal of intervention, the activities selected were not

Table 1
Task analyses for blow-drying hair, using a hair barrette, vacuuming a rug, and using a paper shredder.

Task analysis for blow-drying hair in the bathroom:	
1	Get hair dryer
2	Plug in hair dryer
3	Press on
4	Set timer for 1:00 minute
5	Dry hair upside down
6	Set timer for 30 seconds
7	Dry side of hair
8	Set timer for 30 seconds
9	Dry side of hair
10	Set timer for 30 seconds
11	Dry back of hair
12	Turn off hair dryer
Task analysis for using a hair barrette in the bathroom	
1	Obtains barrette
2	Opens barrette
3	Move hair out of face
4	Pulls back hair from face
5	Insert clip
6	Clip down barrette
7	Fix remaining hair
Task analysis for vacuuming a rug in the classroom:	
1	Get vacuum
2	Unwind cord
3	Plug cord into outlet
4	Hold vacuum from top handle
5	Turn on
6	Vacuum target area
7	Turn off vacuum when area is clean
8	Unplug cord
9	Wind cord up to vacuum
Task analysis for using a paper shredder in the classroom:	
1	Set timer to (instructor chosen time)
2	Turn paper shredder on
3	Obtain paper from bin
4	Feed one piece of paper at a time into paper shredder
5	Turn off timer (when timer rings)
6	Turn off paper shredder

essential for Blake. Blake would not be harmed in any way if responding did not reemerge. During each activity, the investigator had access to a written task analysis that listed the component responses within each activity. The task analyses are displayed in Table 1.

Data were collected on each component response within each activity. A component response was scored as correct if it was completed given the specified prompt level, to be described below. If Blake did not complete a response at the specified prompt level, and/or required that the instructor revert to a previous prompt level, the response was scored as incorrect.

2.4.1. Experimental design

This paper describes four experiments using the same procedures to analyze the effectiveness of a prompt-fading treatment package for one adolescent. Each of four skills was treated in a single-case research experimental design. A pre-test followed by a BAB reversal design was used to assess the effects of the prompt-fading package on the percentage of blow-drying hair and using-a-hair-barrette responses completed in the bathroom,

A pre-test followed by an BABAB design was used to assess the effects of the intervention package on the percentage of vacuuming and paper-shredder responses completed in the classroom. All four experiments began at different times. There was an eight-month, nine-month, and 19-month time interval between the start of the first experiment and the start of each subsequent experiment.

2.5. General experimental conditions

Prior to the study, Blake's parent agreed to have Blake participate, and signed a consent form. The consent form specified that Blake's participation in the study was optional, and that the parent's decision to have her daughter participate could be stopped at any time.

2.5.1. Pre-test/Baseline

Data were obtained on Blake's performance during four regularly scheduled classroom activities (blow-drying hair, using a hair barrette, vacuuming a rug, and using a paper shredder). Prior to beginning an activity, the instructor verbally directed Blake to

Table 2
Prompt levels.

Prompt Level	Description
16	Instructor has a "firm" manual grasp on the learner's hand(s). Instructor's fingers are either (a) placed "firmly" over the learner's fingers or (b) are placed firmly in between the learner's fingers in order to assist the learner in completing each response.
15	Instructor has a "light" manual grasp on the learner's hands. Instructor's fingers are either (a) placed "lightly" over the learner's fingers or (b) placed lightly in between the learner's fingers in order to assist the learner in completing each response.
14	Instructor's fingers are placed "lightly" on top of the learner's knuckles to assist the learner in completing each response.
13	Instructor's hand is placed "lightly" on top of the learner's mid hand to assist the learner in completing each response.
12	Instructor's hand is placed on top of the learner's wrist(s) to assist the learner in completing each response.
11	Instructor's hand is placed on the learner's mid arm(s) to assist the learner in completing each response.
10	Instructor's hand is placed on the learner's elbow(s) to assist the learner in completing each response.
9	Instructor's hand is placed on the learner's tricep(s) to assist the learner in completing each response.
8	Instructor's hand is placed on the learner's shoulder to assist the learner in completing each response.
7	Instructor's hand(s) is placed lightly on the learner's shirt on her shoulder to assist the learner in completing each response.
6	Instructor's hand(s) is periodically tapping the learner's shoulder to assist the learner in completing each response at 140 beats per minute (using a metronome).
5	Instructor's hand(s) is periodically tapping the learner's shoulder to assist the learner in completing each response at 120 beats per minute (using a metronome).
4	Instructor's hand(s) is periodically tapping the learner's shoulder to assist the learner in completing each response at 100 beats per minute (using a metronome).
3	Instructor's hand(s) is periodically tapping the learner's shoulder to assist the learner in completing each response at 80 beats per minute (using a metronome).
2	Instructor's hand(s) is periodically tapping the learner's shoulder to assist the learner in completing each response at 60 beats per minute (using a metronome).
1	Instructor will "shadow" the learner's movements through each response.
0	Instructor decreases his/her proximity to the learner.

engage in the target activity (e.g., "Blake, please blow-dry your hair"). No additional prompts were provided. Feedback was not provided to Blake regarding her performance. The activity ended following (a) no response for 30 s, or (b) an incorrect response.

2.5.2. Prompt fading

Initially, following the verbal direction to engage in the target activity, the instructor provided full manual guidance to assist Blake to complete each component response in the task analysis. Over time, manual prompts were faded. A written description of the prompt-fading sequence along with corresponding photographs, are displayed in Tables 2 and 3.

If Blake did not respond at a given prompt level, or responded incorrectly, the investigator reverted to a previous prompt level. In an effort to remove manual prompts, at prompt-level 6, a shoulder prompt was replaced with shoulder taps. Using a metronome, the investigator's hand tapped the learner's shoulder to assist the learner in completing each response at 140 beats per minute. As prompt levels decreased, the number of taps per minute decreased. This procedure was an innovative way to maintain Blake's responding in the absence of manual prompts.

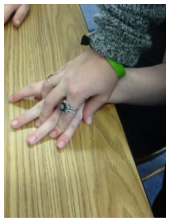
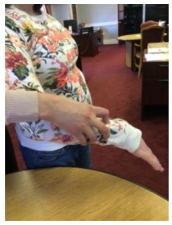
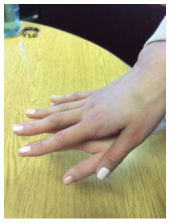
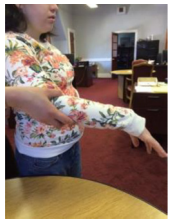
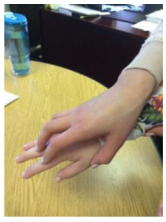
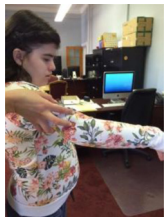
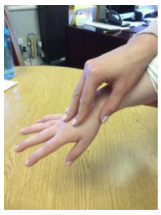
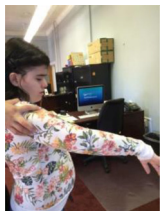
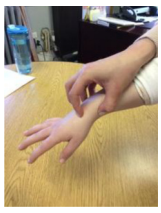
Once taps were removed, instructor proximity systematically decreased from Blake. During the two activities completed in the bathroom, a distance of seven feet placed the investigator out of the bathroom and into the hallway. The investigator would not have been able to observe responding and revert to previous prompt levels when needed if the distance increased any further.

When performance was at 80% or better given the specified prompt level for approximately three consecutive training sessions, the prompt level was faded. With the exception of the initial verbal direction, verbal prompts were not provided. Verbal praise was not provided during any of the activities. Access to stimuli that were previously observed to serve as reinforcers (e.g., snacks), and access to verbal praise, were provided only at the completion of the activity. A session was conducted at different times throughout the school day, and was determined by the availability of the primary investigator, the availability of the setting and stimuli needed to conduct the session, and the usefulness of the response at the time. For example, if Blake entered the school building in the morning, and her hair was in disarray, the primary investigator had Blake use a hair barrette prior to beginning her morning routine. Similarly, the investigator would have Blake vacuum the rug if crumbs were on the floor. The length of a session was dependent upon the length of time it took Blake to complete the task. For example, it took Blake approximately four minutes to blow dry her hair, three minutes to vacuum the carpet, two minutes to use a hair barrette, and three minutes to use a paper shredder. The overall number of sessions was dependent upon when the primary investigator was able to decrease her proximity to seven feet from Blake.

2.5.3. Transfer-of-training

For blow-drying hair and using-a-hair-barrette activities, transfer-of-training probe trials were conducted across a novel bathroom. A session continued to be conducted at different times throughout the school day, and the length of a session continued to be dependent upon the length of time it took Blake to complete the task. During a probe trial, the same prompt level that was provided during the previous prompt-fading session was implemented. Additional feedback was not provided during the activity. Access to reinforcers and verbal praise was provided only at the completion of the activity. Probe trials were conducted approximately one time at each prompt level 1 through 16, and multiple times at prompt level 17 to ensure stability of responding when instructor proximity was decreased.

Table 3
Photographs of prompt levels 16 through 8.

Prompt Level	Corresponding Photograph	Prompt Level	Corresponding Photograph
16		11	
15		10	
14		9	
13		8	
12			

2.5.4. Five-week follow-up

Follow-up sessions were conducted by the primary observer five weeks after the last prompt-fading session across all activities. During the five-week period, no training was provided across the four target activities. The follow-up setting was identical to that used during the prompt fading procedure. The instructor remained at a distance of seven feet from Blake. If Blake erred on a response, the instructor reverted to the previous prompt level (e.g. the instructor stood at a distance of three feet from Blake) to ensure that the response was completed and that Blake was in a position to complete the next response in the response sequence. Reinforcers and praise were not provided at the completion of the activity.

2.6. Interobserver agreement

Two independent observers simultaneously collected data on Blake's performance. The primary observer implemented the prompt-fading procedure. The secondary observer remained at a distance of approximately 5 feet away from Blake throughout the experiment.

Interobserver agreement was calculated using the formula: total number of agreements divided by total number of agreements plus disagreements X 100. An agreement was scored when the two observers agreed that Blake completed a response given the

specified prompt level. A disagreement was scored when one observer scored a response as completed, while the other did not.

2.7. Interobserver agreement results

Interobserver agreement data on training trials were obtained on a minimum of 24% of all prompt fading and baseline conditions, and 17% across all follow-up conditions across the four different activities (blow-drying hair; using a hair barrette; vacuuming a rug; using a paper shredder). A hundred percent agreement was obtained across all conditions across using a-hair-barrette, vacuuming-a-rug and using-a-paper-shredder activities. Ninety nine percent agreement was obtained across all conditions during the blow-during hair activity. These high scores can be easily explained. When the primary observer determined that the participant was about to emit an error at the current prompt level, a more invasive prompt level was implemented. Errors made by the participant were interrupted and minimized. The secondary observer was only able to collect data on whether the primary observer used the current prompt level or reverted to a previous prompt level.

During the blow-drying hair activity, interobserver agreement data were not obtained across transfer-of-training trials during the original pre-test or prompt-fading condition. Interobserver agreement data were collected on 100% of all transfer-of-training trials conducted during baseline, and 30% of the transfer-of-training trials conducted during the prompt-fading condition. One hundred percent agreement was obtained across both the baseline and prompt-fading condition.

During the using-a-barrette activity, interobserver agreement data were not obtained during the initial transfer-of-training trial during the pre-test condition. Interobserver agreement was obtained across a minimum of 21% of all subsequent transfer-of-training trials across baseline and prompt-fading conditions. Interobserver agreement remained at 100%.

3. Results

Individual results for each of the four responses are displayed in Fig. 1 through Fig. 4. Fig. 1 shows the percentage of blow-drying

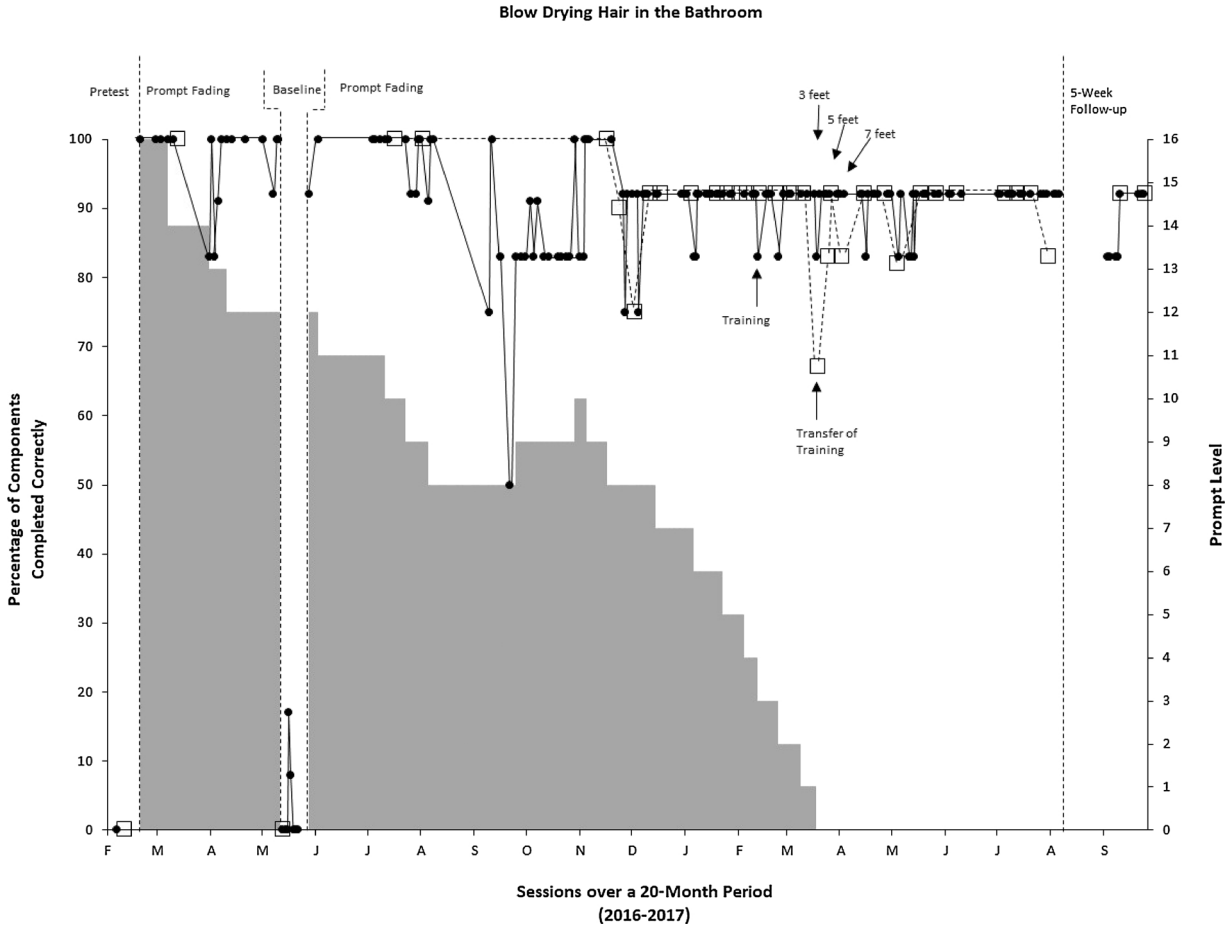


Fig. 1. The percentage of correct blow-drying hair responses completed by Blake during training (closed circles) and transfer-of training trials (open square) across experimental sessions over a 20-month period. The bar graph displays the prompt level used across sessions. Arrows indicate a change in adult proximity.

hair components completed by Blake during the pre-test, the prompt-fading condition, baseline, again during the prompt-fading condition, and the follow-up condition. The vertical broken line shows the point at which a change in experimental condition took place. The solid data points show the percentage of components completed given the specified prompt level. The open squares shows the percentage of components completed in a different bathroom during a transfer–of-training probe trial. The bar graph shows the prompt level that was used at any given time. The arrows indicate a change in adult proximity. Blake's responding was measured over an entire 20-month period.

The data show that during the pre-test condition, Blake completed 0% of the blow-drying hair components correctly. Similarly, during the initial transfer-of-training trial in a different bathroom, Blake completed 0% of the components correctly.

During the first prompt-fading condition, the percentage of components completed correctly (closed circles) immediately increased to 100%. The overall percentage correct had a range from 83 to 100% with a mean of 97%. As manual prompts were faded from level 16 to level 12, little change in percentage correct was displayed, even though the bar graph shows a steady decrease in prompt level. The open square shows that given the specified prompt level, the percentage of components completed in the different bathroom remained at 100%.

During baseline, the percentage of components completed correctly reverted to near zero in the teaching bathroom and remained at 0% during the transfer-of-training probe trial in the different bathroom. The percentage of correct responses had a range from 0 to 17% with a mean of 3%.

When the prompt-fading package was reintroduced with prompting at level 12, the percentage of components completed returned back to previously high levels. The percentage of correct responding during teaching had a range from 50 to 100% with a mean of 91%. Responding during the transfer-of-training probe trials in the different bathroom had a range of 67% to 100% with a mean of 90%.

The data also show that when the prompt-fading procedure was reintroduced, performance maintained over a 20-month period. At prompt level 1, all manual prompts were removed. At prompt level 0, instructor proximity began to systematically decrease. Performance maintained at around 92% when instructor proximity was decreased from zero to seven feet.

During the five-week follow up condition, the primary observer remained at a distance of seven feet from the participant. Blake's performance had a range from between 83 and 92% with a mean of 84% while in the teaching bathroom. Transfer-of-training data were not collected during the follow-up condition.

The results across experiments 2, 3 and 4 are similar to the results in experiment 1 and are presented in figures 2, 3 and 4. Table 4 displays a summary of all data presented in Figs. 1–4.

Table 4
Summary of experimental conditions, prompt levels, range of percentage correct, and overall mean percentage correct in experiment 1, 2, 3, and 4.

Experiment 1 (Blow-Drying Hair)

Condition	Pre-Test	Prompt Fading	Baseline	Prompt Fading	Follow Up
Prompt Level	0	16-12	0	12-0	0
Training Data	0	R = 83-100% M = 97%	R = 0-17 M = 3%	R = 50-100% M = 91%	R = 83-92% M = 84%
Probe Data	0	100%	0%	R = 67-100% M = 90%	(not conducted)

Experiment 2 (Using a Hair Barrette)

Condition	Per-Test	Prompt Fading	Baseline	Prompt Fading	Follow Up
Prompt Level	0	16-11	0	11-0	0
Training Data	0	100%	R = 0-29% M = 4%	R = 57-100% M = 97%	100%
Probe Data	0	R = 85-100% M = 96%	0	R = 57-100% M = 92%	100%

Experiment 3 (Vacuuming)

Condition	Pre-test	Prompt Fading	Baseline	Prompt Fading	Baseline	Prompt Fading	Follow Up
Prompt Level	0	16-7	0	16-8	0	9-0	0
Training Data	0	R = 75-100% M = 91%	R = 0-75% M = 12%	R = 88-100% M = 94%	R = 0-100% M = 55%	R = 56%-100% M = 97%	R = 74-100% M = 91%

Experiment 4 (Using a Paper Shredder)

Condition	Pre-Test	Prompt Fading	Baseline	Prompt Fading	Baseline	Prompt Fading	Follow Up
Prompt Level	0	16-7	0	16 - 7	0	7 - 0	0
Training Data	0	R = 67-100% M = 94%	0	R = 66-100% M = 95%	R = 0-100% M = 66%	R = 83-100% M = 97%	100%

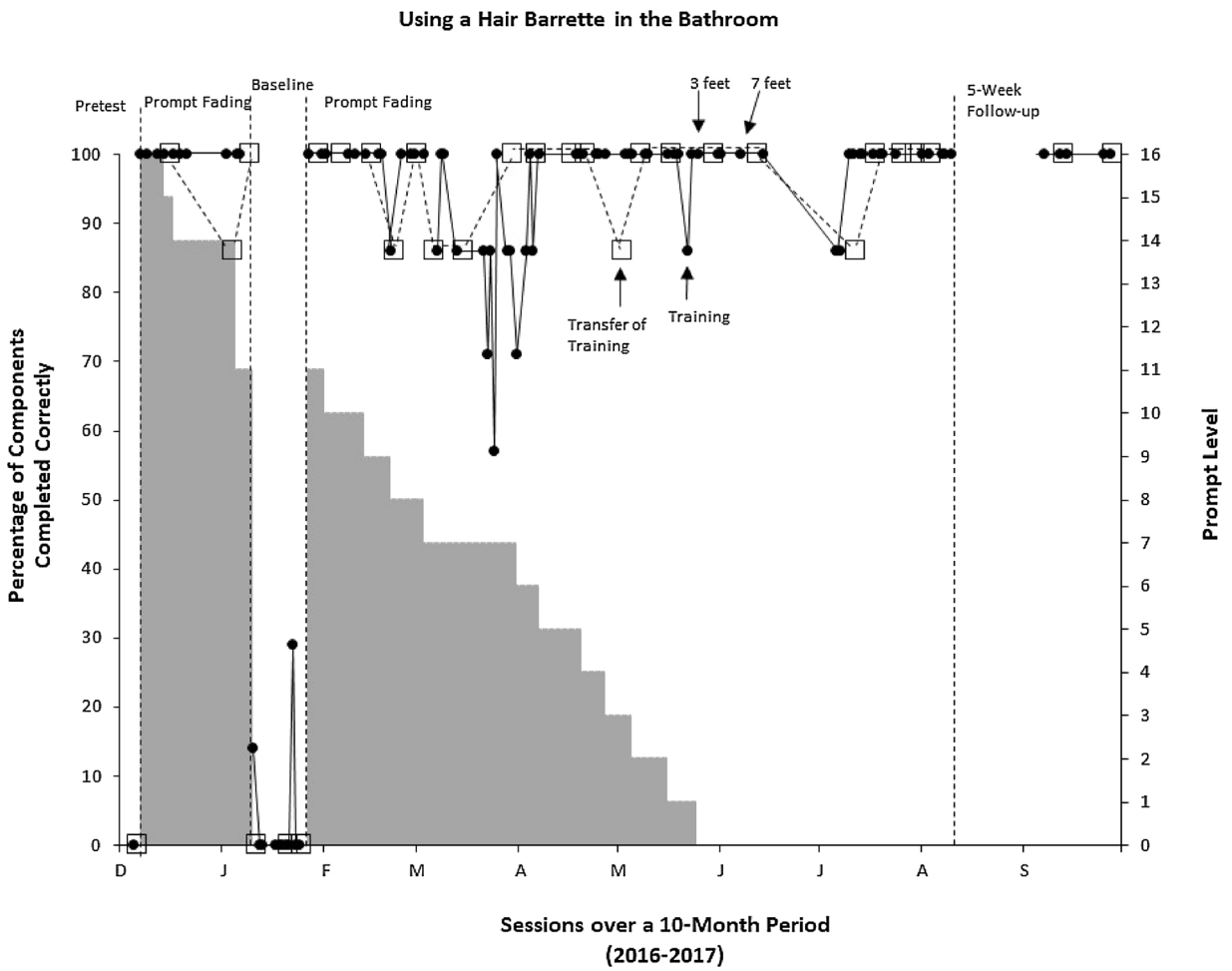


Fig. 2. The percentage of correct using-a-barrette responses completed by Blake during training (closed circles) and transfer-of-training trials (open squares) across experimental sessions over a 10-month period. The bar graph displays the prompt level used across sessions. Arrows indicate a change in adult proximity.

Table 4 shows the order of all experimental conditions across each experiment, prompt levels used during each condition across experiments, range of percentage correct, and overall mean percentage correct.

Results show that there was a systematic increase in percentage of component responding completed correctly with the introduction of the prompt-fading procedure in both the primary treatment setting and the transfer-of-training setting. With the fading out of the prompting procedure and the reduction of trainer proximity, each of the four response sets became independent and remained so at a five-week follow-up period.

4. Discussion

The findings reported here suggest that the prompt-fading procedure was sufficient to produce effective behavior change across a set of four experiments with one participant. As manual prompts were systematically faded, independent responding emerged. The use of a metronome to fade from touching to non-touching is unique to this study. The gradual slowing of the metronome to bridge instructor tapping to non-touching had the effect of gradually introducing successively longer short periods of time between touches so that touching could be faded out entirely. This allowed instructor proximity to be gradually decreased as well.

In terms of learning theory, there are at least two functions of graduated guidance that might have resulted in the increase in independent responding in the present experiment. First, manual prompts might have served as discriminative stimuli for Blake's responding. It is interesting to note that the environmental arrangement and materials associated with experiment 1 and 2 in the bathroom and 3 and 4 in the classroom were not mutually exclusive. That is, generalization did not occur across those arrangements even though they were very similar. The same bathroom was used during both experiments 1 and 2, and the same location in the classroom was used during both experiments 3 and 4. Thus, the environmental arrangement did not set the occasion for responding. Therefore, the manual prompts themselves, may have functioned as discriminative stimuli for responding. In the early stages of the prompt-fading sequence, more intrusive manual prompts were required. Over time, progressively less intrusive prompts were

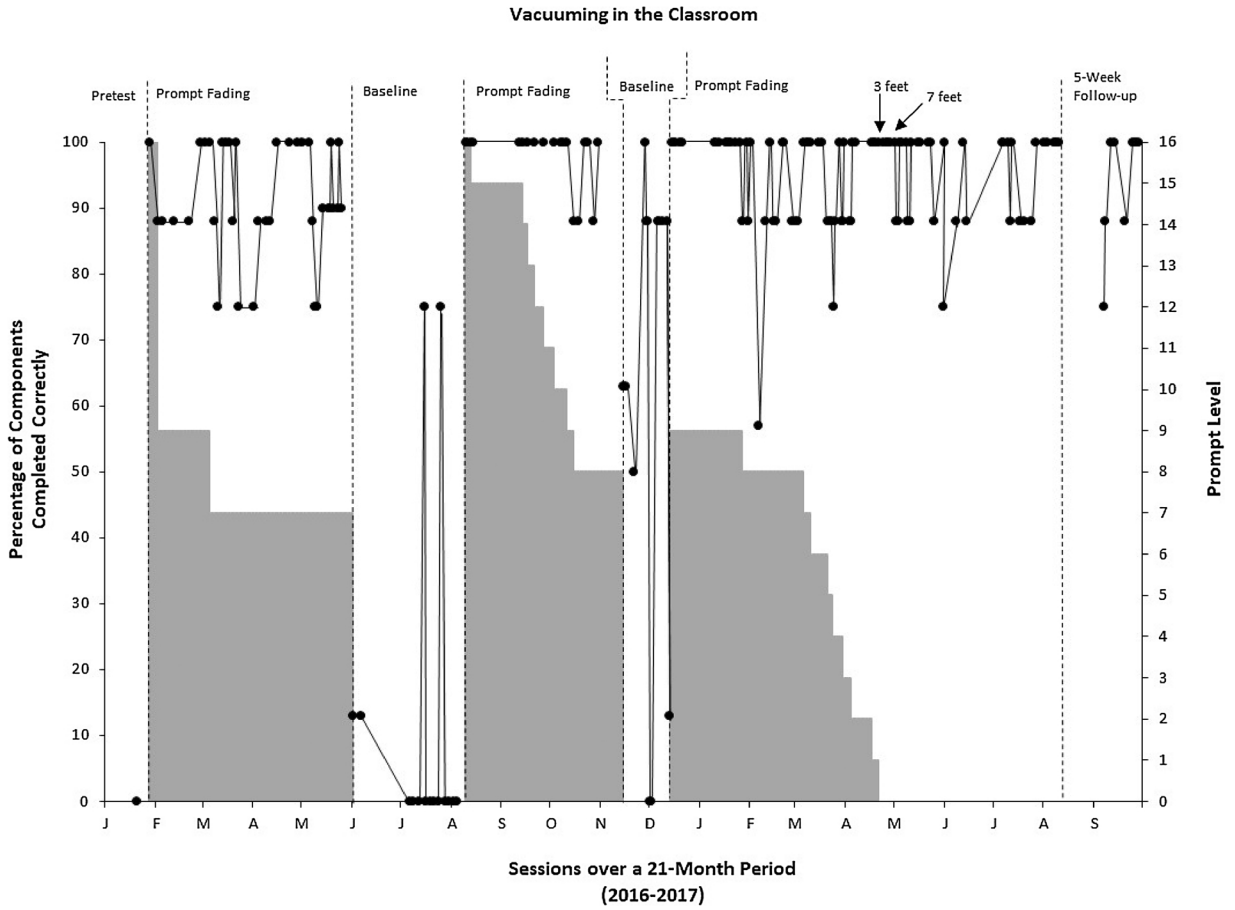


Fig. 3. The percentage of correct vacuuming responses completed by Blake during training trials (closed circles) across experimental sessions. over a 21-month period. The bar graph displays the prompt level used across sessions. Arrows indicate a change in adult proximity.

provided and ultimately removed. It is probable that discriminative stimulus control transferred from the prompts to the natural stimuli in the environment. The natural stimuli while in the bathroom included the presence of the blow dryer, the hair brush, and the mirror. These natural stimuli then set the occasion for blow-drying-hair. While in the classroom, the natural stimuli included the presence of the paper shredder and the paper to be shredded which set the occasion for using the paper shredder.

Second, the manual prompts might have had a reinforcing function. If the manual prompt served as a stimulus that strengthened the previous response, that stimulus may have served as a positive reinforcer (Bijou, 1993).

Common treatments of catatonic symptoms include lorazepam (Mazzone et al., 2014) and electroconvulsive therapy (ECT) when individuals are unresponsive, or insufficiently responsive, to lorazepam (Dhossche, 2014; Wilcox & Duffy, 2015; Luchini et al., 2015). Nevertheless, few published cases and no controlled studies exist on the use of these treatments (Dhossche & Wing, 2006; Dhossche, 2014). It is interesting to note that, for Blake, pharmacological treatment did not result in a reduction in catatonic symptoms. Rather than begin electroconvulsive therapy, the current behavioral procedure provided Blake another option. Given the stigma and questions regarding the potential adverse side effects of ECT, it was beneficial to explore behavioral intervention as an alternative form of treatment.

Only a few published papers were found that reportedly used behavioral interventions (Dhossche & Wing, 2006; Hare & Malone, 2004; Shah & Wing, 2006). Unfortunately, the behavioral interventions that were reported provided incomplete descriptions of interventions and little objective data to support their claims.

In sharp contrast, this paper identifies a successful behavioral treatment package that taught daily living and pre-vocational skills to a young adolescent girl with autism spectrum disorder and catatonia. The skills taught were incompatible with catatonic behavior and maintained over a two-week period following the decrease in adult proximity. These findings indicate beneficial effects of prompt-fading and suggest that further evaluation of behavioral strategies is likely to be valuable. In addition, there has been a heavy reliance on single cases and small case series. This paper highlights the potential utility of reversal designs in this field of research.

It is important to note that treatment integrity data were not collected across the four experiments. It is suggested that future studies attempt to collect these data to ensure the integrity of the procedure employed.

Overall, prompt fading was shown to be effective in helping a young adolescent girl with autism spectrum disorder and catatonia engage in daily living and pre-vocational activities. Prior to this experiment, Blake stopped talking, stopped following verbal

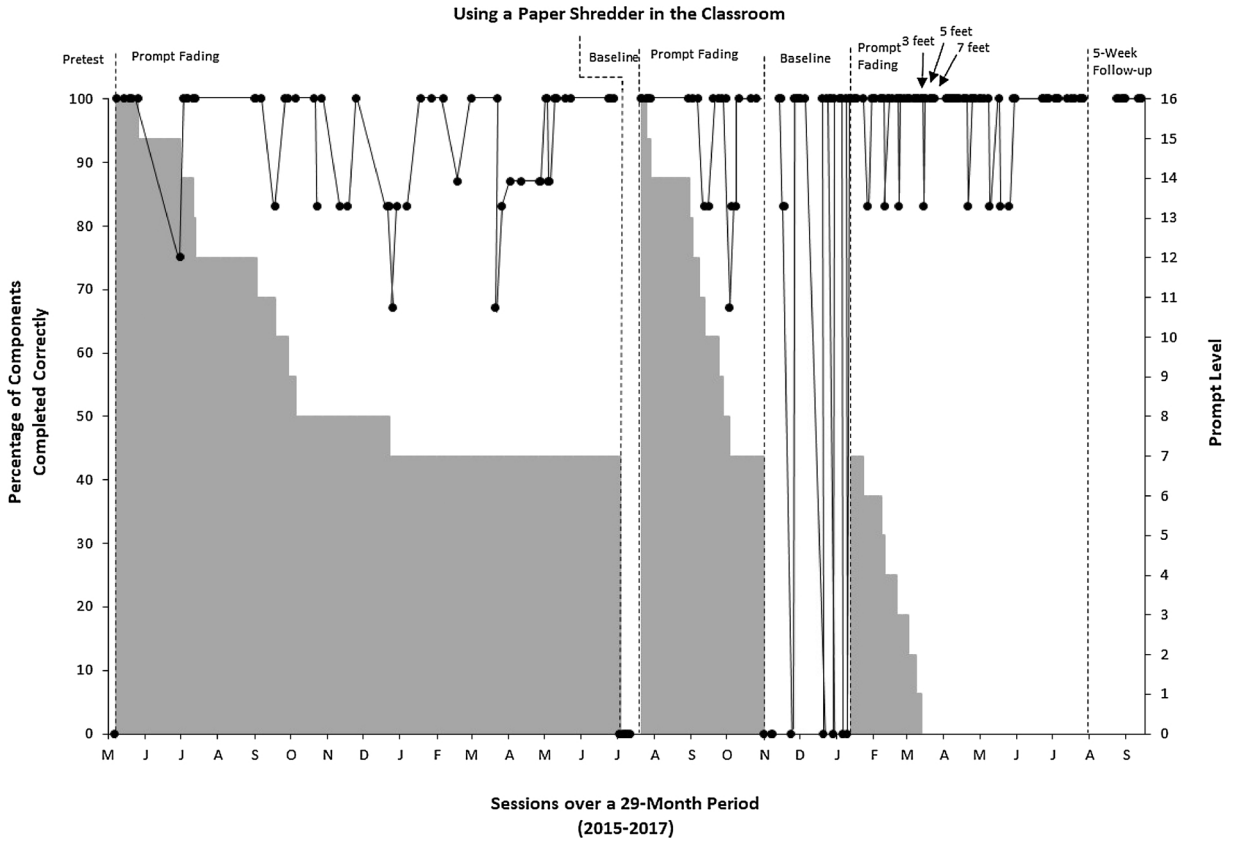


Fig. 4. The percentage of correct using-a-paper-shredder responses completed by Blake during training trials (closed circles) across experimental sessions over a 29-month period. The bar graph displays the prompt level used across sessions. Arrows indicate a change in adult proximity.

directions, stopped walking over thresholds, stopped eating independently, became immobile, maintained rigid postures for extended periods of time, and stopped walking on her own. The authors are pleased to report that although this manuscript presents data on the effectiveness of the prompt-fading procedure with only four activities, the same prompt-fading procedure was used with 15 other activities throughout the course of Blake's school day, and seven activities while in her home environment with her parent and home therapist Although treatment of these 22 other activities was not presented in an experimental design, the introduction of the prompt-fading sequence resulted in a marked increase in independent responding across activities, locations, clinicians and adults. It is important to note that all activities were started at different times throughout the course of the last three years. Regardless of when the prompt fading sequence was introduced for each activity, across all four experiments, performance increased when prompt fading was implemented, decreased when intervention was removed, and reemerged following its reintroduction. The concurrent application of the prompt fading sequence across the other activities at school and at home did not disrupt experimental control across the four experiments presented in this paper.

The treatment of these 26 sets of responses described above does not mean that catatonia was no longer an appropriate label for the symptoms displayed by the learner. Rather, treatment enabled Blake to display independent performance of a wide variety of responses at home and at school.

In future research, it would be interesting to know the extent to which a similar prompt-fading procedure could be used across different individuals to increase behavior incompatible with catatonia. Given the fact that only one subject participated in these four experiments, it is not possible to draw conclusions regarding the effectiveness of the procedure for other individuals with similar profiles, or with individuals presenting with more of less severe symptoms of catatonia. Similarly, it would be interesting to note the extent to which the procedure is replicable across different educational programs. The intervention provided for Blake required extensive staff training efforts and a staff skillful in the use of prompts and prompt fading strategies. Nevertheless, the benefits of the current procedure are extraordinary for Blake. Prompts were removed across a wide variety of activities that span her school and home day.

In summary, the prompt-fading procedure implemented has enabled a young adolescent girl with autism spectrum disorder and a comorbid diagnosis of catatonia to emit chains of motor responses that were otherwise absent from her repertoire. Blake currently participates on class field trips, independently navigates the school hallways and stairs, and is able to accommodate the continual introduction of new activities. Blake is again a functional member of her classroom and her home environment.

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