Research in Autism Spectrum Disorders 5 (2011) 1059–1077

Contents lists available at ScienceDirect

Research in Autism Spectrum Disorders

Journal homepage: http://ees.elsevier.com/RASD/default.asp

Functional assessment of instructional variables: Linking assessment and treatment☆

Tiffany Kodak *, Wayne W. Fisher, Andrea Clements, Amber R. Paden, Nitasha R. Dickes

Center for Autism Spectrum Disorders, University of Nebraska Medical Center, Munroe-Meyer Institute, Nebraska Medical Center, 985450 Nebraska Medical Center, Omaha, NE 68198-5450, United States

ARTICLE INFO

Article history:
Received 24 November 2010
Accepted 30 November 2010
Available online 22 December 2010

Keywords:
Academic interventions
Auditory-visual conditional discrimination
Functional assessment
Instructional variables

ABSTRACT

The purpose of the present investigation was to refine and validate an assessment procedure to identify instructional variables influencing acquisition of conditional discriminations in children diagnosed with autism. An assessment was implemented with eleven individuals to identify the specific instructional variables influencing the individual's responding. A prescribed academic intervention was selected for participants based on the results of the functional assessment. The prescribed intervention was compared to an alternative treatment and control condition. The functional assessment identified several different patterns of responding to instructional variables across participants. The treatment evaluation demonstrated that the prescribed academic intervention was effective in teaching conditional discriminations.

Behavior analysts utilize a number of different assessment procedures in an effort to link assessment results to the selection of treatment (Bourret, Vollmer, & Rapp, 2004; Iwata, Dorsey, Slifer, Bauman, & Richman, 1994a; Iwata, Pace, Cowdery, & Miltenberger, 1994b; Matson, Bamburg, Cherry, & Paclawskyj, 1999; McComas et al., 2009). This approach to treatment identification may result in the provision of more effective interventions. There are several forms of assessment that are frequently used in the field of applied behavior analysis to aid in the selection of treatment (e.g., functional analysis, curriculum-based assessment, assessment of academic performance problems).

One assessment approach requiring further investigation is to isolate variables related to acquisition-based procedures to determine appropriate prompting and intervention strategies. That is, the assessment procedure is designed to identify instructional and/or motivational variables that may influence the student's acquisition of specific skills. For example, Daly, Witt, Martens, and Dool (1997)) described the importance of conducting a functional analysis of academic performance problems. The authors hypothesized that there are five primary reasons why typically developing children may fail to complete their classroom work with a high level of integrity. These five reasons include: (1) the child is not properly motivated to complete the work, (2) the child has not spent enough time practicing the skill, (3) the child needs assistance to complete the task, (4) the child has not had to perform the skill in a particular way before, or (5) the task is too difficult. Although the authors did not directly evaluate these hypothesized variables by conducting an assessment, one of the main purposes of the article was "to stimulate research in the development of procedures that are adaptable to educational

☆ Author note: We thank Laura Mulford, Elizabeth Bullington, Rashea Fuchtman, Carissa Nohr, Lindsey Loutsch, Erica Farris, and Carla Hall for their assistance with data collection.

* Corresponding author. Tel.: +1 402 559 7038.
E-mail address: tkodak@unmc.edu (T. Kodak).

1750-9467/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.rasd.2010.11.012

settings'' (p. 9). In fact, several subsequent studies designed assessment procedures to evaluate one or more of the variables described by Daly et al.

McComas et al. extended the work of Daly et al. (1997) to the examination of instructional variables (i.e., level of modeling, contingencies for responding) on fluency with reading passages (McComas et al., 2009). Three typically developing children performing below grade level on reading passages participated in a brief experimental analysis (BEA) to identify an effective intervention for each participant. Results of the BEA indicated a different reading intervention for each participant. All three participants reached fluency outcomes consistent with their grade level following the implementation of the intervention identified by the BEA. However, the intervention indicated by the BEA was not compared to an alternative intervention procedure to determine whether the results of the assessment identified a superior reading intervention. Additional research comparing prescribed (i.e., those indicated by an assessment procedure) and alternative interventions is warranted to validate the results of the BEA.

Assessment procedures similar to the BEA may have a great deal of utility in assisting teachers and clinicians in identifying an intervention from a large pool of treatment procedures. In the skill-acquisition literature, a relatively large number of prompting procedures have been empirically validated with individuals with developmental disabilities (Charlop, Schreibman, & Thibodeau, 1985; Fisher, Kodak, & Moore, 2007; Rodgers & Iwata, 1991; Saunders & Spradlin, 1989; Wolery & Schuster, 1997). However, selecting the most effective and efficient intervention for a particular individual may present a challenge to clinicians and teachers. For example, if a child does not attend well to instructional stimuli, a number of potential treatment options may be warranted (Lerman, Vorndran, Addison, & Kuhn, 2004). Selection of a treatment procedure may be based on the extant literature regarding the effectiveness of prompting procedures, the therapists preference for certain procedures, or may simply involve a trial-and error process during which multiple treatment are implemented until one is shown to be effective. Although each of these selection strategies may identify an effective procedure, the child could be exposed to several ineffective prompting procedures before an effective treatment is identified. Thus, a critical next step for skill-acquisition research is to identify and validate an assessment procedure that will help determine the instructional variables influencing an individual's responding so that specific, assessment-based academic interventions can be evaluated.

One recent study by Lerman et al. (2004) designed an assessment tool to identify effective interventions for teaching various academic skills. Lerman et al. evaluated a methodology for assessing performance or skill deficits in individuals with autism. Two to three skills (e.g., receptive identification, matching) were assessed with each individual, and the authors evaluated whether the participant's correct responding increased when reinforcement, prompting, or prompting plus reinforcement was introduced into the learning trial. The assessment identified the procedural variables necessary for increasing correct responding during each skill. However, there were several limitations of the investigation. The authors did not differentiate between prompted and unprompted correct responses when creating the graphical displays of the data. As such, it is unclear whether the prompting procedure resulted in increases in correct unprompted responding or if the participant responded following the prompt during every trial. A second limitation is that the authors did not verify the results of the assessment by conducting an extended comparison of the intervention identified in the assessment to an alternative treatment procedure with novel targets. Thus, the methodology developed by Lerman et al. could be extended to (a) differentiate between prompted and unprompted responses, (b) compare the results of the intervention to an alternative treatment procedure, and (c) include additional instructional variables in the assessment that may influence the acquisition of skills.

The purpose of the present investigation was to refine and validate an assessment procedure to identify instructional variables influencing acquisition and evaluate an assessment-based approach to the selection of academic interventions with children diagnosed with autism.

1. Method

1.1. Participants

Eleven children diagnosed with autism participated in Experiment 1, and 4 of the 11 participants also participated in Experiment 2. All diagnoses were based on specific diagnostic criteria established by the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IVR; American Psychiatric Association [APA], 2000) and were provided by doctors and a multi-disciplinary team specializing in the assessment and treatment of ASD. Children were referred to a university-based EI clinic for the treatment of language, academic, and social skills deficits. To participate in the investigation, children had to (a) show clear deficits in acquiring conditional discriminations as evidenced by a score on the Peabody Picture Vocabulary Test (PPVT) III or IV of at least 1.5 standard deviations below the mean, (b) perform simple discriminations (i.e., 80% accuracy on identity matching tasks in which the sample stimulus is a picture and the correct comparison stimulus is a picture that is identical to that sample stimulus), and (c) have a current Individualized Education Program (IEP) or EI program goal related to the acquisition of conditional discriminations.

All participants received between 4.5 and 25 h of ABA-based EI services per week, followed one-step instructions (''Sit down''), imitated gross motor actions (e.g., clapped his/her hands when the therapist said ''do this'' and clapped her hands), and had a generalized matching-to-sample repertoire. Refer to Table 1 for additional information on each participant's age and PPVT standard score and age equivalent.

Table 1
Participants age, diagnosis, PPVT standard scores and age equivalent, and assessment results.

Participant and age (years: months)	Diagnosis/ PPVT standard score (SS) and age equivalent (AE)	BTL assessment results
Victor, 8:7	Autism/20 (SS); <2 (AE)	Low levels of attending, did not acquire target discriminations
Doug, 4:2	Autism/56 (SS); <2 (AE)	Mastered targets in ES prompting and reinforcement condition
Mark, 5:2	Autism/56 (SS); 2:3 (AE)	High levels of attending, did not acquire target discriminations
Oliver, 3:8	Autism/45 (SS); <2 (AE)	Increased attending and mastered targets in IM prompting and reinforcement condition
Eric, 4:10	Autism/66 (SS); 2:7 (AE)	Mastered targets in ES prompting and reinforcement condition
Andrew, 10:1	Autism/20 (SS); <2 (AE)	Low levels of attending, did not acquire target discriminations
Rose, 3:8	Autism/81 (SS); 2:8 (AE)	Mastered targets in reinforcement condition
Kevin, 4:4	Autism/42 (SS); <2 (AE)	Mastered targets in ES prompting and reinforcement condition
Linda, 7:1	Autism/49 (SS); 3:6 (AE)	Mastered targets in reinforcement condition
Bobby, 4:2	Autism/42 (SS); <2 (AE)	Low levels of attending, did not acquire target discriminations
Hal, 4:1	Autism/35 (SS); <2 (AE)	Increased attending in IM prompting and reinforcement condition, did not acquire target discriminations

1.2. Setting and materials

All sessions were conducted in private therapy rooms at a university-based EI program. The session room contained a table, chairs, data collectors, and all relevant session materials (e.g., picture cards, edible items). The target skill that was the focus of assessment and treatment involved teaching spoken-word-to-picture conditional discriminations. We selected spoken-word-to-picture conditional discriminations as target stimuli for the evaluation because these types of discriminations are typically targeted during school-based and EI academic programs, and each child had an IEP or EI program goal related to acquisition of conditional discriminations.

The results of the scores from the PPVT-III or -IV were used to assist in the selection of stimuli for each child during the assessment. The PPVT provides a developmental age range for children's scores on the assessment. A list of target stimuli were generated from a list of words that matched the participant's developmental level (i.e., based on the Living Word Vocabulary; Dale & Fenson, 1996), using only those words from the list that correspond to a picture. For example, according to normative data for the Living Word Vocabulary, over 50% of children can point to pictures of a banana and milk at approximately 12 months of age (Dale & Fenson, 1996). Thus, pictures of these items were included in a group of potential target stimuli for children with receptive identification skills around 12 months of age. Each stimulus consisted of a colored picture of the item.

A pre-test was conducted with each participant, which included items at a similar developmental level as those on the child's ceiling set of the PPVT (excluding actual items from the PPVT). For example, if a participant reached ceiling performance on Set 1 of the PPVT, a set of developmentally comparable stimuli (8 or 16 stimuli for the assessment and 24 stimuli for the treatment evaluation) were generated.

1.3. Response measurement and data collection

The dependent variables across all conditions were *correct responses, prompted correct responses, attending behavior, and problem behavior*. A *correct response* was defined as the participant touching only the picture that corresponded to the sample stimulus (e.g., the participant pointed to a picture of a bus when the therapist said "Point to bus.") within 5 s of the presentation of the sample stimulus. *Prompted correct responses* were defined as the child pointing to the correct picture within 5 s of a prompt. The frequency of prompted correct responses was recorded during the prompting and identity-matching conditions of the functional assessment. *Attending behavior* was defined as the participant looking at the comparison stimuli for at least 4 s (i.e., approximately 1 s for each comparison stimulus). We modified the definition of attending behavior in Hal's treatment evaluation because his prescribed treatment included blocking (i.e., only 2 stimuli were included in the array). Thus, we defined attending during the blocking treatment procedure as looking at the comparison stimuli for at least 2 s. *Problem behavior* was individually defined for each participant and included engaging in disruptive, aggressive, or self-injurious behavior during instructional trials. The percentage of correct responses was calculated using the formula: number of correct responses/number of trials × 100%. The percentage of correct responses for each sample stimulus was calculated using the formula: number of correct responses for a specific sample stimulus (e.g., "Point to bus")/number of presentations of that sample stimulus × 100%. The percentage of prompted correct responses was calculated using the formula: number of prompted correct responses/number of prompts delivered × 100%. The prompted correct responses were not counted as correct responses when determining whether the participant met the criterion for learning the target conditional discriminations (i.e., at least 80% correct for 2 consecutive sessions). The percentage of attending and problem behavior were calculated using the formula: number of occurrences of attending or problem behavior/number of trials × 100%.

1.4. Interobserver agreement

Two independent observers simultaneously collected data during each instructional trial per session. A trial was scored as an exact agreement if both observers recorded the same target responses during that trial (e.g., both score attending). The second observer collected data during 75% of Hal's, 69.4% of Bobby's, 57.5% of Kevin's, 26.9% of Linda's, 44.4% of Rose's, 97.2% of Victor's, 72.7% of Andrew's, 36.1% of Doug's, 54.5% of Oliver's, and 77.8% of Eric's assessment sessions. Exact agreement coefficients were calculated by dividing the number of trials with exact agreements in a session by the total number of trials in the session and multiplying by 100%. Mean exact agreement for all dependent variables for Hal's, Bobby's, Kevin's, Linda's, Mark's, Rose's, Victor's, Andrew's, Doug's, Oliver's assessment was 94.8% (range, 37.5–100%), 92.6% (range, 50–100%), 100%, 89.7% (range, 56.3–100%), 94.5% (range, 87.5–100%), 96.9% (range, 75–100%), 93.7% (range, 56.3–100%), 90.6% (range, 68.8–100%), 95.2% (range, 68.8–100%), 98.4% (range, 62.5–100%), and 97.2% (range, 62.5–100%), respectively. A second observer also collected data during 30.7% of Hal's, 47.5% of Bobby's, 50% of Kevin's, and 86.7% of Linda's treatment sessions. Mean exact agreement for all dependent variables for the treatment evaluation was 96.6% (range, 50–100%) for Hal, 95.5% (range, 62.5–100%) for Bobby, 100% for Kevin, and 89.9% (range, 56.3–100%) for Linda.

1.5. Procedural integrity

Data on the integrity of treatment implementation was collected during assessment and treatment evaluations for each participant. Each trial was scored as correctly implemented (i.e., *procedural integrity* of therapist behavior) across all conditions if the therapist positioned the comparison stimuli in the correct order in front of the participant, presented the sample stimulus in a clear and precise manner (e.g., "Point to dog."), delivered the appropriate consequence following a correct response (consequences varied across conditions), provided a prompt following an incorrect response or no response within the specified time interval (if relevant to the condition), and removed the task materials at the end of a trial. The entire trial was scored as incorrectly implemented if one or more of these procedures was performed incorrectly in a trial. The percentage of trials that were implemented with integrity was calculated using the formula: number of correctly implemented trials/number of trials $\times$ 100%. In the event that treatment integrity was below 90% for 2 consecutive sessions, the therapist was retrained, although this did not occur during the evaluation.

A second trained observer independently collected integrity data during 60.7% of Hal's, 69.4% of Bobby's, 57.5% of Kevin's, 26.9% of Linda's, 89.3% of Mark's, 44.4% of Rose's, 94.4% of Victor's, 72.7% of Andrew's, 36.1% of Doug's, 54.5% of Oliver's, and 77.8% of Eric's assessment sessions, respectively. Procedural integrity was calculated using the formula described above. Mean procedural integrity for assessment sessions was 99.6% (range, 93.8–100%) for Hal, 100% for Bobby, 100% for Kevin, 100% for Linda, 99.6% (range, 93.8–100%) for Mark, 100% for Rose, 96.6% (range, 93.8–100%) for Victor, 100% for Andrew, 99.5% (range, 93.8–100%) for Doug, 100% for Oliver, and 100% for Eric. In addition, procedural integrity data were collected during 30.8% of Hal's, 47.5% of Bobby's, 50% of Kevin's, and 86.7% of Linda's treatment sessions, respectively. Mean procedural integrity for treatment sessions was 99.7% (range, 93.8–100%) for Hal, 99.8% (range, 93.3–100%) for Bobby, 100% for Kevin, and 99.5% (range, 93.8–100% for Linda, respectively.

1.6. Procedure

1.6.1. Pre-test for target stimuli

During each trial, the therapist placed four comparison stimuli on a table directly in front of the participant. The therapist presented the sample stimulus in spoken format (e.g., "Point to dog."). Brief verbal praise was provided if the participant responded correctly within 5 s of presentation of the sample stimulus, and then the therapist presented the next trial. The therapist removed the pictures and provided no feedback if the participant did not respond within 5 s or responded incorrectly.

Each sample stimulus was presented four times in a random order over the course of 8, 16-trial sessions. Only sample stimuli that the participant responded to correctly at or below chance level (e.g., 25% correct; 1 of 4 correct) were used in the subsequent assessment and treatment evaluations. If the participant showed preference for a particular stimulus (pointed to the picture during more than 50% of trials where the picture was presented), the stimulus was excluded. Pre-tests were conducted until we identified 8–40 stimuli (8–16 stimuli for the functional assessment, depending on the experimental design for the assessment procedure, and 24 for the subsequent treatment evaluation). The therapist identified 8 additional target stimuli for inclusion in the replication of the assessment conditions with Linda, Kevin, and Eric.

The participant's level of correct responding during the pre-test was used to determine how the stimuli were assigned to each condition. That is, the pre-test was used to identify a pool of items that the participant identified correctly on either 0% (0 of 4) or 25% (1 of 4) trials. These stimuli were randomly assigned to conditions such that each condition had an equal number of items that were identified correctly on 0% of the pre-test trials and an equal number of items that were identified correctly on 25% of the pre-test trials. Thus, items from a group of categories (e.g., food, clothing, actions) with the same level of correct responding were placed in the pool of stimuli for each condition. In addition, we equated groups of stimuli by the number of syllables in each word.

1.6.2. Preference assessment

The therapist conducted a paired-choice preference assessment based on procedures described by Fisher, Piazza, Bowman, Hagopian, Owens, & Slevin (1992) with each participant prior to the beginning of the assessments to identify stimuli (e.g., toys, food, activities) that were used for reinforcement during the assessment and treatment evaluation. During the preference assessment, 16 stimuli were presented in pairs, and each stimulus was paired once with every other stimulus. The therapist placed the two stimuli an equal distance from the child and told the child to "Pick one." The therapist gave the child the selected stimulus, and the child had the opportunity to consume the food items or interact with the non-food stimuli (e.g., toys, activities) for 20 s. Participants' preferences were rank-ordered from most-to-least preferred based on the formula: number of times the stimulus was selected/number of times the stimulus was presented $\times$ 100%. A daily Multiple Stimulus without Replacement (MSWO; DeLeon & Iwata, 1996) assessment was conducted with the top 5 ranked items from the paired-choice assessment. The two most highly preferred stimuli identified each day were used as the reinforcers during the assessment and treatment evaluations.

2. Experiment 1: functional assessment of instructional variables

The purposes of the functional assessment procedure was to (a) identify instructional variables that influence participant's acquisition of conditional discriminations and (b) identify strategies for teaching conditional discriminations based on the results of the assessment (i.e., develop prescribed treatments). Each phase of the functional assessment was used to identify the type(s) of instructional variables influencing acquisition. The results of the functional assessment were used to prescribe individualized treatments for teaching conditional discriminations.

2.1. Procedure

During the evaluation, two–six sessions were conducted each day for two–five days per week. Each session contained 16 trials, with eight sample stimuli presented twice per session. A trial consisted of placing the four comparison stimuli in an array on the table in front of the participant, presenting the sample stimulus, waiting the allotted amount of time for a correct response, and providing any programmed prompts or consequences depending on the assessment condition.

2.1.1. Baseline

At the start of each trial, the therapist placed four comparison stimuli on a table directly in front of the participant. The therapist presented the sample stimulus in spoken format (e.g., "Point to dog."). The therapist provided brief verbal praise if the participant responded correctly within 5 s of the sample stimulus, and then the therapist presented the next trial. Task materials were removed and the therapist did not provide feedback if the participant responded incorrectly or did not respond within 5 s.

2.1.2. Baseline without praise (Linda only)

The procedures were identical to the baseline except that no differential consequences were provided for correct responding. The therapist removed task materials and implemented the next instructional trial regardless of whether Linda responded correctly or did not respond within 5 s.

2.1.3. Reinforcement (Sr+) condition

The procedures were identical to baseline except that the therapist gave the participant his or her most preferred stimulus (identified during the preference assessment described above) on a fixed-ratio 1 (FR-1) schedule following correct responding within 5 s of the sample stimulus. Participants whose most preferred stimulus was food received one small bite of food (e.g., one fruit snack). Participants whose most preferred stimulus was a non-food item (e.g., toy) received 20 s of access to the item.

2.1.4. Extra stimulus (ES) prompting and reinforcement condition

This condition was identical to the reinforcement condition except that the therapist delivered an extra-stimulus (ES) prompt (i.e., a position prompt) on each trial in which the participant did not point to the correct stimulus within 5 s of the presentation of the sample stimulus (e.g., "Touch dog"). That is, the therapist moved the correct stimulus 6 in closer to the participant and re-presented the sample stimulus if the participant pointed to one of the incorrect comparison stimuli or did not emit a response within 5 s. The therapist delivered verbal praise and the high preference stimulus if the participant pointed to the correct stimulus within 5 s of the presentation of the sample stimulus. Only praise was provided for correct prompted responses. The materials were removed and the next trial began if the participant did not emit a response within 5 s or if he/she emitted an incorrect response following the prompt.

2.1.5. Identity matching (IM) prompting and reinforcement condition

This condition was only included in the functional assessment with participants who did not display criterion-level performance (i.e., correct responding above 80% for 2 consecutive sessions) during the reinforcement or ES prompting and reinforcement conditions and who were inattentive during sessions (i.e., did not attend during at least 80% of trials for more

than half of the baseline, reinforcement, and ES prompting and reinforcement sessions). Refer to Fig. 11 for a flow chart of the order of assessment conditions and decision-making process in the functional assessment. The IM prompting and reinforcement condition was identical to the ES prompting and reinforcement condition described above except that rather than delivering an ES prompt, the therapist delivered an IM prompt (Fisher et al., 2007). That is, the therapist held up a picture card that was identical to the correct stimulus and said, "This is ___" (while pointing to the picture being held); "point to __" (while gesturing to the comparison stimuli). For example, if the target stimulus was a picture of a dog, the therapist held up a picture of a dog that was identical to the correct comparison stimulus during the IM prompt. The therapist delivered verbal praise and the high preference stimulus for correct unprompted responding. Only praise was provided for correct prompted responding. If the participant did not respond correctly within 5 s of the IM prompt, the materials were removed and the therapist initiated the next trial.

2.1.6. Experimental design

A reversal (e.g., ABCABC) design (Kevin, Linda, and Doug), a concurrent multiple baseline design(Victor, Andrew, Oliver, Eric, Mark, and Rose) or a non-concurrent multiple baseline design (Bobby and Hal) was used to compare levels of responding during baseline (A), reinforcement (B), prompting and reinforcement (C), and evaluate attending (D), if necessary.

3. Results

The results of each participant's functional assessment are listed in Table 1. Due to the large number of completed assessments, only a select number of our participants' assessment results are displayed in Figs. 1–6. The results of Bobby's functional assessment are displayed in Fig. 1 (top panel). Low levels of correct unprompted responding occurred during the baseline, reinforcement, and ES prompting and reinforcement conditions. Although Bobby engaged in high levels of correct prompted responding when the ES prompt was provided during the ES prompting and reinforcement condition, this increase in prompted responding did not result in acquisition of the target stimuli. In addition, attending behavior (displayed in Fig. 2, top panel) was below the criterion level (e.g., 80% attending) during all but one session of the functional assessment. Thus, Bobby's failure to acquire the target conditional discriminations appeared to be related to low levels of attending to the stimuli. Bobby did not engage in any problem behavior during the assessment. Although his assessment results would have

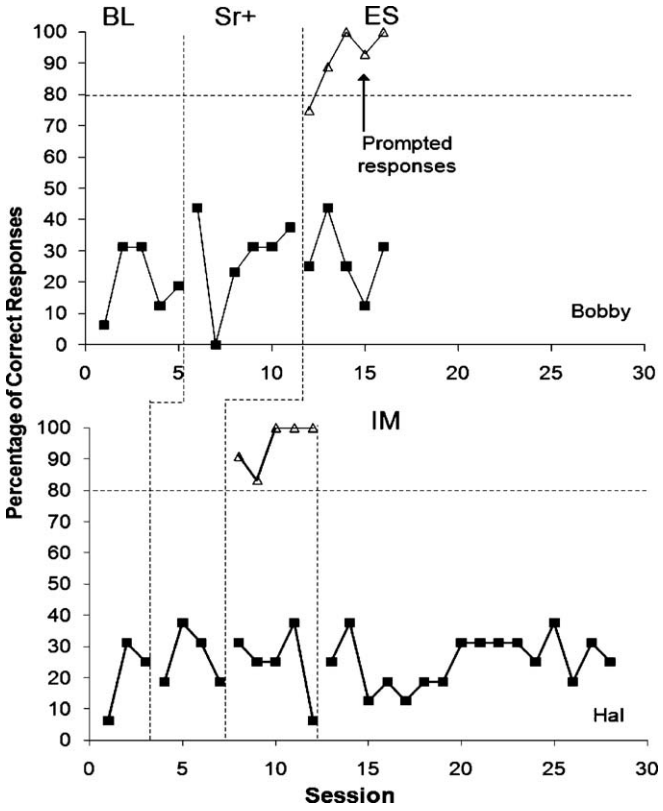

Fig. 1. The percentage of correct responses during Bobby's (top panel) and Hal's (bottom panel) functional assessment. BL = baseline condition, Sr+ = reinforcement condition, and ES = ES reinforcement and prompting condition.

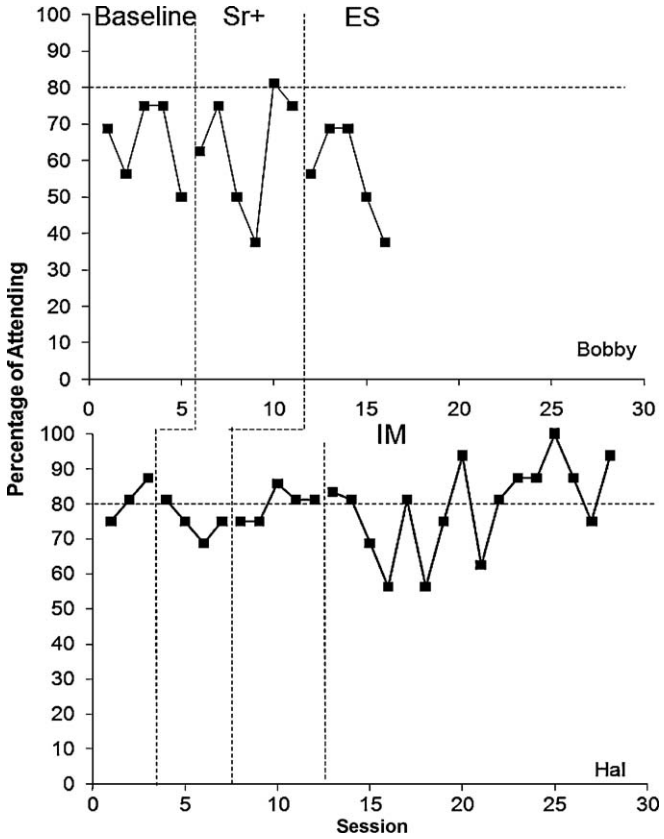

Fig. 2. The percentage of attending during Bobby's (top panel) and Hal's (bottom panel) functional assessment.

been confirmed by proceeding to the IM prompting and reinforcement condition in the functional assessment, this condition was not in place at the time the evaluation was conducted with Bobby (he was the pilot participant for the investigation).

Hal's functional assessment results are shown in Fig. 1 (bottom panel). Correct unprompted responding remained at chance level during the baseline, reinforcement, and ES prompting and reinforcement conditions. Correct prompted responding was near 100% during the ES prompting and reinforcement condition; however, responding to the ES prompt did not result in acquisition of the target stimuli. Levels of attending (shown in Fig. 2, bottom panel) were variable and below the attending criterion during 50% of sessions across all assessment conditions. Thus, we implemented the IM prompting and reinforcement condition to determine whether Hal's attending and correct unprompted responding would increase in this condition. Results indicated that Hal's attending increased (he attended above the criterion level during 75% of sessions) during the IM prompting and reinforcement condition, although correct unprompted responding remained at chance level. Hal did not engage in any problem behavior during the assessment conditions.

The results of Kevin's functional assessment are displayed in Fig. 3. Levels of correct unprompted responding (top panel) were somewhat variable in the baseline and reinforcement conditions, although his attending (bottom panel) was nearly 100% during all sessions. Kevin's correct unprompted responding reached the mastery criterion during the ES prompting and reinforcement condition. As such, we replicated the functional assessment conditions with a new set of 8 target stimuli. Correct unprompted responding was again variable in the baseline and reinforcement conditions despite attending during 100% of trials across sessions. Although Kevin's correct prompted responding was more variable in the replication of the ES prompting and reinforcement condition, we obtained similar results for correct unprompted responding when Kevin met the mastery criterion during this condition. Kevin did not engage in any problem behavior during either assessment.

Linda's functional assessment results are shown in Fig. 4. During baseline, Linda showed variable levels of correct unprompted responding (top panel) and attending (bottom panel). The initial baseline phase included praise for correct responding, and it appeared that Linda was acquiring some of the target discriminations when the therapist provided feedback for correct responding. Thus, we removed praise in the next baseline phase, and the therapist did not provide any differential consequences for correct or incorrect responding. Linda's correct unprompted responding remained near 70% despite removal of praise for correct responding, although levels of attending remained variable. When the reinforcement condition was introduced, Linda immediately displayed mastery-level performance, and attending was above the criterion during the majority of sessions.

Eight new target stimuli were identified to replicate Linda's functional assessment. The sequence of conditions varied in the second functional assessment in order to first evaluate responding during baseline in the absence of differential

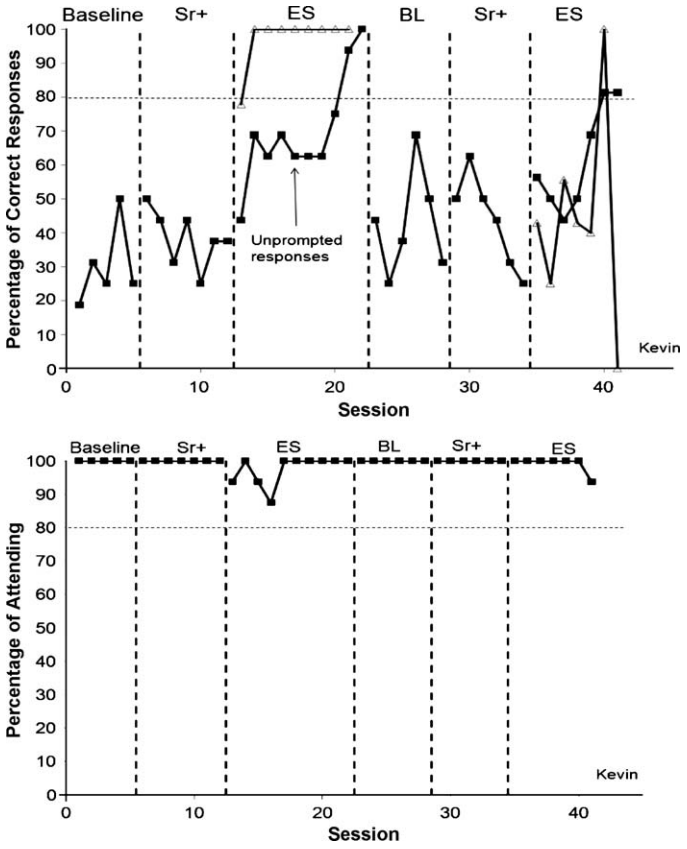

Fig. 3. The percentage of correct responses (top panel) and attending (bottom panel) during Kevin's functional assessment.

consequences (i.e., praise was not provided for correct responding). Correct responding during the baseline without praise condition was variable and near chance level, and Linda attended during 100% of trials across sessions. When the therapist provided praise following correct responding, correct unprompted responding increased although responding did not reach the mastery criterion and attending decreased and was variable. During the reinforcement condition, the therapist provided praise and highly preferred items contingent on correct unprompted responding, and Linda's correct unprompted responding immediately met the mastery criterion although attending remained variable.

The results of Doug's assessment are displayed in Fig. 5 (top panel). Doug's correct responding remained near chance level in the baseline and reinforcement conditions. Correct prompted responding was consistently high in the ES prompting and reinforcement condition, which resulted in an increase in correct unprompted responding. Doug's correct unprompted responding met the mastery criterion in the ES prompting and reinforcement condition. Doug's attending was above the criterion for the majority of sessions in the baseline and ES prompting and reinforcement conditions (Fig. 6, top panel), although we observed highly variable levels of attending during the reinforcement condition.

Rose's assessment results are displayed in Fig. 5 (middle panel). She engaged in variable levels of correct responding during baseline. Correct responding immediately increased to mastery levels when highly preferred items were provided in the reinforcement condition. Rose engaged in high levels of attending throughout all conditions of the functional assessment (Fig. 6, middle panel).

The results of Mark's assessment are displayed in Fig. 5 (bottom panel). Mark's levels of correct unprompted responding remained at chance level throughout the assessment. Although Mark consistently responded correctly following the ES prompt, the ES prompting and reinforcement condition did not produce increases in correct unprompted responding. Mark's attending was above the criterion during the majority of sessions throughout the evaluation, although attending was variable (Fig. 6, bottom panel).

4. Experiment 2: treatment evaluation

The purpose of the treatment evaluation was to establish the predictive validity of the functional assessment by testing the prescribed interventions with a subset of participants with a larger set of stimuli (i.e., 24 novel stimuli from the pre-test), over a longer period of time (i.e., up to 150 sessions), and in comparison to alternative treatments (i.e., ones not related to the participant's assessment outcomes).

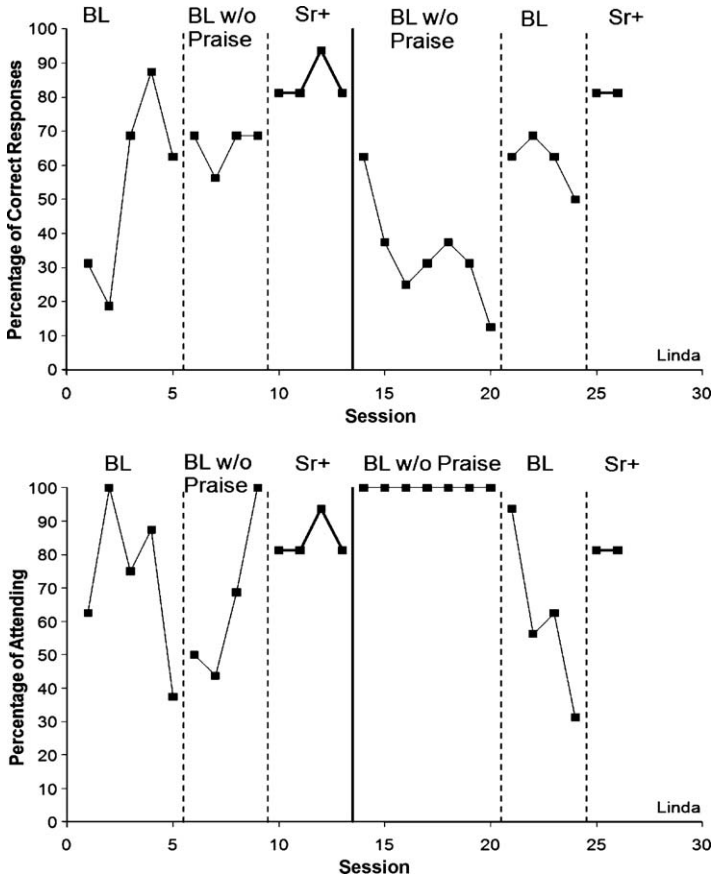

Fig. 4. The percentage of correct responses (top panel) and attending (bottom panel) during Linda's functional assessment.

We evaluated three conditions with each participant: (a) baseline (control condition), (b) the participant's prescribed treatment based on the results of the functional assessment (e.g., reinforcement for children exhibiting mastery level responding during the reinforcement condition of the functional assessment), and (c) one of the alternative treatments that was *not* functionally related to the participant's assessment results (e.g., one selected randomly from the treatments prescribed for participants with different outcomes on their functional assessment), which was referred to as the *alternative* treatment. Thus, we conducted this evaluation to determine if the prescribed treatment was more effective for teaching conditional discriminations than baseline and an alternative treatment.

We used an adapted alternating treatments design to compare acquisition across the three treatment conditions (Sindelar, Rosenberg, & Wilson, 1985). We assigned 8 stimuli to each treatment condition and equated the conditions in relation to the level of correct responding for each target in the pre-tests and the number of syllables in each word. These conditions were assigned randomly to sessions in blocks of three such that each condition was conducted once in each block of three sessions. Three to six sessions were conducted each day, two to five times per week. The therapist conducted sessions until the participant reached criterion performance (80% correct for 2 consecutive sessions) in one of the treatment conditions.

4.1. Procedure

4.1.1. Preference assessment

The therapist conducted a daily MSWO assessment (as described in Experiment 1) to identify the participant's two most preferred items for use during the treatment evaluation.

4.1.2. Prescribed treatment for children displaying mastery level responding during the reinforcement phase

Results of participants whose correct responding (a) was less than 80% during the baseline, and (b) increased to at least 80% or above for 2 consecutive sessions (i.e., criterion level) during the reinforcement condition suggested that a motivational rather than a skill deficit was the variable responsible for the participant's low levels of correct responding during the baseline condition. Reinforcement was the prescribed treatment for individuals who acquired the target discriminations during the reinforcement condition of the functional assessment.

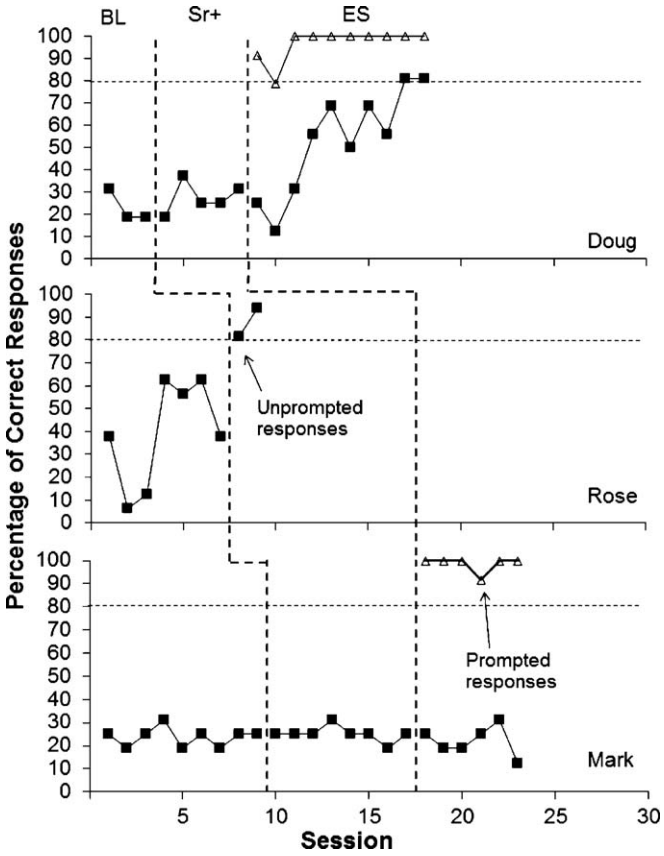

Fig. 5. Percentage of correct responses during Doug's, Rose's, and Mark's functional assessment.

The prescribed treatment was identical to the procedure described for the reinforcement condition of the assessment. Linda acquired the target stimuli during the reinforcement condition of the functional assessment. We compared her prescribed treatment (i.e. reinforcement) to an alternative treatment that was randomly selected, which was the IM prompting and reinforcement procedure (refer to Table 2 for a description of each participant's prescribed and alternative treatment). However, unlike the description of the IM prompting and reinforcement procedure in the functional assessment, it is important to note that only mild praise (e.g., "That's right") and no high-preference stimuli were provided for correct unprompted responding during the alternative treatment for children who had reinforcement as a prescribed treatment because of the prediction that reinforcement was the functional treatment component for these participants. Thus, the therapist delivered reinforcement (i.e., an edible item) in Linda's prescribed treatment but not in the alternative treatment.

4.1.3. Prescribed treatment for children displaying mastery level responding during the ES prompting plus reinforcement condition

Participants who showed high levels of attending behavior (attended during at least 80% of trials) and who showed criterion-level performance during the ES prompting and reinforcement condition of the functional assessment were prescribed the ES prompting and reinforcement treatment.

The prescribed treatment for children displaying mastery level responding during the ES prompting and reinforcement condition was identical to the procedure described for the ES prompting and reinforcement condition of the functional assessment. Kevin mastered the target conditional discriminations in the ES prompting plus reinforcement condition of the functional assessment; therefore, the ES prompting and reinforcement condition was his prescribed treatment. The alternative treatment that was randomly selected for Kevin's treatment evaluation was the treatment prescribed for children who displayed high levels of attending behavior but who did not acquire the target discriminations during the assessment. That is, the alternative treatment was blocking (described in detail below under the subheading "Prescribed treatment for children who did not acquire the target discriminations and who displayed low levels of attending behavior"). However, unlike this prescribed procedure for children with these assessment results, which involved blocking plus an embedded IM prompt, Kevin's blocking treatment *did not* include an IM prompt. We did not evaluate the blocking procedure (without the IM prompt) as a prescribed treatment with any of the participants.

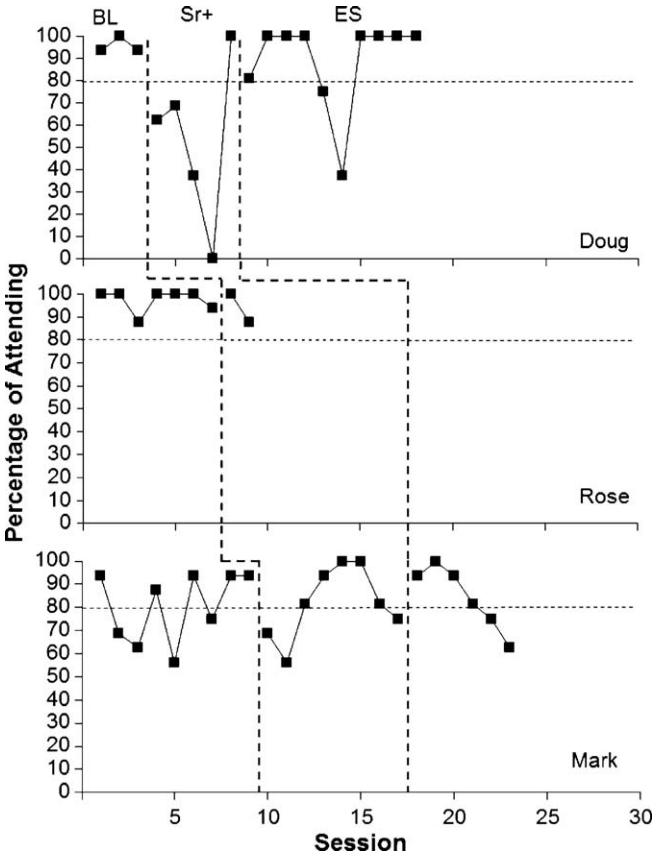

Fig. 6. Percentage of attending during Doug's, Rose's, and Mark's functional assessment.

4.1.4. Prescribed treatment for children exhibiting low levels of attending behavior

Participants who showed low levels of attending behavior (attended during less than 80% of trials) and who did *not* show criterion-level performance during the ES prompting and reinforcement condition may require a procedure to increase the probability of attending behavior in order to learn conditional discriminations. In a previous investigation, an embedded IM prompt increased correct responding in two individuals who did not learn discriminations because they failed to attend to the comparison stimuli in conditions during which other prompts (e.g., ES prompts) were utilized (Fisher et al., 2007). Fisher et al. hypothesized that the IM prompt functioned as a differential observing response that increased the likelihood of participants attending to the sample and comparison stimuli. Thus, reinforcement plus an embedded IM-prompting procedure was the prescribed treatment for children with this pattern of responding during the functional assessment.

Treatment was identical to the procedure described during the IM prompting and reinforcement condition of the functional assessment. The IM prompting and reinforcement procedure was prescribed for Bobby based on the results of his functional assessment. We randomly selected the ES prompting plus reinforcement treatment as the alternative treatment that was compared to Bobby's prescribed treatment.

Table 2
The assessment results, prescribed treatment, and alternative treatment for each participant in Experiment 2.

Participant	BTL results	Prescribed treatment	Alternative treatment	Comments
Bobby	Low levels of attending; did not acquire target discriminations in ES prompting and reinforcement condition	IM prompting and reinforcement	ES prompting and reinforcement	
Hal	Increased attending in IM prompting and reinforcement condition; did not acquire target discriminations	Blocking plus IM prompt	Reinforcement	
Kevin	Mastered targets in ES prompting and reinforcement condition	ES prompting and reinforcement	Blocking	
Linda	Mastered targets in reinforcement condition	Reinforcement	IM prompting	No tangible item for correct responding during IM prompting condition

4.1.5. Prescribed treatment for children who did not acquire target discriminations and who exhibit low levels of attending behavior

The results of participants who displayed low levels of attending (attended during less than 80% of trials) during the functional assessment and who continued to show low levels of correct responding during the IM prompting and reinforcement condition despite an increase in attending behavior indicate that the discrimination task may need to be simplified to promote acquisition. Although there are a number of procedures that are appropriate for use with individuals who display difficulty acquiring conditional discriminations, the blocking procedure developed by Saunders and Spradlin (1990) has demonstrated effectiveness with individuals with severe impairments in cognitive functioning. In addition, blocking does not require modification of instructional stimuli that may be time consuming or cumbersome to teachers in various educational settings (e.g., schools). Thus, the blocking procedure with an embedded IM prompt was the prescribed procedure for individuals who displayed difficulty acquiring conditional discriminations and who engaged in low levels of attending behavior.

Hal displayed this pattern of responding during the assessment, and blocking combined with an IM prompt was his prescribed treatment. During treatment, we reduced the size of the array to two stimuli and used a blocking procedure to teach a set of conditional discriminations (Saunders & Spradlin, 1990). Prior to the start of the first session, one sample stimulus (e.g., "Point to horse.") was selected randomly from the set of 8 stimuli assigned to this treatment. The therapist repeatedly presented one sample stimulus (with two comparison stimuli in an array) in a 16-trial session until Hal displayed criterion-level performance (i.e., at least 80% correct for one 16-trial session). If Hal did not point to the correct stimulus within 5 s of presentation of the sample stimulus, the therapist provided an IM prompt.

Following criterion-level performance for the first stimulus, the therapist presented a second sample stimulus (e.g., "Point to bird.") in the same manner as the first until Hal displayed criterion-level performance to the second stimulus. The size of the blocks then was reduced by half (to 8 trials for each block). The therapist presented one of the two stimuli (randomly selected) repeatedly for the first half of the session (8 trials) and presented the other stimulus in the second half of the session (8 trials). Each time Hal reached criterion-level performance with these two stimuli, the therapist decreased the block size by half until the block size reached 1 and both stimuli were randomly alternated in trials throughout the same session. We repeated the blocking procedure across sets of two stimuli until Hal mastered all target stimuli in this condition. We compared Hal's prescribed treatment to a randomly selected alternative treatment, which was reinforcement.

5. Results

Bobby's treatment evaluation is displayed in Fig. 7. Bobby's correct unprompted responding was near chance level during the beginning of treatment across all conditions (top panel). However, the stimuli in the prescribed treatment (i.e., IM prompting and reinforcement) reached mastery-level responding, and correct unprompted responding remained low during the control and alternative treatment conditions. In addition, the prescribed treatment resulted in higher levels of attending (bottom panel) than the alternative and control conditions. In fact, Bobby's attending was never above the criterion in the alternative treatment condition. Thus, Bobby's results indicated that the prescribed treatment based on the results of the functional assessment was a superior treatment procedure.

The results of Hal's treatment evaluation are shown in Fig. 8. Hal did not acquire the target discriminations and exhibited low levels of attending behavior in the functional assessment. The prescribed treatment for Hal was blocking plus an embedded, IM prompt. Blocks of two stimuli were targeted for teaching, and Hal mastered the first set of stimuli in 26 sessions. The second and third sets of stimuli were acquired more quickly, although the final set of stimuli required 35 sessions to reach the mastery criterion. Thus, Hal acquired all target stimuli in the prescribed treatment condition. Correct unprompted responding in the alternative and control conditions remained at chance level throughout the entire treatment evaluation. Hal's attending (bottom panel) was above the criterion in 65 sessions (66% of the sessions) during the prescribed treatment, while attending was above the criterion in only 7 (7% of sessions) and 20 sessions (20% of sessions) during the control and alternative treatment conditions, respectively. Therefore, the prescribed treatment was the only treatment procedure resulting in mastery of target discriminations and higher levels of attending.

Kevin's treatment evaluation indicated that the prescribed treatment (ES prompting and reinforcement for children who display mastery level responding in the ES prompting and reinforcement condition of the functional assessment) was superior to the control and alternative treatment conditions (Fig. 9). The alternative treatment (blocking) did not result in any correct unprompted responses, while responding in the control condition remained near 50% throughout the treatment evaluation (top panel). Kevin appeared to respond away from the first stimulus trained in blocking, which is why his correct responding remained at zero for several sessions. In comparison, the prescribed treatment resulted in rapid acquisition of the target discriminations. Kevin reached mastery-level responding in just five sessions of the prescribed treatment. Attending (bottom panel) was 100% across all conditions.

The results of Linda's treatment evaluation are shown in Fig. 10. Correct unprompted responding increased across sessions of the prescribed treatment (reinforcement). Linda achieved criterion-level responding after only four sessions of treatment during the prescribed treatment, and mastery-level responding was obtained in five sessions. Correct unprompted responding during the control condition remained below 50%. High levels of correct unprompted responding were observed during the initial session of the alternative treatment (i.e., IM prompt). Correct unprompted responding increased to the mastery-level criterion in five sessions of the alternative treatment. Thus, both the prescribed and

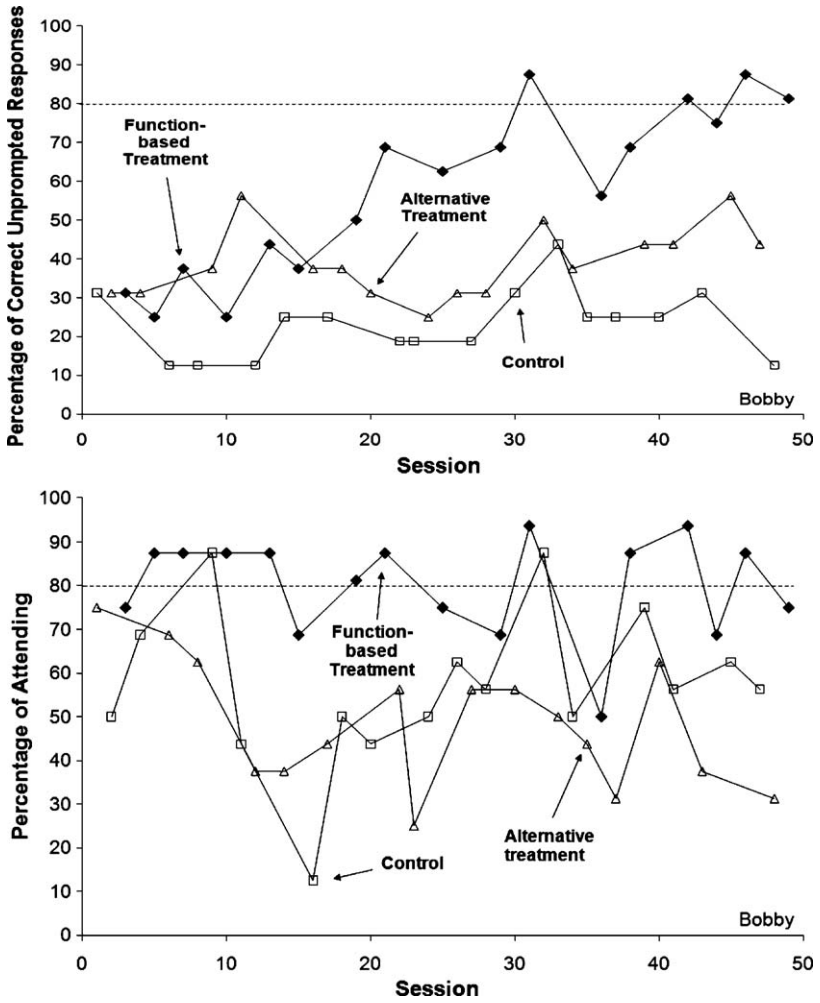

Fig. 7. The percentage of correct responses (top panel) and attending (bottom panel) during Bobby's treatment evaluation.

alternative treatments reached the mastery criterion in approximately the same number of sessions. Levels of attending were similar during the prescribed and alternative treatments (Fig. 10, bottom panel). Linda's attending was only above the criterion during one session in the prescribed and alternative treatments, although attending was never above the criterion in the control condition. Overall, results indicated that both the prescribed and alternative treatments were effective interventions.

6. Discussion

The functional assessment allowed for an evaluation of specific instructional variables that may influence acquisition of conditional discriminations with individuals diagnosed with autism. Based on the results of the functional assessment, a prescribed treatment procedure was identified for each pattern of responding. The 11 participants all displayed different patterns of responding during the functional assessment. Results of the treatment evaluation with a subset of the participants indicated that the prescribed treatment based on the participant's assessment results was superior or equal to (in Linda's case) the alternative treatment and control conditions for all participants. Therefore, we validated the utility of the functional assessment by demonstrating that the assessment procedure effectively identified an ideal treatment procedure for teaching conditional discriminations to individuals diagnosed with autism (see Fig. 11).

The results of the study extend the literature on functional assessment and function-based treatment in multiple ways. First, the results extend those of Lerman et al. (2004) by validating the results of an assessment procedure to identify effective academic interventions for individuals with autism. Although Lerman et al. evaluated whether participant's correct responding increased under various assessment conditions (i.e., reinforcement, prompting), the authors did not report data on unprompted and prompted correct responding separately. Thus, participant may have responded correctly following prompts although the prompts did not result in an increase in correct unprompted responding. In the current investigation,

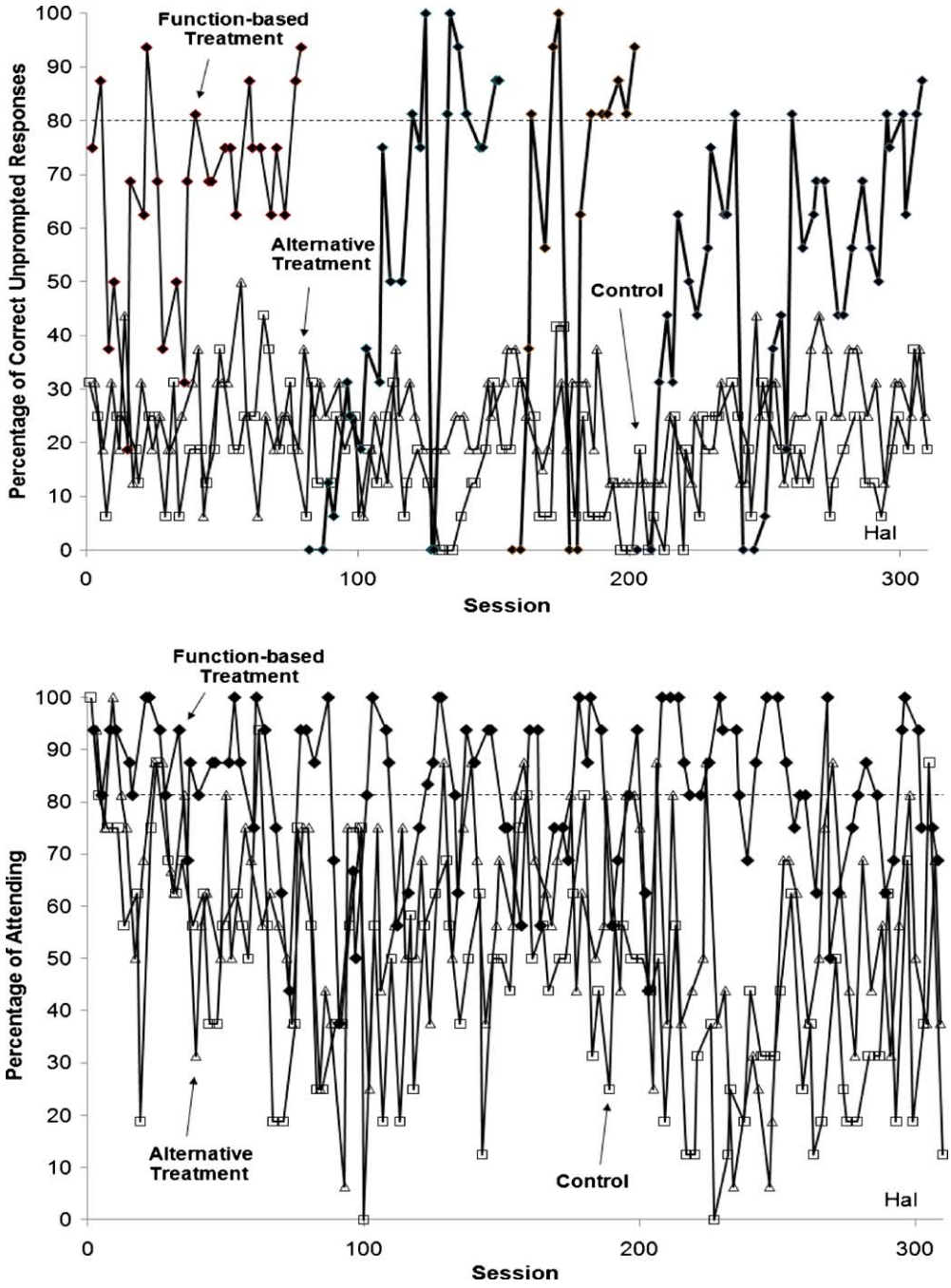

Fig. 8. The percentage of correct responses (top panel) and attending (bottom panel) during Hal's treatment evaluation.

eight participants engaged in high levels of correct prompted responses during the ES prompting and reinforcement condition, and responding to the prompt only resulted in increased correct unprompted responding in three participants (Doug, Eric, and Kevin). As such, if we graphed data in the present investigation as total correct responses instead of correct prompted or unprompted responses, the results may have indicated that the ES prompt was an effective treatment procedure. This could have led to use of an ineffective treatment procedure for five of the participants. In fact, Bobby's alternative treatment procedure in the treatment comparison was ES prompting and reinforcement, and results indicated that Bobby's correct unprompted responding remained near chance level throughout the treatment evaluation. This finding highlights the importance of conducting an assessment that measures correct unprompted responding so that the most effective treatment procedure can be identified.

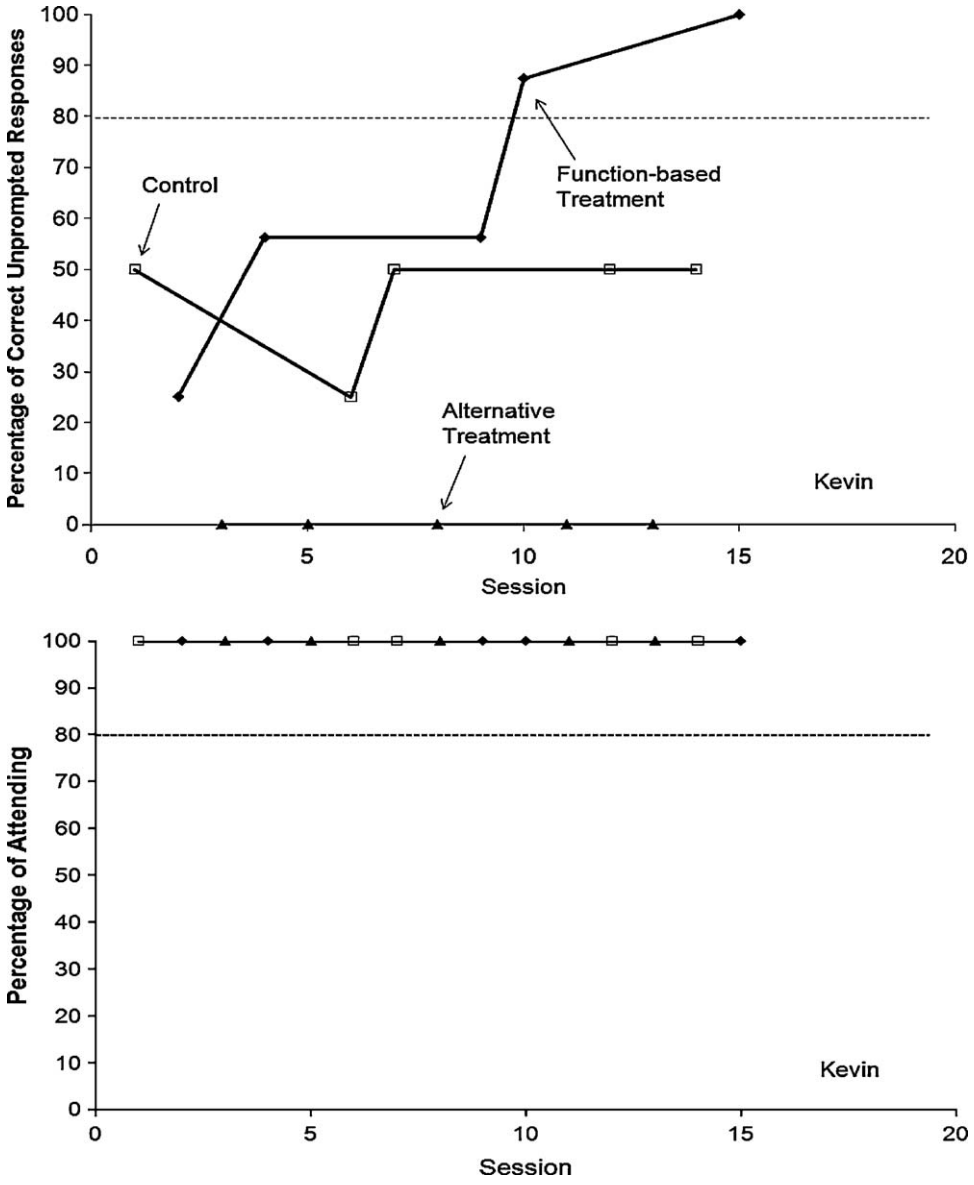

Fig. 9. The percentage of correct responses (top panel) and attending (bottom panel) during Kevin's treatment evaluation.

The current findings also extend the literature on functional assessment by evaluating an assessment procedure to identify multiple instructional variables influencing an individual's acquisition of conditional discriminations. We extended the results of Lerman et al. (2004) and McComas et al. (2009) by evaluating additional instructional variables (i.e., attending, simplified teaching procedures) influencing the rate of acquisition of conditional discriminations. In addition, we extended previous studies that evaluated assessment-based academic interventions (Bourret et al., 2004; Lerman et al., 2004; McComas et al., 2009) by comparing the prescribed treatment (based on the results of the assessment) with an alternative (empirically validated) treatment and control condition. Although the assessment identified a procedure that was effective for teaching conditional discriminations to seven participants, a treatment comparison is important to validate the results of the assessment. In the absence of a treatment comparison, it remains unclear whether the prescribed treatment is more effective or efficient than other, commonly used intervention procedures. The results of the functional assessment indicated that different treatment procedures were prescribed for participants, and the prescribed treatments were superior to other empirically validated treatment procedures for three of the four participants. As such, the functional assessment may aide in the identification of individual variables that affect children's response to common intervention procedures used to teach conditional discriminations.

There were several limitations of the present investigation. Linda's prescribed and alternative treatment both resulted in similar rates of acquisition of the target discriminations. The alternative treatment that was randomly selected was an

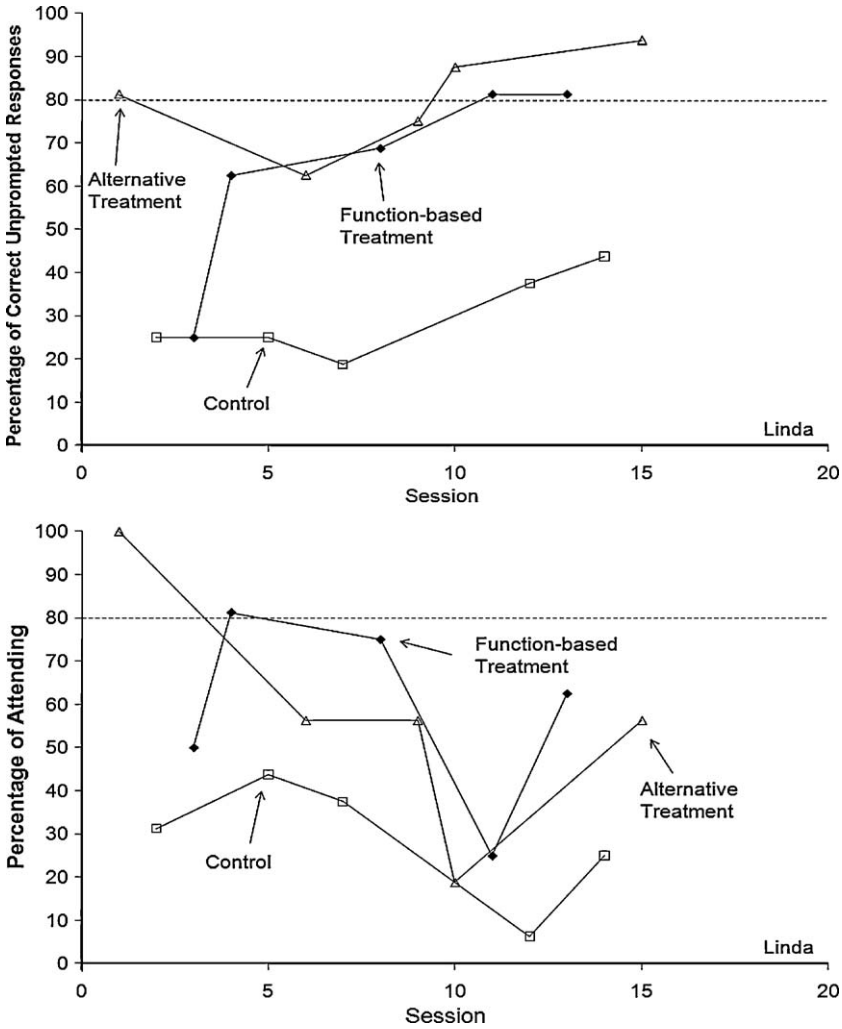

Fig. 10. The percentage of correct responses (top panel) and attending (bottom panel) during Linda's treatment evaluation.

embedded, IM prompt. Given Linda's lower levels of attending during the functional assessment and treatment evaluation, it's possible that Linda would benefit from a procedure to increase attending (e.g., IM prompt). However, high levels of attending during treatment were not observed during the IM condition. Thus, it remains unclear whether an IM prompt was beneficial during treatment. An alternative explanation for high levels of correct responding during the alternative treatment is that the therapist provided praise for correct responding during the IM prompt treatment. Linda displayed somewhat higher levels of correct responding during the functional assessment when praise was provided following correct responding. Although correct responding did not reach mastery level during the functional assessment when only praise was provided, the combination of praise and an IM prompt, which was delivered contingent on incorrect responses or failure to respond within 5 s of presentation of the sample stimulus during the treatment evaluation, may have provided sufficient motivation to engage in correct unprompted responses.

Linda's baseline procedures in the functional assessment varied from those of the other participants. The initial baseline included praised following correct responding, and we observed an increase in correct unprompted during this condition. In the replication of the assessment, the therapist did not provide any differential consequences following correct responding in the initial baseline (i.e., baseline w/o praise). When the therapist provided praise for correct responses in the second baseline phase (i.e., baseline), Linda's correct responding increased in the first session, but the data showed a downward trend in the remainder of the phase. Correct responding increased to mastery level in the first two sessions of the reinforcement condition during which the therapist provided highly preferred edibles for correct responding. It is possible that Linda would have met the mastery criterion had we continued to conduct sessions in the baseline condition that included praise. However, the purpose of the assessment was to identify the most effective and *efficient* treatment procedure because the participants included in the evaluation had a history of slow acquisition of conditional discriminations (i.e., PPVT scores were at least 1.5 standard deviations below the mean). Thus, continuing to run baseline sessions with praise following

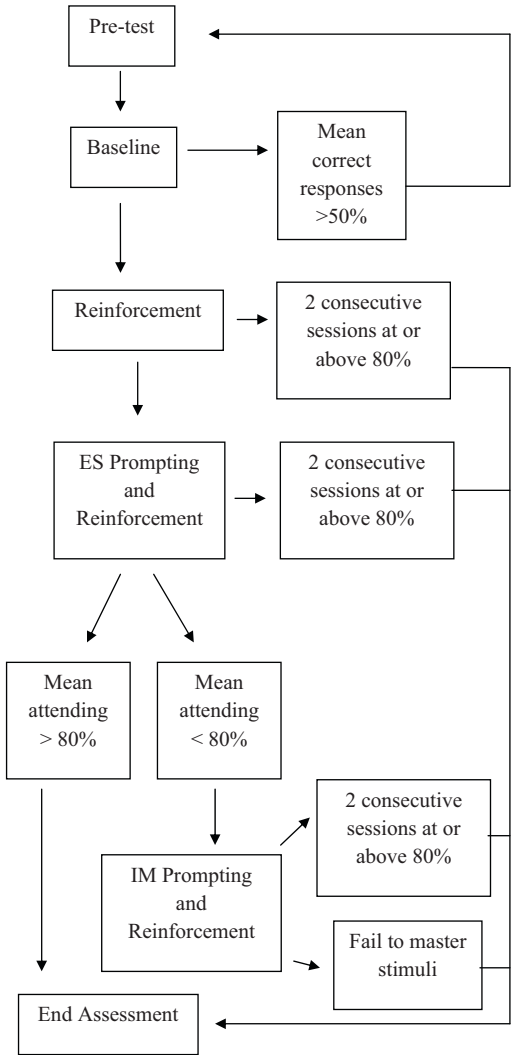

Fig. 11. A flow chart for the order of BTL assessment conditions.

correct responding may have eventually resulted in mastery, but acquisition of conditional discriminations occurred rapidly when the therapist delivered highly preferred items (e.g., edibles) contingent on correct responding. Future research is needed to identify children who show some acquisition in baseline conditions that include praise. Children with this pattern of responding in the functional assessment could participate in an additional evaluation in which the rate of acquisition of conditional discriminations is compared during baseline (with praise) and reinforcement conditions. This type of evaluation may help identify how best to conduct baseline sessions in the functional assessment to capture the conditions under which an effective and efficient treatment can be identified.

The selection of an alternative treatment procedure could also be considered a limitation of the evaluation. The alternative treatment could have included those used in the child's natural environment to teach conditional discriminations. However, selecting intervention in this manner would have created a "straw man" comparison because the procedures utilized in several of our participant's classroom settings were not characteristic of any empirically validated prompting procedure (e.g., repeating the instruction multiple times without delivering a controlling prompt). Another approach to selecting an alternative intervention is to identify one treatment procedure based on best practices from which to compare all prescribed interventions based on the results of the functional assessment. However, selecting one treatment that may constitute best practice for all participants could be difficult given the student's unique responses to the empirically validated academic interventions included in the functional assessment. Additional studies could evaluate one of the aforementioned strategies for selecting an alternative intervention, and compare the results of the alternative intervention to the prescribed treatment from the functional assessment.

Another limitation of the evaluation is that the IM prompting and reinforcement condition was not conducted in Bobby's functional assessment to confirm the appropriate, prescribed treatment. Bobby was the pilot participant for this

investigation, and the IM prompting and reinforcement condition was not part of the assessment procedure at the time we conducted his functional assessment. Despite the absence of this condition in the assessment, the treatment evaluation indicated that the IM prompting and reinforcement treatment procedure produced mastery-level responding, more sessions with criterion-level attending, and was superior to the control and alternative treatment conditions.

The length of time required to attend to materials to meet the definition of attending may be considered another potential limitation of the investigation. The amount of time necessary to adequately scan the stimuli in the array may vary across participants. The attending criterion was set at a level that seemed adequate to ensure the participants looked at each stimulus (i.e., approximately 1 s per stimulus). However, several variables may influence the adequacy of this criterion. For example, some participants may be able to scan the array in less than 4 s. Time spent scanning materials may be related to the participant's cognitive functioning, although future research is needed to evaluate this relationship. Regardless of whether an individual is capable of scanning an array in less than 4 s, sustained attention to educational materials is an important component of effective instruction. As such, the evaluation of a treatment procedure to increase attending in individuals who did not attend to stimuli for at least 4 s is warranted.

The assessment tool in the present investigation only identified specific instructional variables influencing children's acquisition of conditional discriminations. We selected conditional discriminations as a target skill because these types of discriminations are considered by many to be critical building blocks necessary for the development of generative language (Spradlin & Brady, 1999), and the ability to discriminate is a fundamental skill for many types of tasks and is typically a high-priority goal in many educational programs for individuals diagnosed with autism (Green, 1996). However, it remains unclear whether the instructional variables identified in the assessment would be similar across different skills. Future research should examine the utility of the functional assessment with other types of academic skills.

Although none of our participants displayed problem behavior during the assessment and treatment comparison, many individuals with ASD engage in problem behavior during academic tasks (Hanley, Iwata, & McCord, 2003; Iwata et al., 1982, 1994a,b). Lerman et al. (2004) reported a history of problem behavior in the majority of participants included in the study, but the authors did not indicate whether problem behavior occurred during the assessment. Thus, individuals with ASD may be more likely to display problem behavior that may interfere with the acquisition of conditional discriminations. The test condition relevant to individuals displaying problem behavior that could be included in future functional assessments.

Certain assessment outcomes (e.g., children who do not acquire target discriminations in any of the assessment conditions, children exhibiting low levels of attending behavior) may be more common in individuals with ASD given the cognitive deficits associated with most of the ASD diagnoses. Thus, future research should examine the prevalence of various assessment outcomes across individuals with different diagnoses, and evaluate prescribed academic interventions associated with these outcomes. In addition, idiosyncratic instructional variables may influence learning and warrant unique academic interventions (e.g., side biases). Previous research has identified idiosyncratic functions of individual's problem behavior (Carr, Yarbrough, & Langdon, 1997), and it is likely that instructional variables influencing the rate of acquisition may also be idiosyncratic across individuals. Future research should examine whether additional assessment conditions are necessary as the functional assessment in the present investigation is conducted with more individuals.

The current study sought to extend the literature linking functional assessment to the selection of effective, prescribed academic interventions. This approach to the identification of effective interventions could improve the manner in which academic interventions are selected for individuals with developmental disabilities. With additional research on assessment-based academic interventions, we can begin to individualize treatment in hopes of bridging the gap between the skill level of individuals with developmental disabilities and their typically developing peers.

References

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed. Text revision). Washington, DC: Author.

Bourret, J., Vollmer, T. R., & Rapp, J. T. (2004). Evaluation of a vocal mand assessment and vocal mand training procedures. *Journal of Applied Behavior Analysis, 37*, 129–144.

Carr, E. G., Yarbrough, S. C., & Langdon, N. A. (1997). Effects of idiosyncratic stimulus variables on functional analysis outcomes. *Journal of Applied Behavior Analysis, 30*, 673–686.

Charlop, M. H., Schreibman, L., & Thibodeau, M. G. (1985). Increasing spontaneous verbal responding in children using a time delay procedure. *Journal of Applied Behavior Analysis, 18*, 155–166.

Dale, P. S., & Fenson, L. (1996). Lexical development norms for young children. *Behavior Research Methods, Instruments, and Computers, 28*, 125–127.

Daly, E. J., III, Witt, J. C., Martens, B. K., & Dool, E. J. (1997). A model for conducting a functional analysis of academic performance problems. *School Psychology Review, 26*, 554–574.

DeLeon, I. G., & Iwata, B. A. (1996). Evaluation of a multiple-stimulus presentation format for assessing reinforcer preferences. *Journal of Applied Behavior Analysis, 29*, 519–532.

Fisher, W. W., Kodak, T., & Moore, J. W. (2007). Embedding an identity-matching task within a prompting hierarchy to facilitate acquisition of conditional discriminations in children with autism. *Journal of Applied Behavior Analysis, 40*, 489–499.

Fisher, W., Piazza, C. C., Bowman, L. G., Hagopian, L. P., Owens, J. C., & Slevin, I. (1992). A comparison of two approaches for identifying reinforcers for persons with severe and profound disabilities. *Journal of Applied Behavior Analysis, 25*, 491–498.

Green, G. (1996). Early behavior intervention for autism: What does research tell us? In G. Maurice, G. Green, & S. C. Luce (Eds.), *Behavior interventions for young children with autism*. Austin, TX: Pro Ed.

Hanley, G. P., Iwata, B. A., & McCord, B. E. (2003). Functional analysis of problem behavior: A review. *Journal of Applied Behavior Analysis, 36*, 147–185.

Iwata, B. A., Dorsey, M. F., Slifer, K. J., Bauman, K. E., & Richman, G. S. (1994). Toward a functional analysis of self-injury. *Journal of Applied Behavior Analysis, 27*, 197–209.

Iwata, B. A., Pace, G. M., Cowdery, G. E., & Miltenberger, R. G. (1994). What makes extinction work: An analysis of procedural form and function. *Journal of Applied Behavior Analysis, 27*, 131–144.

Lerman, D. C., Vorndran, C., Addison, L., & Kuhn, S. A. C. (2004). A rapid assessment of skills in young children with autism. *Journal of Applied Behavior Analysis, 37*, 11–26.

Matson, J. L., Bamburg, J. W., Cherry, K. E., & Paclawskyj, T. R. (1999). A validity study on the Questions About Behavioral Function (QABF) scale: Predicting treatment success for self-injury, aggression, and stereotypies. *Research in Developmental Disabilities, 20*, 163–175.

McComas, J. J., Wagner, D., Chaffin, M. C., Holton, E., McDonnell, M., & Moon, E. (2009). Prescriptive analysis: Further individualization of hypothesis testing in brief experimental analysis of reading fluency. *Journal of Behavioral Education, 18*, 56–70.

Rodgers, T. A., & Iwata, B. A. (1991). An analysis of error-correction procedures during discrimination training. *Journal of Applied Behavior Analysis, 24*, 775–781.

Saunders, K. J., & Spradlin, J. E. (1989). Conditional discrimination in mentally retarded adults: The effect of training the component simple discriminations. *Journal of the Experimental Analysis of Behavior, 52*, 1–12.

Saunders, K. J., & Spradlin, J. E. (1990). Conditional discrimination in mentally retarded adults: The development of generalized skills. *Journal of the Experimental Analysis of Behavior, 54*, 239–250.

Sindelar, P. T., Rosenberg, M. S., & Wilson, R. J. (1985). An adapted alternating treatment design for instructional research. *Education and Treatment of Children, 81*, 67–76.

Spradlin, J. E., & Brady, N. C. (1999). Early childhood autism and stimulus control. In P. M. Ghezzi, W. L. Williams, & J. E. Carr (Eds.), *Autism: Behavior analytic perspectives*. Reno, NV: Context Press.

Wolery, M., & Schuster, J. W. (1997). Instructional methods with students who have significant disabilities. *The Journal of Special Education, 31*, 61–79.