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Effects of Discrimination Abilities on Functional Analysis Outcomes

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Abstract

This study evaluated the extent to which conditional discrimination abilities affected a participant's differential responding during a standard multielement analogue functional analysis (FA). Eight individuals participated. The Assessment of Basic Learning Abilities (ABLA) was conducted with each participant prior to the FA to determine his or her discrimination ability. A brief FA was then conducted with all eight participants and recorded responding in FA conditions with and without the inclusion of programmed discriminative stimuli (S^Ds). Results indicated that all participants able to make a conditional discrimination demonstrated differential responding during the FA whereas only half of the participants unable to make conditional discriminations did so. Results also indicated that the inclusion of programmed S^Ds facilitated discrimination for the majority of the participants who were able to make a conditional discrimination and did not affect the responding of the participants who could not make the conditional discrimination.

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Effects of Discrimination Abilities on Functional Analysis Outcomes

Analog Functional Analysis (FA) methodology is a widely used assessment that systematically arranges the environment in order to determine the variables that maintain aberrant behavior. Representing the highest experimental control within the general functional assessment approach, FA assessment systematically manipulates both social and physical environmental events that might differentially effect behavioral responding. Five conditions comprise the assessment: alone, attention, play, demand, and tangible. The standard way of conducting a functional analysis is through the use of a multielement design in which behavior is measured under rapidly alternating conditions until differential responding is observed (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994).

The advantages of using a multielement treatment design include its utility for rapidly comparing many variables within the context of other potentially uncontrolled variables and to reduce multiple treatment interference that can arise from long historical exposure to experimental variables (Haines & Baer, 1989). There are also several disadvantages to using the multielement design. Multiple treatment interference is often seen when using a multiple baseline design which may be due to length of changeover interval between treatments or by lack of discrimination between treatment conditions (McGonigle, Rojahn, Dixon, & Strain, 1987). Sequence, carryover, and alternation effects, all referring to one experimental treatment interfering with another, must all be considered and anticipated when using a multielement design (Haines & Baer, 1989).

While the analogue functional analysis has been shown to be the most effective assessment procedure in determining functions of problem behavior, there are also several disadvantages to its methodology. The assessment can be very tedious and time consuming, requiring exposure to potentially aversive experimental settings, and does not always provide conclusive results. In the most widely referenced article on functional analysis, Iwata et al. (1982/1994) found that three of nine participants did not show differentiation in their behavioral responding across conditions. The authors provide some insight as to why this may have occurred:

> "Although it is impossible to determine what may have accounted for these results, several possibilities appear likely. Each of these subjects was either quite young or profoundly retarded, and it is possible that the different conditions were not clearly discriminable to them (Iwata et al., 1982/1994)."

The popularity of the analogue functional analysis has lead to further research on improving the assessment. One manipulation is the brief functional analysis, a shorter version of the original functional analysis. The brief functional analysis allows for individuals to be assessed in a shorter period of time, without using less accurate assessments (e.g., descriptive analysis, caregiver interviews). For example, Northup et al. (1991) used a brief functional analysis to identify maintaining variables of aggressive behavior in 3 individuals. They conducted 5 to 10 minute conditions with a 1 to 2 minute break between each condition. In a comparison study, Wallace & Knights (2003) conducted a brief functional analysis using 2 minutes per condition, and an extended functional analysis using 10 minutes per condition, with 3 individuals with developmental disabilities. Results of the study demonstrated that the brief assessment identified the function of problem behavior for 2 of 3 participants. A large-scale evaluation (N=79) of brief functional analysis by Derby et al. (1992) concluded that undifferentiated responding was observed in about half of the cases, which they attributed partially to a lack of discrimination between conditions.

Rapid discrimination is critical during a functional analysis, especially during the brief functional analysis, where conditions are alternating frequently. Therefore, another addition to the functional analysis methodology is the inclusion of programmed discriminative stimuli. A discriminative stimulus is defined as a stimulus that has been associated with either reinforcement or punishment and functions to establish stimulus control over a desired behavior (Martin & Pear, 2008). In response to Iwata's (1994) comment on discrimination, many researchers utilizing analog functional analysis methodologies now include salient antecedent cues, or discriminative stimuli, (e.g., colored t-shirts or different colored condition rooms) in order to aid participants in discriminating between the alternating FA conditions. Stimulus control, as defined by Michael (1982), is a stimulus change which, given the momentary effectiveness of a reinforcer, increases the probability of occurrence or frequency of a response because the stimulus condition has been correlated with the response having been followed by that particular reinforcer. Sidman (1960) states that stimulus control is often desirable when examining a behavior in a multielement design.

The inclusion of signaled cues or programmed discriminative stimuli in experimental methodology has been shown to aid in differential responding. For example, Redd (1969) observed differential responding of young boys with intellectual disabilities in the presence of different adults. He concluded that each adult came to function as a discriminative stimulus for a particular schedule of reinforcement, thereby gaining stimulus control over the boys' behavior. In a more recent study on discriminative stimuli, Conners et al. (2000) compared the responding of eight participants during functional analysis conditions either with or without discriminative stimuli. Each participant was subjected to an analogue functional analysis including discriminative stimuli followed by an analogue functional analysis without discriminative stimuli. Results indicated that the inclusion of salient cues aided in discrimination between conditions in only half of the participants. These authors also indicate that they were unable to identify any characteristics of the participants that may have been correlated with differential outcomes.

The Assessment of Basic Learning Abilities (ABLA), developed by Kerr, Meyerson, and Flora in 1977, measures the discrimination abilities required for successful performance on various discrimination tasks. The test assesses the ease with which 6, two-choice discriminations can be made in the motor, visual, and auditory categories (Kerr, Meyerson, & Flora, 1977). Research on the ABLA has determined that the discriminations required in the test are on a continuum of complexity ranging from a simple motor task to conditional discriminations involving visual and auditory stimuli. Simple discriminations involve the presence of one stimulus or stimulus dimension whereas conditional discriminations involve at least 2 stimuli that change function from trial to trial. A conditional discrimination is defined as a discrimination following an "if-then" logic which occurs within or across sensory modalities. ABLA level four, a visual quasi-identity match-to-sample discrimination, is the first ABLA level in which a conditional discrimination is assessed (Williams & Jackson, 2006).

According to Barlow and Hayes (1979), the basis of an alternating treatments design, also known as the multielement design, is stimulus discrimination and it is crucial that discriminations are clearly formed. In the case of the standard analogue functional analysis using a multielement design, inclusion of discriminative stimuli should enhance the participant's ability to make a conditional discrimination. For example, in a functional analysis, a participant would have to be able to conditionally discriminate that the color green is associated with the attention condition. Therefore, logically speaking, the reinforcer for problem behavior signaled by green is attention, or in other words: if green, then attention.

Many functional analyses result in undifferentiated responding between conditions and the presumed cause of the mixed results is often lack of discrimination between conditions (e.g., Conners et al., 2000; Derby et al., 1992; & Iwata et al., 1982/1994). To date, no other empirical studies have been conducted on discrimination abilities and differential responding between conditions in an analogue functional analysis. If a participant is unable to make conditional discriminations, discriminations between conditions of a functional analysis may not be observed, which may contribute to undifferentiated rates of responding in the functional analysis. By testing participants' discriminative abilities using the ABLA, the researcher or clinician may be able to further predict whether or not differentiated results are likely in the standard multielement design and if salient discriminative stimuli will aid in the discrimination between the socially mediated functional analysis conditions. The purpose of the present study was to examine the relationship between conditional discrimination skills as assessed by the ABLA and the occurrence of differentiated responding on an analog functional analysis.

Phase I: Assessment of Basic Learning Abilities

Method

Subjects and Setting

Ten individuals participated, 9 of whom attended a segregated school for children with multiple disabilities. All had been diagnosed with intellectual disabilities and had limited adaptive skills, including deficits in expressive language and compliance with instructions. All participants were accepted into this study based on a referral for what was assumed by caregivers to be socially-mediated problem behavior. Ben was an 8-year-old boy diagnosed with moderate mental retardation who engaged in property destruction (throwing objects or moving furniture, defined as moving any piece of furniture other then a chair more than one inch). Kayla was a 9-year-old girl diagnosed with moderate mental retardation who engaged in aggression (pinching). Doug was a 14-year-old boy diagnosed with severe mental retardation and cerebral palsy who engaged in, what his teacher reported to be, non-compliance (slumping, defined as head down with neck parallel to the floor and eyes and nose pointed straight down). Jordan was a 7-year-old boy diagnosed with traumatic brain injury who engaged in aggression (hitting or kicking others or throwing objects at them). Jack was a 14-year-old boy diagnosed with Angelman Syndrome who engaged in property destruction (throwing objects, hitting or kicking walls or furniture, forcefully and repeatedly banging his wheel chair into furniture, tearing paper, removing posters from walls, or biting non-edible objects). Kenny was an 8-year-old boy diagnosed with pervasive developmental disorder who engaged in tantrum behavior (screaming, crying, stomping feet, and flopping). Megan was a 16-year-old girl diagnosed with autism who engaged in self-injurious behavior

(SIB) (hand biting, defined as closing the teeth against the skin on the hand). Chris was a 16-year-old boy diagnosed with failure to thrive who engaged in aggression (hitting, kicking, scratching, or biting others). Ed was a 15-year-old boy diagnosed with severe mental retardation and cerebral palsy who engaged in loud vocalizations (grunting, defined as any guttural utterance above normal conversation level). Seth was a 12-year-old boy diagnosed with autism who engaged in SIB (wrist biting, defined as closing the teeth against the skin on the wrist). Nine participants' sessions were conducted in a vacant classroom at the school for children with multiple disabilities, which contained tables, chairs, bookshelves, and other relevant session materials (see below). Kenny, who did not attend that school, had his sessions conducted in a therapy room at a day-treatment program for adults with intellectual disabilities, after normal operating hours. The room was arranged almost identical to that of the other experimental site and contained a table, chairs, and other relevant session materials. The entire assessment ranged from about 20 min to 60 min in length, depending on participants' response time. Table 1 summarizes the 8 participants functioning level and communication skills.

Materials

Visual and Auditory Stimuli. All six tests used the same general materials as originally described by Kerr, Meyerson and Flora (1977). A large coffee can (15.5 cm in diameter and 17.5 cm in height) covered with plain yellow construction paper was used along with a box (14cm x 14cm x 10cm) covered in dark red-on-red striped paper. The opening of the can was approximately 188 sq cm while the opening of the box was about 196 sq cm. Additionally, a small yellow cylinder, a small red cube, and an irregularly shaped piece of grey foam were used.

Response Measurement and Reliability

Responses were recorded based on frequency of occurrence. Two trained experiments conducted the ABLA with each participant. Response outcomes were agreed upon by both experiments trial-by-trial. Data were recorded using paper and pencil, and interobserver agreement (IOA) was assessed by having the second experimenter simultaneously collect data during at least one assessment level for 50% of participants. Records were compared on a response-by-response basis. Percentage of agreement was calculated by dividing the number of intervals in agreement by the total number of intervals and multiplying by 100%. Mean IOA across sessions was 100%.

Procedural integrity checks were conducted to be sure that the main components (i.e., correct materials used, teaching trial occurred, reinforcement provided after each correct response, correction procedure used after each error) were present in each session. A trained observer watched video recordings of sessions and used a checklist to assess procedural integrity. Procedural integrity was assessed during at least one assessment level for 50% of participants. Mean procedural integrity scores for the ABLA were 100%.

Procedures

Preference Assessment

A paired-stimulus (PS) preference assessment (Fisher et al., 1992) was administered with 7 of the 10 participants to determine their top three most highly preferred items which were used as reinforcers during the ABLA as well as during the tangible sessions in the FA. Each of 9 stimuli was paired with another until all stimuli had been paired together. For 3 of the participants (Chris, Ed, and Doug), due to lack of responding during the Fisher et al. (1992) procedure, a multiple stimulus with replacement (MSW) preference assessment (DeLeon & Iwata, 1996) was conducted. The MSW preference assessment was administered by arranging at least 5 items in front of the participant and allowing them to select one. The selected item was manipulated by the participant then placed back into the array of 5. This procedure was repeated 10 times and the 3 items chosen most often were said to be most highly preferred.

Assessment of Basic Learning Abilities (ABLA)

The ABLA is composed of six levels that takes approximately 30 minutes to conduct. During the assessment, the participant was seated directly across from the experimenter. The participant was provided with a demonstration of a task, followed by a guided trial, then a chance to perform independently. Testing began once the participant was able to demonstrate the task correctly and independently. A continuous reinforcement schedule was used throughout all testing sessions, where a preferred item and praise were delivered contingent on each correct response. Errors were followed by a correction procedure that included a demonstration, guided trial, and an opportunity to respond independently. Following standard ABLA testing criteria (Jackson, Williams, & Biesbrouck 2006; Kerr, Meyerson, & Flora, 1977; Martin, Yu, & Vause, 2004) testing continued until eight consecutive correct responses (pass) or eight cumulative errors (fail) occurred.

ABLA Level 1, Motor Response. The participant was required to put an object in a container. This level demonstrated the ability to perform a simple motor task.

ABLA Level 2, Position Discrimination. The participant was required to place a piece of foam into the container on the left when both the red box and yellow can were present in a fixed position. This type of discrimination required a simultaneous visual discrimination of position, color, shape, or size.

ABLA Level 3, Visual Discrimination. The participant was required to place a piece of foam in the yellow can when the position of the red box and the yellow can were randomly rotated. This type of discrimination required a simultaneous visual discrimination relevant of color, shape, or size.

ABLA Level 4, Match-to-Sample Discrimination. The participant was required to place a yellow cylinder in a yellow can and a red cube in a red box when the position and presentation order of the can and the box were randomly rotated. This type of discrimination was a conditional visual-visual quasi-identity match relevant to color or shape.

ABLA Level 5, Auditory Discrimination. The participant was required to place a piece of foam in the appropriate fixed-position container when the tester randomly said, “red box” (in a high-pitched rapid voice) or “yellow can” (in a low-pitched slow voice). This type of discrimination was a conditional auditory-visual nonidentity discrimination requiring both auditory and visual cues, or position. Consensus in the ABLA literature (Martin, Yu, & Vause, 2004) is that those individuals who pass ABLA level 5 will also pass ABLA level 6, therefore this level was not conducted in the present study.

ABLA Level 6, Auditory-Visual Discrimination. The participant was required to place a piece of foam in the appropriate randomly rotated container when the tester randomly said, “red box” (in a high-pitched rapid voice) or “yellow can” (in a low-pitched slow voice). This type of discrimination was a conditional auditory-visual nonidentity discrimination requiring both auditory and visual cues but excluding position.

Results

Table 1 displays the results of each participant's ABLA score and identifies each participant's diagnosis and anecdotal communication abilities. Kenny was the only participant to pass all 6 levels of the ABLA, receiving a score of 6, respectively. Kenny was able to communicate using full sentences of spoken language. Ben, Kayla, Megan, and Seth all received an ABLA score of 4 and they all communicated with either sign, gesture, or assistive technology. Jordan and Chris received an ABLA score of 3, both of whom communicated through very limited gesturing. Jordan, diagnosed with traumatic brain injury, began matching items, following simple instructions, and acquiring spoken verbal language 6 weeks after the initial assessment. Due to this drastic change in abilities, the ABLA was conducted for a second time and Jordan received an ABLA score of 6, as denoted by the asterisk in Table 1. Although it is highly unusual that an individual's ABLA score would change without excessive training (Meyerson, Kerr, & Flora, 1977) it is not surprising due to his diagnosis that Jordan's ABLA level advanced significantly after a critical period of learning occurred post his traumatic injury. Doug and Jack both received an ABLA score of 2. Doug did not engage in any noticeable form of conventional communication, whereas Jack gestured to communicate. Ed was provided with an adapted ABLA due to his limited motor skills. Ed had greater motor control of his eyes, head, and neck, than he did with his arms or hands. The ABLA was therefore conducted relying on orientation, defined as eyes and nose pointed toward the item, as opposed to using the hands to make a response. Ed received a score of ABLA 1. Ed did not display any recognizable form of conventional communication.

Phase II: Functional Analyses

Method

Subjects and Setting

Eight of the 10 individuals from Phase I participated. Participants were selected based on their ABLA scores, four participants at ABLA level 4 or above (Ben, Kayla, Kenny, and Megan) and four participants at ABLA level 3 or below (Doug, Chris, Ed, and Jack), and on a first-come first-served basis. Seth was excluded from this phase as he was the fifth participant tested at ABLA level 4 and Jared was excluded from this phase due to the rapid and drastic change in his skills and abilities. Seven participants' sessions were conducted in a vacant classroom at a segregated school for children with multiple disabilities, which contained tables, chairs, bookshelves, and other relevant session materials (see below). Kenny's sessions were conducted in a therapy room at a day-treatment program for adults with intellectual disabilities, after normal operating hours. The room was set up almost identical to that of the other experimental site and contained a table, chairs, and other relevant session materials.

Materials

Discriminative Stimuli. In addition to the materials needed for each condition (see below), the functional analysis conditions with programmed discriminative stimuli included colored t-shirts worn by the experimenter with a large white shape (approximate area 20 sq cm) printed on the front so that each color and shape corresponded to one condition: black with no shape to signal the alone condition, green with a circle to signal the attention condition, yellow with a star to signal the play condition, red with a triangle to signal the demand condition, and blue with a square to signal the tangible condition. An overhead projector and printed slides were used to project the corresponding color and shape onto one wall of the specified session room. During the functional analysis conditions without discriminative stimuli, no additional materials were used.

Response Measurement and Reliability

Responses of problem behavior were recorded based on frequency of occurrence for discrete behaviors or percentage of intervals for continuous behaviors. Data were also collected on participants' compliance with task demands as well as experimenters' behaviors of providing attention, escape, and tangibles for procedural integrity purposes.

Data were collected by trained observers on handheld computers (Palm Zire Model m120) and were summarized as number of responses per minute (discrete behaviors) or percent of intervals in which responding occurred (continuous behaviors). Interobserver agreement (IOA) was assessed during 30% of sessions for each participant by having two observers simultaneously but independently collect data. Participant behavior data (i.e., aggression, SIB, etc.) were compared on an interval-by-interval basis for all 30 intervals, length of 10-s each. Agreement percentages were calculated by dividing the number of agreement intervals plus fractions of disagreement intervals (smaller number of behaviors divided by the larger number of behaviors for each disagreement interval), dividing by the total number of intervals, then multiplying by 100%. Mean interobserver agreement across participants was 95.9% (range, 84.8% to 99.5%). The low of 84.8% was atypical and occurred for only one participant, Jack, whose rate of property destruction was extremely high. Examination of the data for that participant indicated that one of the observers was unable to score the behavior as quickly as the other. All other participants had a mean agreement that exceeded 94%.

Procedural integrity was assessed during 30% of sessions for each participant by having two observers simultaneously but independently collect data. Experimenter behavior data (attention, escape, tangible) were compared on an interval-by-interval basis for all 30 intervals, length of 10-s each. Agreement percentages were calculated by dividing the number of agreement intervals plus fractions of disagreement intervals (smaller number of behaviors divided by the larger number of behaviors for each disagreement interval), dividing by the total number of intervals, then multiplying by 100%. Mean procedural integrity for the attention, demand, and tangible conditions were 94.9%, 96.4%, and 98.3%, respectively.

Procedures

The functional analysis in this experiment was based on the one described by Iwata et al. (1982/1994). Subjects were exposed to four assessment conditions (alone, attention, play, and demand) in a multielement design. Kenny, Chris, and Ed were exposed to a fifth condition, tangible, based on caregiver reports of a possible tangible function maintaining the target behavior. Each condition was 5 min in length and each session was comprised of 4 to 5 conditions. A 1 min break was provided between conditions. Sessions were conducted twice per day, 1 to 3 days per week, depending on participant availability. Normal levels of background noise were present throughout each condition (i.e., experimenter discussion, ringing phone, keyboard typing).

Demand. The participant and experimenter were seated in a room with task materials. The experimenter issued continuous task demands to the participant about every 10 s using a three-prompt sequence (instruction, instruction plus model, instruction plus physical guidance). Problem behavior resulted in a 30-s break from demands and compliance resulted is praise, followed immediately by another demand. The purpose of this condition was to determine whether the behavior was maintained by social-negative reinforcement.

Attention. The participant and experimenter were seated in a room with leisure items available to the participant. At the beginning of session the experimenter engaged in a solitary activity, such as reading. The participant was allowed to manipulate the leisure items. Attention in the form of concern or disapproval was delivered contingent on problem behavior. The purpose of this condition was to determine whether the behavior was maintained by social-positive reinforcement.

Alone. The participant was seated alone in a room with no materials available. The experimenter was not present in this condition and no interaction occurred. However, during a majority of the conditions, the experimenter had to be present to collect data and to maintain the safety of the participant. Therefore, the condition was termed *Ignore* and the experimenter was in the room, faced away from the participant, and delivered no attention. Problem behavior resulted in no consequences. The purpose of this condition was to determine whether the behavior was maintained by automatic reinforcement and if the behavior persisted in the absence of social consequences.

Play. The experimenter and participant were seated in a room with leisure items available, similar to the attention condition. The experimenter delivered praise and physical contact on a 30-s fixed-time (FT) schedule, independent of problem behavior. The play condition served as a control for the other test conditions.

Tangible. The experimenter and participant were seated in a room with leisure items available. The participant was given access to the leisure materials for at least 1 min. At the start of the session, the experimenter blocked participant's access to the leisure materials. The leisure items were re-presented to the participant contingent on problem behavior. The participant was allowed to manipulate the leisure items for 30-s. The purpose of this condition was to determine whether the behavior was maintained by access to tangibles.

Experimental Design

All functional analyses were conducted using a multielement design. Each participant was assessed using the ABLA followed by the FA with S^Ds and the FA without S^Ds. A counterbalanced alternating treatments design was used in Phase II with both the FA with S^Ds and the FA without S^Ds in order to compare results within and across subjects. The 8 participants were divided into 2 groups, where each group was comprised of 2 participants at or above ABLA level 4, and 2 participants below ABLA level 4. To control for possible sequencing effects, Group 1 was exposed to the alternating treatments design beginning with the FA with S^Ds followed by the FA without S^Ds whereas Group 2 was exposed to the alternating treatments design beginning with the FA without S^Ds followed by the FA with S^Ds. Both functional analyses were alternated in the counterbalanced group design until differentiation was seen in at least 3 sessions with S^Ds or until a total of 10 sessions were completed.

FA with S^Ds. During this phase, a separate experimenter was assigned to conduct each condition. Each experimenter wore a different colored shirt and a corresponding colored light was projected onto one wall of the session room. A shape associated with each colored condition was used to control for possible color blindness. For example, the attention condition was conducted by experimenter 2 who wore the green shirt with a white circle on it and a green light with a white circle was projected onto the wall. The play condition was then conducted by experimenter 3 who wore the yellow shirt with a white star on it and a yellow light with a white star was projected onto the wall.

FA without S^Ds. Sessions were conducted as in FA with S^Ds, except all programmed S^Ds were removed. Each functional analysis condition was conducted by a single experimenter. To maintain consistency across days, the same experimenter ran the session daily and a plain black shirt was worn by the experimenter.

Results

The data were graphed and inspected visually. If differential responding was not clearly determined through visual inspection, discrimination between conditions was measured based on the general procedure for the structured criteria for visual inspection of a functional analysis as described by Hagopian et al. (1997). An upper criterion line and a lower criterion line were drawn to approximately one standard deviation above and one below the mean of the control (play) condition. Differentiation was said to have occurred if at least half of the data points in each condition fell above the upper criterion line.

Figure 1 shows the results of the functional analysis for Ben, Kayla, Kenny, and Megan. The participants in Figure 1 all tested at or above ABLA level 4. Ben's data showed differentiated responding in the demand condition and also some differentiated responding in the attention condition after 8 sessions. Progressive separation of conditions was seen over sessions with S^Ds, suggesting that S^Ds may have assisted in Ben's ability to discriminate between conditions. Kayla's data reflected a clear attention function after 6 sessions. The inclusion of S^Ds appeared beneficial to Kayla's ability to discriminate between the alone and attention conditions. Kenny's data reflect clear differentiation in the demand condition. Kenny's functional analysis was only conducted over 4 sessions due to the intensity of the behavior and the request by his caregiver to end participation. In these 4 sessions, it does appear that the inclusion of S^Ds was beginning to be associated with Kenny's ability to differentiate between conditions. Megan's functional analysis was conducted over 6 sessions and although Megan did not reach criteria to finish, sessions were terminated due to the low frequency but high intensity of her SIB. Megan's data showed differential responding exclusively during the demand condition. The inclusion of programmed S^Ds did not appear to influence Megan's responding between conditions. Thus, results obtained for Ben, Kayla, Kenny, and Megan suggest that all the individuals at ABLA level 4 or above displayed differential responding during functional analysis conditions and that the inclusion of programmed S^Ds may have facilitated their ability to discriminate between the rapidly alternating conditions. Kayla's results suggest that the presence of programmed S^Ds was perhaps necessary for differential responding to occur.

Figure 2 displays the results of the functional analyses for Doug, Chris, Ed, and Jack. The participants in Figure 2 all scored below ABLA level 4. Doug's data showed no differential responding between conditions upon visual inspection. After the general procedure for visual inspection of functional analysis (Hagopian et al., 1997) was applied, there was still no differentiation between conditions, resulting in no conclusion. Programmed S^Ds did not appear to make a difference in the results of Doug's analysis. Chris's data resulted in undifferentiated responding between conditions and programmed S^Ds seemed to have no effect on his behavior. The general procedure for visual inspection of functional analysis (Hagopian et al., 1997) did not offer any further conclusions. Ed's data reflect an automatic function maintaining his behavior with responding occurring primarily in the alone condition. The inclusion of programmed S^Ds did not appear to influence Ed's responding. Jack's data showed differential responding in the attention condition beginning in the fourth session. The inclusion of programmed S^Ds did appear to have aided in Jack's ability to discriminate between conditions.

Discussion

This study examined the extent to which conditional discrimination abilities as assessed by the ABLA were necessary to produce differential responding in the standard multielement functional analysis by exposing 8 participants of varying discrimination abilities to functional analysis conditions with and without programmed S^Ds. Participants who received a score of ABLA level 4 and above (Ben, Kayla, Kenny, and Megan) all had functional analysis data that could be classified as differential responding and a presumed function of their target behavior. The inclusion of programmed visual S^Ds during the multielement functional analysis appeared to facilitate differential responding for 3 participants (Ben, Kayla, and Kenny) who were able to make conditional discriminations. Participants who scored below ABLA level 4 (Doug, Chris, Ed, and Jack) displayed more variability in their responding between conditions of the functional analysis. Differentiated results were seen in the data of Ed and Jack. The inclusion of programmed S^Ds appeared to facilitate Jack's behavior of discriminating between conditions. These results suggest that using the ABLA to assess conditional discrimination abilities prior to functional assessments may be helpful in determining the likelihood of obtaining clear differentiated results in a standard functional analysis, as well as the utility of the inclusion of programmed discriminative stimuli in the functional analysis.

Assuming that the ability to make a conditional discrimination may be a prerequisite to differential responding in the multielement design of a standard functional analysis, it is curious as to why the data of two of the 4 participants who scored below ABLA level 4 (Ed and Jack) resulted in identifiable functions of behavior. Ed's data showed low rates of behavior primarily occurring in the alone condition, indicating an automatic function of behavior, although a requirement of participation in this study was engagement in socially mediated behavior. Ed's caregivers identified Ed's behavior of grunting as likely being socially mediated through access to attention, access to tangible items, and escape from demand, therefore Ed participated in the study and his data were included in this analysis. Caregiver reports are not generally considered reliable in the determination of maintaining variables of problem behavior. However, due to the discrepancy between indirect assessment through a caregiver interview and results of the FA coupled with Ed's low rate of responding during the analogue analysis, it was possible that the FA did not provide an accurate identification of function of behavior for Ed and further analysis would be necessary. Alternatively, if Ed's behavior were truly maintained by automatic reinforcement it would be likely that results in a standard functional analysis would be reached, regardless of discrimination ability, as automatically maintained behavior occurs regardless of any environmental stimulation or change. On the other hand, Jack's data showed a high rate of behavior and clear differentiation was observed in the attention condition after the fourth session. Jack scored at level 2 on the ABLA, indicating that he was not able to make conditional discriminations. It should be noted that Jack engaged in noncompliance during the

ABLA and often threw testing materials, refused to respond, or responded impulsively without scanning the testing materials prior to making the response. The ABLA was administered 3 times with intention to provide opportunity to respond appropriately for varying highly preferred reinforcers. Jack never tested beyond ABLA level 2; however, it was anecdotally observed that Jack would occasionally respond to simple instructions, which indicated that Jack was possibly able to make auditory-visual discriminations, a discrimination skill appearing at ABLA level 6. Given that the ABLA levels progress in a hierarchy (Williams & Jackson, 2009), it is likely that Jack was able to make conditional discriminations, however the noncompliance may have masked Jack's true ability to make these discriminations. Clearly differentiated results during the functional analysis support the possibility of Jack's ability to make higher-level discriminations. In addition to the differential responding seen in the results, Jack's data also showed that the inclusion of programmed S^Ds facilitated differential responding between the alone and attention conditions, indicating sensitivity to programmed visual S^Ds, therefore suggesting the ability to make a conditional discrimination.

Each condition of the functional analysis includes naturally occurring S^Ds whether or not programmed S^Ds are included. Anecdotal observation during this study and analysis of responding in participants who were able to make conditional discriminations (Ben, Kayla, Kenny, and Megan) suggested that the inclusion of programmed S^Ds were most helpful in aiding in discrimination between the alone and attention conditions, especially when the alone condition was conducted as an ignore condition and an experimenter was present in the assessment room. This notion was seen specifically in the results for Kayla and Jack where differential responding occurred primarily in the attention conditions and was facilitated by the inclusion of programmed S^Ds. The ignore and attention conditions have similar arrangements whereas the natural S^Ds may not be as salient as the natural S^Ds in the demand condition, for example, where demand materials are present.

The inclusion of programmed S^Ds did not aid in the facilitation of differential responding between conditions for Megan. The data from Megan's FA suggest the opposite effect of what was expected based on the above conclusions of conditional discrimination ability and differential responding. Megan engaged in low rates of SIB and responded exclusively in the demand conditions without programmed S^Ds. As mentioned above, there are naturally occurring S^Ds in the demand condition, such as the presence of demand materials, which may have facilitated Megan's responding during the demand conditions without programmed S^Ds. Additionally, Kayla's data show one high data point where responding occurred in the attention condition in the absence of programmed S^Ds. In Kayla's case, it is likely that her history of exposure to programmed S^Ds during 2 previous sessions may have aided in her differential responding during the fourth session.

The ability to engage in a conditional discrimination, as assessed by ABLA level 4, appears to be the critical level at which participants will be able to discriminate between conditions of a functional analysis due to the "if-then" logic described at that level (Williams & Jackson, 2009). The participant would need to display the ability to discriminate between visual antecedent stimuli in order to anticipate consequences for behavior: if green, then attention. The ability to engage in the conditional discrimination is therefore a likely prerequisite to the differential responding resulting from discrimination between conditions.

Assuming that the inclusion of programmed S^Ds during a functional analysis are beneficial for participants who are able to make conditional discriminations, as results of this study suggest, it is possible that the findings of this study may answer questions of discrimination abilities and differentiated results in previous research (e.g., Conners et al., 2000, Derby et al., 1992, & Iwata et al., 1982/1994). Conners et al. (2000) indicated that they were unable to make any correlations between those participants who showed differentiation between conditions and those who did not. They concluded that some participants' behavior was more sensitive to the contingencies presented in the functional analysis then others. With respect to these findings, it may be that some participants are more sensitive to the naturally occurring contingencies and S^Ds; however it is also likely, based on the results of this study, that the participants whose behavior was not influenced by programmed S^Ds may have not had the necessary discrimination abilities for these visual S^Ds to be beneficial. Additionally, another correlation of differentiated responding and discrimination abilities may be indicated by verbal language ability, as the participants able to make conditional discriminations were all also able to communicate though spoken verbal language, sign, or gesture. Similar to the anecdotal explanation made by Iwata et al. (1982/1994), this study concluded that participants with profound disabilities, specifically those unable to make conditional discriminations as assessed by the ABLA, may not be able to discriminate between the different conditions in the standard multielement functional analysis.

This study contained three major limitations that may have affected the generality of the results. The first limitation, as previously noted, was the inability to conduct a true alone condition. Due to the classroom setting and school policies, the participants were not allowed to be alone in a room and one-way mirrors were not available for observation. As such, it is unclear whether different results would have been obtained if there were no experimenter present in the room during the alone condition. A second limitation resulted from the existing limitations of the ABLA, which include the possibility of noncompliance masking true discrimination ability and the difficulty of conducting this assessment with a participant that has limited motor ability. The ABLA was modified for one participant, Ed, due to his inability to make gross motor movements with his hands. Additionally, Jack engaged in noncompliance during the ABLA assessment, as discussed in the previous section. Therefore, it is possible that the ABLA did not accurately assess discrimination ability in these 2 participants. Finally, this study used only brief functional analyses with 5 min conditions and results may have been different if conditions were conducted for longer amounts of time.

In addition to suggesting that the ability to make a conditional discrimination is a necessary prerequisite for differential responding in a standard multielement functional analysis, the results of the present study also have implications for clinical assessment of problem behavior. The present outcomes suggest that differential responding may not occur in a functional analysis if the participant is below ABLA level 4. Benefits of the analogue functional analysis may be greatly reduced if the participant is unable to make the conditional discrimination, as quickly assessed by the ABLA. Analogue FA can be costly, time consuming, and potentially aversive to the client or participant. Therefore, the ABLA may be a worthy assessment, with duplicate purposes, to conduct prior to deciding which functional behavior assessment to use in order to reduce the time and resources applied to conducting analogue functional analysis that is potentially likely to result in undifferentiated responding. If a participant does test below ABLA level 4, a different assessment methodology, for example, direct behavior assessment, indirect behavioral assessment, or a pair-wise functional analysis, may be a more beneficial methodology in identifying function of behavior thank a standard multielement functional analysis. Future research could be conducted on identifying function of problem behavior using the above mentioned methodologies with participants who cannot perform a conditional discrimination and who engage in a potentially socially mediated behavior, particularly access to attention. Additionally, if past participants from the existing literature on functional analysis are still available, a further analysis could be conducted to determine the ABLA level of the participant and whether or not differential responding was observed.

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Participant Name	Age	Diagnosis	Communication	ABLA Score
Kenny	8	PDD	Vocal	6
Kayla	9	Moderate MR	Gesture	4
Ben	8	Moderate MR	Sign	4
Seth	12	Autism	PECS	4
Megan	16	Autism	Dynavox	4
Jordan	7	TBI*	No Conventional Language	3
Chris	16	FTT	Limited Gesture	3
Jack	14	Angelman Syndrome	Gesture	2
Doug	14	Severe MR; CP	No Conventional Language	2
Ed	15	Severe MR; CP	No Conventional Language	1

* This participant's discrimination abilities changed during the present study.

Table 1. Participant diagnoses, anecdotal communication abilities, and discrimination abilities as indicated by the ABLA.

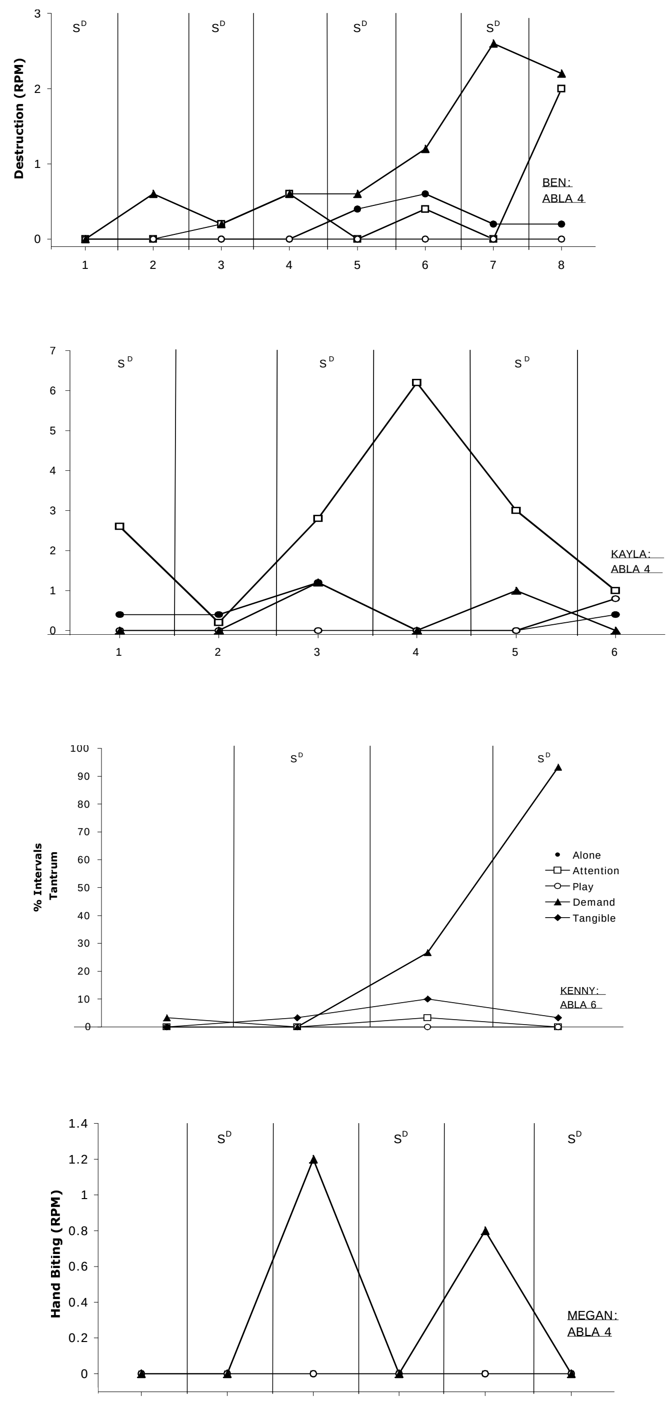

Figure 1. FA data graphed, including S^Ds, for participants at or above ABLA level 4.

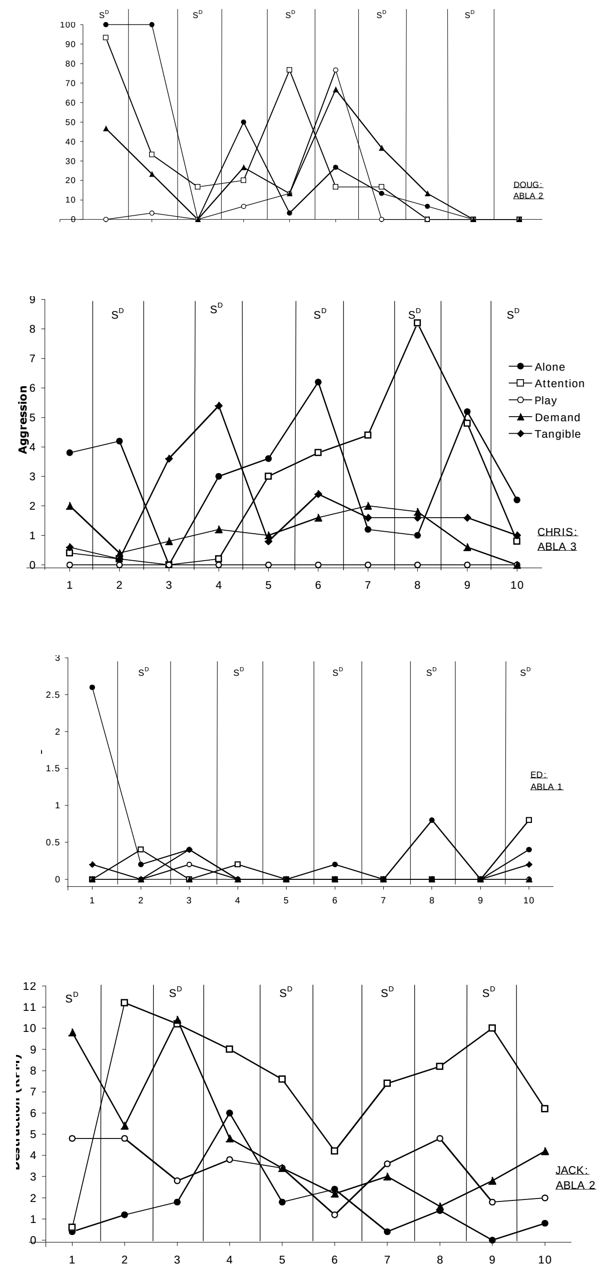

Figure 2. FA data graphed, including S^Ds, for participants below ABLA level 4.