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Effects of Discrimination Abilities on Functional Analysis Outcomes

Abstract

This study evaluated the extent to which conditional discrimination abilities affected a participant's differential responding during a multielement analogue functional analysis (FA). 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 conducted with eight participants and responses were recorded during conditions with and without the inclusion of programmed discriminative stimuli (S^Ds). Results indicated that all participants able to make a conditional discrimination, as assessed by the ABLA, demonstrated differential responding during the FA whereas two of the four participants unable to make conditional discriminations showed differential responding. 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. It was concluded that individuals who were unable to make conditional discriminations are less likely to show differentiated results in a functional analysis and the inclusion of programmed S^Ds may not aid in discrimination between conditions for these individuals.

Analog Functional Analysis (FA) methodology is a widely used assessment to determine the variables that maintain aberrant behavior. FA assessment systematically manipulates both social and physical environmental events that might differentially affect behavioural responding and is considered the most reliable method. Five conditions typically comprise the assessment: Alone, Attention, Demand, Tangible, and Play (control condition). The standard way of conducting a functional analysis is through the use of a multielement design in which behaviour is measured under rapidly alternating conditions until differential responding is observed (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994).

Simply stated, an FA is conducted to aid in determining the function or purpose of a specific behaviour. Features of a common classroom or home environment are conceptualized as different component variables and each of these variables are separately presented in the analysis to help determine under what conditions problem behavior will occur most often. The FA is conducted by exposing the participant to brief conditions in which each single variable is occurring. For example, in the Alone condition, there is no one present in the assessment room and the participant is left by themselves; in the Attention condition, a therapist is present in the

assessment room, but only interacts with the participant contingent upon engaging in the target behaviour. In the Demand condition, the therapist presents a series of task demands and the therapist removes the demand for a short period of time contingent upon occurrence of the target behaviour. In the Tangible condition, a preferred toy or leisure item is withheld from the participant and returned for a short time contingent upon occurrence of the target behaviour. The Play condition is a control condition in which the environment is rich with all preferred items, attention and all task demands are removed, and there is no consequence for occurrence of the target behaviour. By collecting data on the target behaviour during each of these conditions, the therapist can determine under which condition (i.e., under which environmental variable and consequence) the target behaviour is most likely to occur. Differential responding within the FA is necessary to derive a conclusion regarding the function of the behaviour. In other words, there needs to be higher rates of responding in a given condition compared to the control or other conditions in order to conclude that the behaviour likely occurs because of a specific consequence (i.e., attention or escape from a demand). Given the brief nature of the exposure to each condition within the FA, a participant who can discriminate between conditions is more likely to show differentiated responding, therefore providing conclusive assessment results. Additionally, a minimally language abled participant who can generate a rule regarding the differing conditions within the FA may engage in the target behaviour to receive a preferred consequence. For example, a participant might deduce that when the red shirted therapist comes into the room with demand materials, they can bite their hand and the therapist will leave. For participants who cannot generate such a rule, differentiation between conditions may take longer or may not be seen at all.

While the analogue functional analysis has been shown to be the most effective assessment procedure in determining functions of problem behaviour, there are also several challenges to its methodology. 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 behavioural responding across conditions:

> 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, p. 206)

The popularity of the analogue functional analysis has led 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 behaviour 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 and Knights (2003) conducted a brief functional analysis using 2 minutes per condition, and an extended functional analysis using 10 minutes per condition, with three individuals with developmental disabilities. Results of the study demonstrated that the brief assessment identified the function of problem behaviour for two of three 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 for only a few brief time periods. Therefore, another question that has been examined is whether the results of functional analysis could be influenced by the presence or absence of discriminative stimuli associated with the different conditions. A discriminative stimulus is defined as a stimulus, the presence of which has been associated with either reinforcement or punishment for a specific behaviour and functions to establish control of that stimulus over the occurrence or non occurrence of that behaviour (Martin & Pear, 2008). In a FA, salient antecedent cues, or discriminative stimuli, (e.g., different therapists, or therapists wearing different coloured t-shirts or different

coloured condition rooms) have been used to enhance discrimination between alternating conditions. For example, 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 half of the participants. These authors indicated that they were unable to identify any characteristics of the participants that may have been correlated with differential outcomes. However, the participants' discrimination abilities were not assessed or reported in that study. Given that discrimination between conditions is required for differential responding, it would be valuable to examine whether this variable could influence the results of a FA.

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 six, 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 (difficulty) ranging from a simple motor task to conditional discriminations involving visual and auditory stimuli. Simple discriminations involve the reliable occurrence of a behaviour in the presence of one stimulus or stimulus dimension whereas conditional discriminations involve reliable occurrence of a behaviour in the presence of a stimulus depending on the presence of an additional stimulus from trial to trial. For example a learner can gain reinforcement for pointing to the letter A, but not B when presented with two letters A and B. This is a simple discrimination. However when the learner points to A or B only when a teacher vocally says "A" or "B" this is a conditional discrimination (pointing to A is now dependent upon hearing "A" and not "B"). A conditional discrimination can be described as following an "if-then" logic which occurs within or across sensory modalities. The ABLA tests simple discriminations such as placing a piece of foam into a container, or placing a piece of foam into a yellow versus a red container, as well as conditional discriminations such as placing the foam into a yellow or red container only when the tester says "Yellow can" or Red box." ABLA level 4, a visual quasi-identity match-to-sample discrimination, is the first ABLA level in which a conditional discrimination is assessed (Williams, Jackson & Biesbrouck, 2006). This task requires the participant to place a red block only into a red container and a yellow cylinder only into a yellow container.

In the case of the standard analogue functional analysis using a multielement design (treatments alternating from one to another), inclusion of specific environmental features that are only associated with specific conditions (i.e., potential discriminative stimuli) should aid in the participant's ability to make a conditional discrimination. For example, in a functional analysis, a participant could conditionally discriminate that the colour green, associated with the Attention condition, predicts that engaging in a target behaviour will result in attention. Therefore, logically speaking, the reinforcer for problem behaviour signalled by green is attention, or in other words: if green, then attention. The conditional discrimination would occur between conditions (i.e., if red, escape; if green, attention).

To date, no 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 during an analogue FA and if salient discriminative stimuli will aid in the discrimination between the functional analysis conditions. It could be assumed that the presence of discriminative stimuli would only be effective in aiding in the discrimination between conditions if the participant is able to make a conditional discrimination. The purpose of the present study was to examine the relationship between conditional discrimi-

nation skills as assessed by the ABLA and the occurrence of differentiated responding during an analog functional analysis.

Methods

Subjects and Setting

Prior to conducting this research, the methodology for this study was approved by the Institutional Review Board of the Office of Human Research at the University of Nevada, Reno.

Assessment of Basic Learning Abilities: Ten individuals participated, nine 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 behaviour. To protect the identity of the participants, the following names are pseudonyms. 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 2.5 centimeters). 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, an escape behaviour (defined as head down with neck parallel to the floor and eyes and nose oriented 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 behaviour (screaming, crying, stomping feet, and flopping). Megan was a 16-year-old girl diagnosed with autism who engaged in self-injurious behaviour (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 identically 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 10 participants' functioning level and communication skills.

Functional Analysis: Eight of the 10 individuals from the ABLA phase 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 the FA phase as he was the fifth participant tested at ABLA level 4 and Jordan was excluded from the FA 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.

Table 1. Participant Diagnoses, Anecdotal Communication Abilities, and Discrimination Abilities as Indicated by the ABLA

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 study from an ABLA score of 3 to 6.*

Materials

Assessment of Basic Learning Abilities: 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 (14 cm × 14 cm × 10 cm) covered in dark red-on-red striped paper. Additionally, a small yellow cylinder, a small red cube, and an irregularly shaped piece of grey foam were used.

Functional Analysis: In addition to the materials needed for each condition (see below), the functional analysis conditions with programmed discriminative stimuli included coloured t-shirts worn by the experimenter with a large white shape (approximate area 20 cm^2) printed on the front so that each colour 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 colour 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

Assessment of Basic Learning Abilities: Two trained experimenters conducted the ABLA with each participant during reliability checks. Agreement on target behaviour response outcomes between experimenters were computed on a trial-by-trial basis. 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. Percentage of agreement was calculated by dividing the number of responses in agreement by the total number of responses and multiplying by 100%. Mean IOA across sessions was 100%.

Procedural integrity checks were conducted to evaluate whether the main procedural components (i.e., correct materials used, teaching trial occurred, reinforcement provided after each correct response, correction procedure used after each error) were carried out correctly 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%.

Functional Analysis: Problem behaviours were recorded based on frequency of occurrence for discrete behaviours (i.e., one hand bite) or percentage of intervals for continuous behaviours (i.e., ongoing screaming). Data were also collected on participants' compliance with task demands as well as experimenters' behaviours 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 behaviours) or percent of intervals during 10 s intervals in which responding occurred (continuous behaviours). Interobserver agreement (IOA) was assessed during 30% of sessions for each participant by having two observers simultaneously but independently collect data. 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 behaviours divided by the larger number of behaviours for each disagreement interval), dividing by the total number of intervals, then multiplying by 100%. The fractions of disagreement intervals within each interval were included because multiple occurrences of behaviour occurred within one interval. Mean interobserver agreement across participants was 95.9% (range, 84.8% to 99.5%). The low value 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 behaviour 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 behaviour 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 behaviours divided by the larger number of behaviours 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

Preference Assessment

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

Assessment of Basic Learning Abilities (ABLA)

The ABLA is composed of six levels that take approximately 30 minutes to conduct. During the assessment, the participant is seated directly across from the experimenter. The participant is 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. The score that the individual receives matches the level completed on the ABLA.

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 based on position, colour, 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 based on colour, 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 based on colour 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 level 5 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.

Functional Analysis (FA)

Participants 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 behaviour. Sessions, which involved exposure to one of the FA conditions, were 5 min in length. Blocks of 4 to 5 sessions were conducted twice per day, one to three days per week. Conditions were presented in a fixed sequence to arrange for a strong establishing operation for the reinforcer in a given condition by preceding that condition with a condition in which the reinforcer was absent. A 1-min break was provided between conditions. 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 a task demand once every 10 s, specific to the individual's typical academic classroom demands, to the participant using a three-prompt sequence (instruction, instruction plus model, instruction plus physical guidance). Problem behaviour resulted in a 30 s break from demands and compliance resulted in praise, followed immediately by another demand. The purpose of this condition was to determine whether the behaviour was maintained by escape from demand or social-negative reinforcement.

Attention: The participant and experimenter were seated in a room with highly preferred 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 behaviour. The purpose of this condition was

to determine whether the behaviour was maintained by social-positive reinforcement.

Alone/Ignore: The participant was seated alone in a room with no materials available. Normally, the experimenter is not present in this condition and no interaction with the participant occurs. However, during this study, 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. The experimenter was able to collect data by discretely observing the participant in their peripheral vision. Problem behaviour resulted in no consequences. The purpose of this condition was to determine whether the behaviour was maintained by automatic reinforcement (sometimes referred to as sensory reinforcement) and if the behaviour persisted in the absence of social consequences.

Play: The experimenter and participant were seated in a room with highly preferred leisure items available, similar to the Attention condition. The experimenter delivered praise and physical contact every 30 s, independent of problem behaviour. The Play condition served as a control for the other test conditions.

Tangible: The experimenter and participant were seated in a room with highly preferred 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 behaviour. The participant was allowed to manipulate the leisure items for 30 s. The purpose of this condition was to determine whether the behaviour 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 the FA phase with both the FA with S^Ds and the FA without S^Ds in order to compare results within and across subjects. The eight participants were divided into two groups, where each group included two participants at or above ABLA level 4, and two 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 three sessions with S^Ds or until a total of ten sessions were completed. This criterion was selected so that there was multiple exposure to conditions with S^Ds and to allow for ample opportunity to see if the inclusion of these S^Ds facilitated discrimination.

FA with S^Ds: During this phase, a different experimenter was assigned to conduct each condition. Each experimenter wore a different coloured shirt and a corresponding coloured light was projected onto one wall of the session room. A shape associated with each coloured condition was used to control for possible colour 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. All functional analysis conditions were conducted by the same experimenter who wore a plain black shirt.

Results

Assessment of Basic Learning Abilities

Table 1 displays the results of each participant's ABLA score, diagnosis, and anecdotal communication abilities. Kenny could speak in full sentences and was the only participant to pass all six levels of the ABLA, receiving a score of 6. Ben, Kayla, Megan, and Seth all received an ABLA score of 4 and they all communicated

with 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 ABLA 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 after 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.

Functional Analysis

The data were graphed and inspected visually (Michael, 1974). 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). This standardized criterion is useful when determining if differentiated results have occurred when visual analysis is not sufficient. To conduct this analysis, 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. Specifically, the Hagopian et al. (1997) analysis was only needed for Doug, Chris and Ed.

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 7 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 six 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 four sessions due to the intensity of the behaviour 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 six 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 functioning at ABLA level 4 or above displayed differential responding during functional analysis conditions and that the inclusion of programmed S^Ds may have facilitated Ben and Kayla's ability to discriminate between the rapidly alternating conditions. Ben and Kayla's results suggest that the presence of programmed S^Ds may have facilitated their differential responding in two of the three conditions (Alone and Attention conditions for Ben and Alone and Demand conditions for Kayla).

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. The general procedure for analyzing dat in a functional analysis (Hagopian et al., 1997) was therefore applied. The upper criterion line (CL), as per protocol, was drawn at approximately 10%. Given that Doug's data met the rules for low magnitude of effect in which more than one of the points was above the CL by only a small amount, the upper CL was

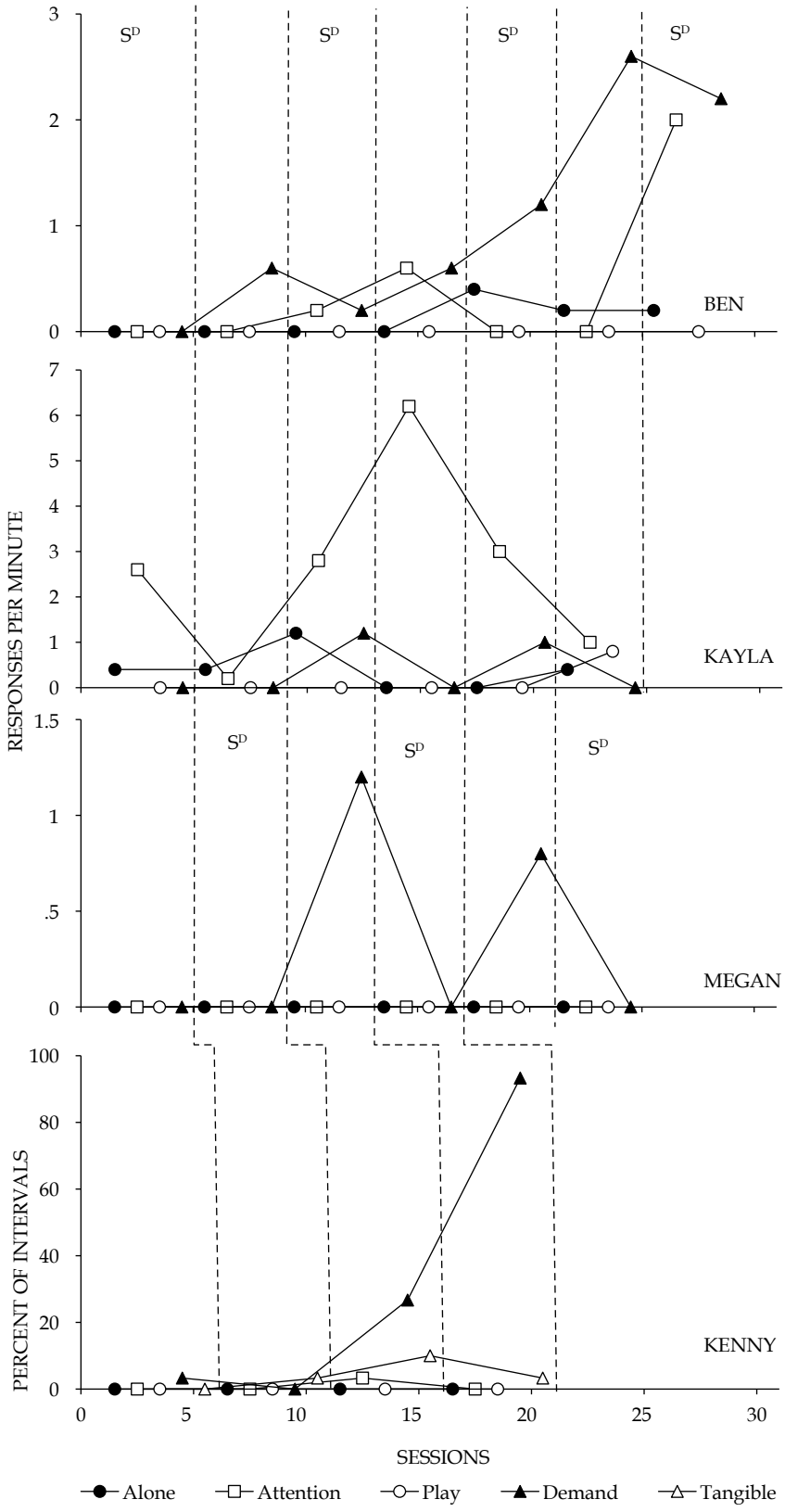

Figure 1. FA data for participants who were able to make a conditional discrimination (at or above ABLA level 4).

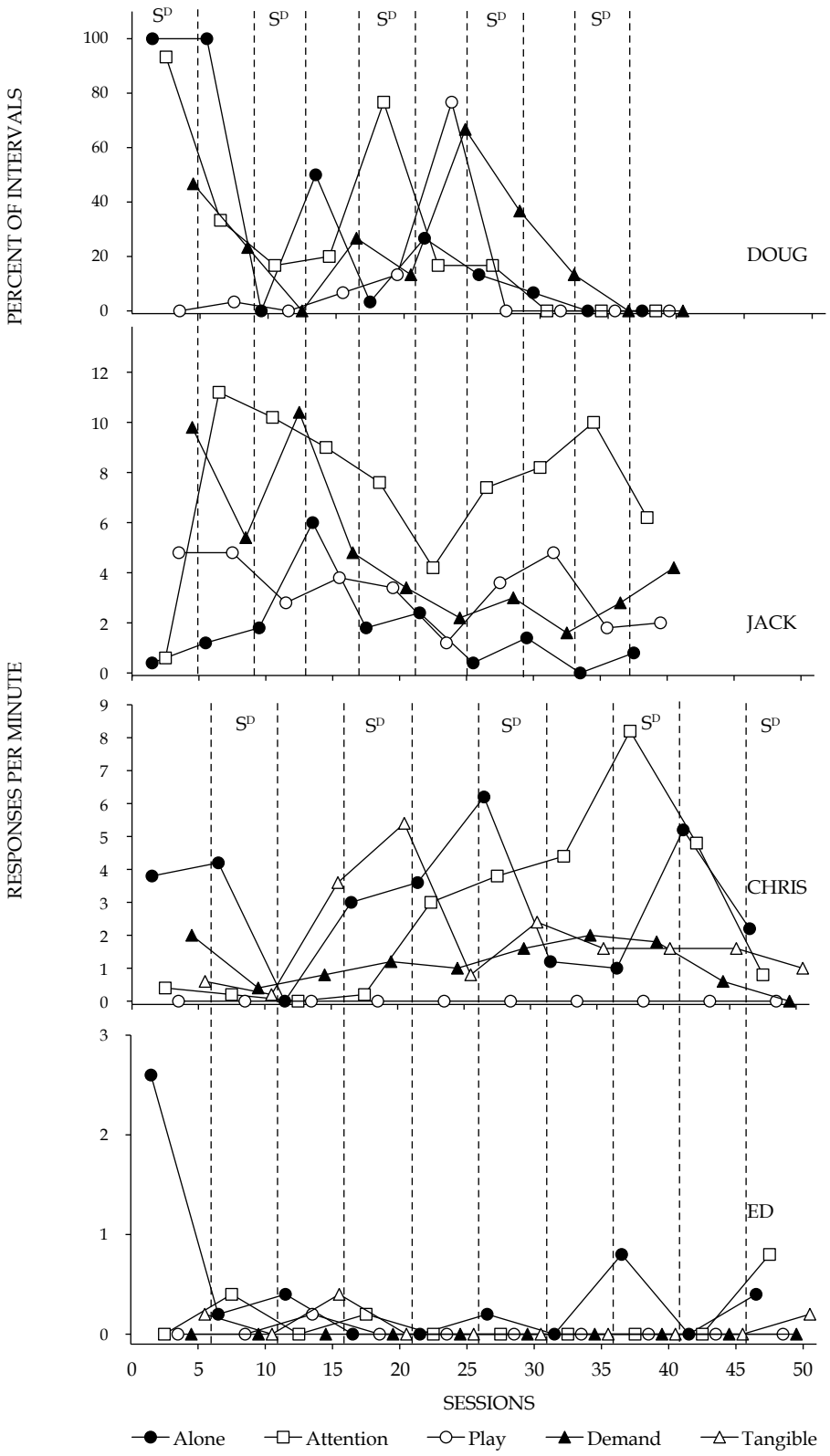

Figure 2. FA data for participants who were unable to make a conditional discrimination (below ABLA level 4).

raised by the recommended 20%, so that the upper CL was at 30%. For the Alone, Attention and Demand conditions, only three of ten data points were above the upper CL, therefore the data were determined to not be differentiated, 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 differentiated responding in all conditions (as compared to the Play condition) and programmed S^Ds seemed to have no effect on his behaviour. The general procedure for visual inspection of functional analysis (Hagopian et al., 1997) provided that Chris's data would be concluded as automatically maintained aggression, however because all conditions are high rate and variable, further analysis would be warranted, as recommended by the authors. Therefore, the brief functional analysis provided minimally conclusive results and further analysis would be necessary to provide certain conclusions with regard to the function of Chris's aggression. Ed's data reflect an automatic function maintaining his behaviour 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. It is unclear as to whether or not the inclusion of programmed S^Ds 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 associated with differential responding in the standard multielement functional analysis by exposing eight 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 behaviour. The inclusion of programmed visual S^Ds during the multielement functional analysis appeared to facilitate differential responding for three 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 may have facilitated Jack's behaviour 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 four participants who scored below ABLA level 4 (Ed and Jack) resulted in identifiable functions of behaviour. Ed's data showed low rates of behaviour primarily occurring in the Alone condition, indicating an automatic function of behaviour, although a requirement of participation in this study was engagement in socially mediated behaviour. Ed's caregivers identified Ed's behaviour 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 behaviour. 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 behaviour for Ed and further analysis would be necessary. Alternatively, if Ed's behaviour 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 behaviour occurs regardless of any environmental stimulation or change. On the other hand, Jack's data showed a high rate of behaviour 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 three 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 behaviour: 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' behaviour 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 behaviour 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 four 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 two participants. A third limitation is that 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. The final limitation is that the order of FA conditions was held constant across session blocks. As previously mentioned, this was done to provide strong establishing operations given the limited break between conditions and to control for the nature of the brief functional analysis.

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 behaviour. 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 behaviour 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 behaviour assessment, indirect behavioural assessment, or a pair-wise functional analysis, may be a more beneficial methodology in identifying function of behaviour than a standard multielement functional analysis. Future research could be conducted on identifying function of problem behaviour using the above mentioned methodologies with participants who cannot perform a conditional discrimination and who engage in a potentially socially mediated behaviour, 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 during the FA.

Key Messages From This Article

People with disabilities: You have the right to the most effective and least intrusive assessment procedures. These assessments should be conclusive and should be available to you at the lowest cost possible.

Professionals: In order to provide the most effective treatment, you must have effective and conclusive assessment procedures. Cost/

resource efficiency, behavioural necessity and anticipated outcomes should be considered prior to implementing certain assessments.

Policymakers: It is important that the assessment procedures supported in legislation have been scientifically proven to be the most effective, least intrusive, and most cost and time efficient.

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