

Teaching Eye Contact to Children with Autism: A Conceptual Analysis and Single Case Study

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Abstract

Eye contact occurs very early in development and serves many functions for the young child. It has been implicated in the development of social, cognitive, and language skills. A substantial number of children with autism fail to develop this important skill and therefore experimenters with both developmental and behavior analytic perspectives have researched methods to teach eye contact. However, only a few researchers have recently attempted to condition the response of the communication partner as a reinforcer for social behavior and thereby arrange the conditions under which typical children develop social responses. The purpose of this case study was to extend the analysis of typical development of social skills to the teaching of eye contact as a language pragmatic skill to a child with autism. Data from a single case study of a child with autism are provided.

KEYWORDS: Eye Contact, Social Skills, Mands, Extinction, Autism, Motivating Operations

It has been suggested that eye contact, sometimes referred to as (eye) gaze behavior or eye-to-face gaze (Mirenda, Donnellan, & Yoder, 1983) serves an important social function for young children even before vocal responding begins to develop (Stern, 1985). In early development, eye contact serves to regulate face-to-face social interactions (Lee, Eskritt, Symons, & Muir, 1998; Leekam, Baron-Cohen, Perrett, Milders, & Brown, 1997) and contribute communicatively to social interactions (Tiegerman & Primavera, 1984). Later, eye contact responses coordinate the visual attention between another individu-

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al and an object of interest (Arnold, Semple, Beale, & Fletcher-Flinn, 2000) and have been found to be an influencing variable in language acquisition (Podrouzek & Furrow, 1988).

Deficits in various nonverbal social-communicative behaviors, particularly in dyadic (i.e., eye-to-face) and triadic eye gaze (i.e., joint attention directed at a third party or object) are commonly identified as the earliest indicators and most noticeable deficits of developmental delays and of Autism Spectrum Disorder in particular (Baron-Cohen, Allen, & Gillberg, 1992; Mirenda et al., 1983; Wimpory, Hobson, Williams, & Nash, 2000; Woods & Wetherby, 2003). Because of the various social functions eye contact may serve, failure to emit this important behavior may have significant implications for children with autism. In addition, there are possible educational concerns associated with poor eye contact. Specifically, previous research has suggested that the diversity of prelinguistic pragmatic skills exhibited (e.g., eye contact, joint attention) is predictive of the rate of subsequent vocabulary acquisition (Kleinke, 1986) and it has also been suggested that poor eye contact may adversely affect the educational gains of children with autism due to the relationship between eye contact and attending to the teacher and instructional demands (Greer & Ross, 2007; Lovaas, 1977).

Given the potential negative outcomes correlated with deficits in eye contact, the development of eye contact responses in children with autism has drawn the attention of many researchers. Theories related to cognition, affect, social meaning, and theory of mind have been offered to account for the development of eye contact and for the characteristic deficit in children with autism (Baron-Cohen, 1988; Burgoon, Coker, & Coker, 1986). In addition, the effects of various behavior analytic principles and procedures on eye contact responses have been investigated.

Early behavior analytic investigations targeted eye contact responses to achieve instructional attention prior to beginning academic programs using vocal and physical prompts (Foxy, 1977; Greer & Ross, 2007; Helgeson, Fantuzzo, Smith, & Barr, 1989; Lovaas, 1977; Lovaas, 1981; Mirenda et al., 1983). The premise of these interventions was that if children with autism failed to orient toward the instructor, they would also fail to respond and learn (Foxy, 1977; Helgeson et al., 1989; Lovaas, 1977; Lovaas, 1981). Despite the capacity of these behavioral interventions to increase eye contact with children with autism, there have been increasing concerns regarding the functionality of such interventions (Arnold et al., 2000; Mirenda et al., 1983; Rollins, 1999; Seibert & Oller, 1981; Turkstra, 2005). Specifically, the results of studies investigating eye contact as a prerequisite skill for

intensive instruction showed limited generality across social settings, other functions, or other instructors and persons (Fay & Schuler, 1980; Wing, 1976). In addition, the use of vocal and physical prompting for eye contact responses has some possible disadvantages. First, some children may resist the use of physical prompts and consequently emit interfering behaviors. Second, the use of prompts to teach eye contact requires an additional instructional step related to prompt fading. Prompts, especially vocal prompts, may be difficult and time consuming to fade, resulting in slower skill acquisition.

Beginning in the 1980s and continuing into the present day, behavior analytic studies targeting eye contact have departed from the rigid instructional models of earlier research and instead targeted eye contact within social contexts through various social-interactive strategies (Tiegerman & Primavera, 1984). An array of procedures, including peer modeling, peer implemented pivotal response training, role playing, contingent imitation, time delay, and naturalistic behavior modification techniques combining discrete trial training (DTT) and pivotal response training (PRT) have all been shown to produce modest increases in a variety of social behaviors, including eye contact and joint attention (Berler, Gross, & Drabman, 1982; Hwang & Hughes, 1995; Hwang & Hughes, 2000; Koegel & Frea, 1993; Pierce & Schreibman, 1995; Whalen & Schreibman, 2003).

Although the results of these more recent behavior analytic studies have demonstrated moderately improved generalization over earlier studies, they did not present an analysis of eye contact that was conceptually systematic (Baer, Wolf, & Risley, 1968). Moreover, these studies did not include an analysis of the possible role of social and motivational variables implicated in the learning of eye contact responses by typical children. In other words, within these studies, social consequences were not conditioned as reinforcers but instead the eye contact responses were strengthened by "extrinsic" reinforcers in the form of the presentation of tangibles, social praise, or edible items. Both Whalen and Schreibman (2003) and Jones and Carr (2004) cited this as a limitation within their studies on gaze shift when teaching joint attention responses.

The procedure employed in the current case study was designed with consideration of the limitations of previous behavior analytic research aimed at increasing eye contact responses. Specifically, given the lack of generality and potential problems associated with vocal and physical prompting of eye contact responses used in a number of previous studies, the procedures implemented in this case study were designed to induce the eye contact response in the same manner that typical children acquire this important response in a number of ways.

First, eye contact responses were induced through the implementation of extinction for previously acquired requests. Although extinction is frequently implemented to reduce problem behavior, one side effect is to induce response variability (Lerman & Iwata, 1996). When extinction of a high probability response occurs, but the environmental arrangement is such that a motivating operation (MO) is still present (Michael, 1993), novel or previously reinforced less probable members of a response class may be induced. The responses induced by extinction may be aberrant behavior such as aggression, self-injury, or property destruction (Lerman & Iwata, 1996). However, a number of studies have demonstrated that extinction also induced appropriate, adaptive behaviors that were then increased through the arrangement of reinforcing contingencies (Carbone, Sweeney-Kerwin, Attanasio, & Kasper, 2010; Duker & Van Lent, 1991; Grow, Kelley, Roane, & Shillingsburg, 2008; Harding, Wacker, Berg, Rick, & Lee, 2004; Lalli, Zanolli, & Wohn, 1994; Morgan & Lee, 1996).

Next, studies that have employed social-interactive strategies have produced moderately better outcomes related to establishing eye contact responses and therefore one such strategy, specifically mand training, was used in this case study. Mundy, Sigman, Ungerer, Sherman (1986) reported that children with autism fail to make eye contact when making verbal requests. Using Skinner's (1957) taxonomy of verbal behavior, requests would be classified as mands. Skinner (1957) defined the mand as "...a verbal operant that is reinforced by a characteristic consequence and is therefore under the control of relevant conditions of deprivation and aversion" (pp. 35-36). This is one of the first verbal responses acquired by most children (Sundberg & Michael, 2001). Moreover, the language pragmatic skill of eye contact usually accompanies this type of verbal behavior (Podrouzek & Furrow, 1988) very early in development. Research has suggested, however, that children with autism often fail to emit these important social responses while manding (Podrouzek & Furrow, 1988). A study by Plavnick and Ferreri (2012) suggested that teaching procedures designed to increase mand responses may also increase collateral social behavior, such as eye gaze, for children with autism. Given the findings of Plavnick and Ferreri (2012) and the numerous additional benefits to mand training (Sundberg & Michael, 2001), this appeared to be an appropriate condition in which to begin targeting eye contact responses.

Finally, the procedure described and employed in this case study attempted to address the limitation identified by a number of previous researchers concerning the use of "extrinsic" reinforcement to establish and maintain eye contact responses. Preliminary work

by Isaksen and Holth (2009) suggested a promising method for conditioning social attention as reinforcement that did not include the use of "extrinsic" reinforcement. As one phase of establishing joint attention responses and initiations for children with autism, Isaksen and Holth (2009) conditioned social approval, in the form of the smiling and nodding of an adult, as reinforcement. In this phase of training, children with autism sat across a table from an adult and were only allowed to take preferred items when the adult was smiling and nodding. Attempts to take the items when smiling and nodding were not occurring were blocked by the adult. The researchers asserted that these procedures established adult smiling and nodding as conditioned reinforcement for the eye contact responses that produced them. In other words, the results of this experiment suggested that the children's looking responses were ultimately increased by the reinforcing effects of the adult's smiling and nodding. Similar to the Isaksen and Holth (2009) study, the procedure implemented in the current case study was derived from a functional analysis of the environmental variables that may account for the acquisition of eye contact responses for typical individuals.

There were two purposes of the current case study. First, this case study was designed to extend the literature on teaching social pragmatic skills, specifically eye contact responses, to children with autism. Second, this case study evaluated an extension to a child with autism of a teaching procedure derived from an analysis of the motivational and discriminative variables responsible for the acquisition of eye contact responses in typical children.

Method

Participant

The participant, Jake, was a 3-year-old boy with a primary diagnosis of autism. Jake's vocal mand repertoire was multiply controlled in that mands occurred under the control of both a relevant motivating operation and the presence of preferred items which served a discriminative function. Prior to the beginning of the study, data on the frequency and variety of mands emitted were recorded over a 3 month period. According to these data, at the time of this study, Jake had learned to emit over 300 mand responses and emitted an average of about one mand per min during a 3 hr instructional session. An Assessment of Basic Language and Learning Skills (ABLLS, Partington & Sundberg, 1998) conducted approximately 3 months prior to beginning this study indicated that Jake exhibited limited tact, listener, and intraverbal repertoires. In addition, Jake had a history of emitting interfering problem behaviors in the form of bolting, flopping, kick-

ing, crying, and whining. Sequence analysis data were collected on occurrences of problem behavior and allowed for the tentative identification of the function of behavior by noting the correlation between a problem behavior and its putative evocative or antecedent stimulus. Based on the sequence analysis data collected, it appeared the major functions of Jake's interfering problem behavior were socially mediated positive reinforcement and socially mediated negative reinforcement. The sequence analysis data also revealed that problem behavior was occurring at a rate of five episodes of problem behavior per 3 hr session. Prior to the onset of this study, behavior reduction procedures were implemented that consisted of teaching procedures to reduce the value of escape from instructional tasks as a reinforcer, extinction for problem behavior, and reinforcement for vocal mands. After 3 months of intervention, Jake's interfering problem behavior was reduced to an average rate of one episode of problem behavior per 3 hr session by the beginning of this study.

Setting

Jake was enrolled at a private clinic that provided one-to-one educational services to individuals with autism and other developmental disabilities. Instruction and treatment was guided by the principles of applied behavior analysis (ABA) and incorporated Skinner's (1957) analysis of verbal behavior. The educational setting consisted of two classrooms and one activity room. Approximately nine other children were receiving intensive one-to-one instruction simultaneously within this setting. Across the classrooms and activity room, a wide variety of items and activities were available to students. Examples include gross motor activities (e.g., trampoline, bikes, basketball hoop), fine motor activities (e.g., puzzles, beads, shape sorters), academic activities (e.g., books, workbooks, computers), and toys (e.g., plastic figurines, cars, trucks, puppets).

Jake attended the clinic three times per week for 3 hr. These sessions consisted of one-on-one intensive teaching in the form of DTT interspersed with natural environment teaching. Mand training was conducted across all settings for the entire 3 hr session. The play environment was enriched with items such as food, toys, and activities that had previously been demonstrated to serve as reinforcers in that the delivery of these items following behavior produced an increase in the frequency of that behavior. Access to these items was manipulated so as to contrive MOs and arrange opportunities to teach mand responses.

Four different instructors delivered instruction during baseline and treatment conditions. All instructors were supervised by a

doctoral level Board Certified Behavior Analyst © (BCBA) with more than 30 years of experience working in the field of ABA with adults and children with autism and a Board Certified Assistant Behavior Analyst with 6 years of experience in the field of ABA working with children with autism. Three of the four instructors held bachelor's degrees and one held a master's degree and was a certified speech and language pathologist. The instructors had been employed at the clinic for an average of 12 months (range, 2-18 months). All instructors underwent a 2-week, competency-based training program upon being hired at the clinic where this research was conducted. Following the initial training period, monthly checks for treatment integrity were conducted.

Response Definition & Dependent Variable

An eye contact response was defined as movement by Jake's head and eyes so as to make direct contact with the eyes of the person from whom he was manding immediately prior to or simultaneous with the vocal mand response. A specific criterion for the duration of eye contact was not established in order to promote natural and functional response topographies. Eye contact responses of any duration were counted. A correct response was defined as the production of a one-word vocal mand that was immediately preceded or accompanied by an eye contact response. An incorrect response was defined as the production of a vocal mand that was not immediately preceded or accompanied by an eye contact response. The dependent measure in this study was the percentage of mands accompanied by eye contact during a 3 hr session.

Response Recording

Jake's instructors also served as the data recorders throughout the study. An instructor was seated in close proximity (no more than 2 ft away) to Jake, either on the floor or across a table, with a data sheet on a clip board. Trial-by-trial data on the frequency of mand responses emitted across items and activities were recorded throughout the entire 3 hr session. In addition, the occurrence of an eye contact response was recorded by circling a "yes" on a data sheet when the vocal mand was immediately preceded or accompanied by eye contact. Mands that were not preceded or accompanied by eye contact were recorded by circling a "no." The percentage of mand trials accompanied by eye contact was determined by dividing the number of trials with eye contact by the number of mand trials with eye contact plus the number of trials without eye contact and converting the ratio to a percentage.

Instructors manipulated various environmental stimuli and conditions so as to increase the value of items and activities as reinforcers and contrive opportunities for Jake to mand. The number of trials or opportunities to mand was not predetermined but instead based on the reinforcing value of stimuli within the environment and the evocative effect of these stimuli on Jake's mand repertoire.

Interobserver Agreement

All sessions were videotaped to allow for measurements of interobserver agreement (IOA). Either the second or third author of this study viewed approximately 20 min of the video recorded from every session and recorded data independent of the instructors for the purposes of assessing IOA. The data records of the second observer were then compared to those of the instructor and an agreement between the instructor and second observer was scored when both observers recorded a response as either correct or incorrect. A disagreement was scored when the instructor recorded a correct response and the second observer recorded an incorrect response, or vice versa. IOA was calculated by dividing the number of agreements by agreements plus disagreements and converting the ratio to a percentage. IOA was calculated as 89% during baseline and 92% during treatment.

Design and Procedures

An AB design was used in this case study. This type of design does not allow one to suggest there is a functional relation between the dependent and independent variables. It may instead demonstrate a correlation between the independent and dependent variables.

General procedures. The items and activities used as reinforcers were selected based on behavior Jake emitted suggesting MOs related to the items. Examples of these behaviors included looking at, reaching for, guiding the instructor to, or requesting an item or activity. Whenever Jake demonstrated possible motivation for an item, the instructor waited for up to 5 s for Jake to emit a vocal one-word mand. If Jake continued to demonstrate possible motivation for the item but did not emit a vocal mand within 5 s the instructor provided a vocal prompt by stating the name of the item. Jake consistently emitted mand responses under the control of an MO and the presence of the reinforcing item and consequently vocal prompting of mand responses rarely occurred during this study.

Baseline. In the baseline condition, all vocal mands were immediately followed by the delivery of the item or activity requested regardless of the occurrence of an eye contact response. The consequences for mands took the form of 30 s access to requested items and activi-

ties, consumption of food items, or until Jake initiated another trial by emitting a mand for a different or additional item. If Jake did not initiate another trial after the items requested were consumed by emitting a mand response at the end of the consequence period, the instructor manipulated environmental stimuli so as to contrive an MO for some stimulus and arranged an opportunity for Jake to mand again. Following all vocal mands with or without eye contact the instructor responded conversationally (e.g., "Yeah, let's play with the dinosaurs") but did not make explicit statements or provide praise for the mand response or eye contact.

Extinction and differential reinforcement during mand training. If Jake manded for an item or activity and eye contact occurred immediately prior to or simultaneous with the vocal mand, the item or activity requested was delivered immediately. Consequences took the form of 30 s access to requested items and activities, until food items were consumed, or until Jake initiated another trial by emitting a mand for a different or additional item. If Jake did not initiate another trial by emitting a mand response at the end of the reinforcement period, the instructor manipulated environmental stimuli so as to contrive an MO for some stimulus and arranged an opportunity for Jake to mand again.

When Jake emitted a mand response that was not accompanied by eye contact, extinction was implemented by withholding the reinforcer specific to the mand. If Jake continued to produce additional vocal mands without emitting an eye contact response after the initiation of the extinction period, the reinforcer continued to be withheld. The extinction period continued until a vocal mand was immediately preceded or accompanied by an eye contact response. Only vocal mands immediately preceded or accompanied by eye contact resulted in reinforcement. For correct responses that occurred only after extinction was implemented the magnitude of the reinforcer was decreased regardless of the amount of time that had passed (e.g., 1 s between an incorrect or correct response, versus 2 min between an incorrect and correct response). Magnitude was manipulated for items and activities by providing shorter durations of access and was manipulated for food by providing smaller portions of the item.

Results

The percentage of vocal mands accompanied by eye contact responses during both baseline and the extinction and differential reinforcement condition is displayed in Figure 1. Across both conditions, Jake emitted a mean of 150 mands (range, 61-180). In baseline, the mean percentage of mands accompanied by eye contact was 10%

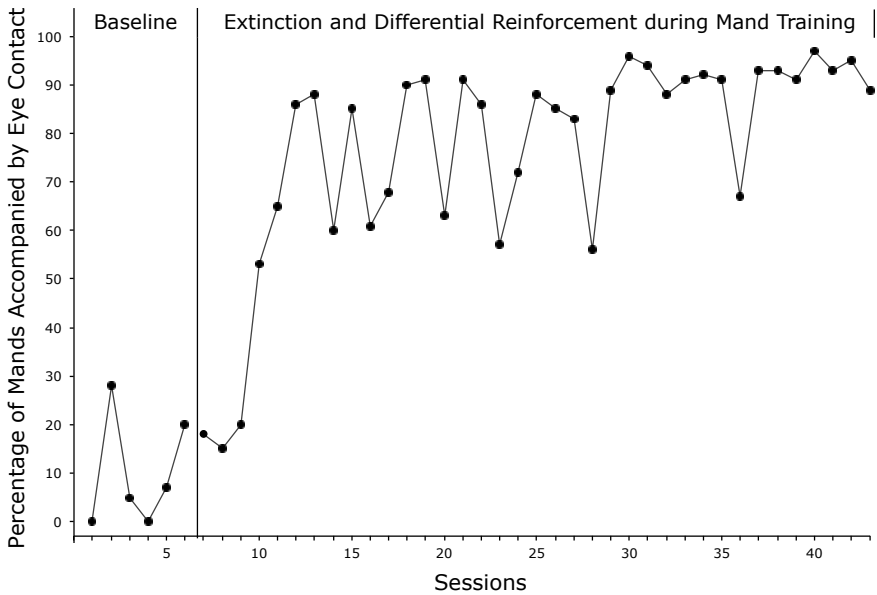


Figure 1. The percentage of mands accompanied by eye contact per session during baseline and treatment conditions for Jake.

(range, 0-28) across six sessions. These results were consistent with the long-standing level of responding observed clinically prior to the beginning of formal data collection. In the first three sessions of the extinction and differential reinforcement condition, the average percentage of mands accompanied by eye contact increased to about 18% (range, 15-20), suggesting that early in the treatment phase, Jake's mand responses frequently contacted the extinction and differential reinforcement contingency for incorrect responses. A notable and relatively immediate increase in eye contact responses occurred beginning in Session 10. Although responding during Sessions 10 through 28 showed some variability, the majority of data points were above 80% with the lowest percentage of correct responses falling to only 55%. The mean percentage of mands accompanied by eye contact during the extinction and differential reinforcement procedure was approximately 77% (range, 15-97), a considerable increase over the baseline level. Moreover, the mean percentage of mands accompanied by eye contact responses for the last 15 sessions of the treatment condition was above 90% (range, 67-97) and overall the percentage of eye contact was relatively stable.

Discussion

The purpose of the current case study was to extend the literature on teaching social pragmatic skills, specifically eye contact responses, to children with autism. Furthermore, this case study sought to determine the effectiveness of a teaching procedure derived from an analysis of the motivational and discriminative variables responsible for the acquisition of eye contact responses for typical children. The data from this single case study showed that, compared to baseline, the percentage of eye contact responses was substantially higher after the implementation of the treatment method. These results suggest that the procedures offered in this case study may be effective in increasing eye contact for some children with autism. In addition, these findings extend the literature on the topic of teaching social pragmatic skills by demonstrating that it may be possible to induce eye contact responses through extinction for previously reinforced mands (Carbone et al., 2010; Duker & Van Lent, 1991; Grow et al., 2008; Harding et al., 2004; Lalli et al., 1994; Lerman & Iwata, 1996; Morgan & Lee, 1996).

In the present case study, Jake emitted a low rate of eye contact responses during baseline. To overcome this skill deficit in behavior analytic research, response prompts are frequently implemented to supplement the control for the response and ensure that the behavior contacts the reinforcer.

In this situation, a vocal or physical prompt may have been implemented to produce the eye contact response as demonstrated in previous studies on this topic (Foxy, 1977; Greer & Ross, 2007; Lovaas, 1977; Lovaas, 1981). To avoid the potential problems associated with response prompts, all previously reinforced mands were placed on extinction during the treatment condition to take advantage of response variability induced by extinction. Early on in the treatment condition, Jake continuously manded for items or activities and showed little response variability. During the fourth treatment session, however, response variability increased and eye contact responses accompanied the vocal mand and were selected through reinforcement. Future research should examine the extent to which procedures that promote extinction induced response variability are effective in increasing eye contact responses for participants with zero or near-zero baseline levels of eye contact responses. Jake's baseline level of responding was relatively low suggesting that this procedure could be effective even with minimal initial response repertoires. The suspected reinforcer for the eye contact response was the sight of the eyes or face of the listener, since the response increased in frequency following this consequence. What follows is an analysis of how the

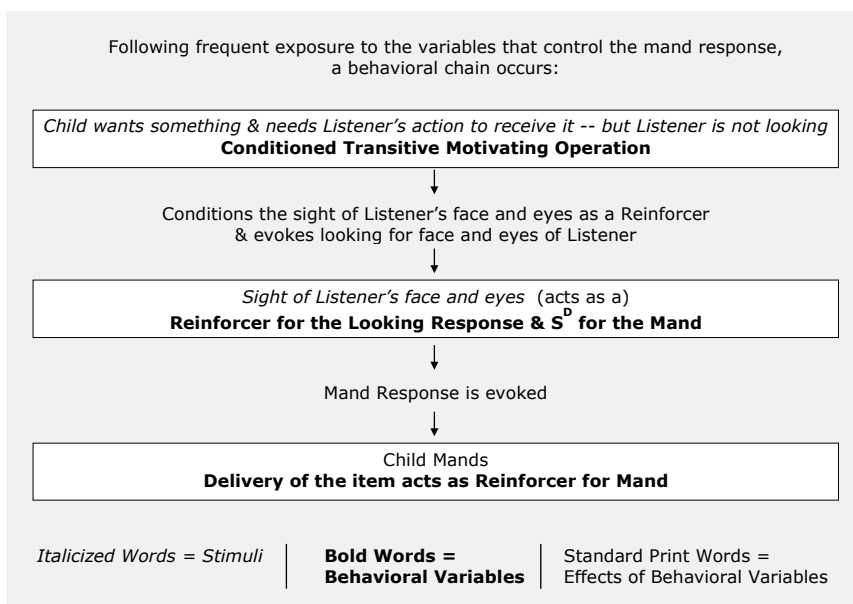


Figure 2. Description of the behavioral variables that evoke the eye contact response and select and maintain it by reinforcement in the form of social attention of a communication partner.

procedures within this case study may have achieved the important outcome of conditioning the eye gaze of the communication partner as a reinforcer and therefore increased the eye contact responses. As previously described, a number of behavior analytic methods have been applied in an effort to increase eye gaze behavior. However, only a few authors have offered a functional analysis of eye gaze behavior that includes consideration of all relevant motivational and discriminative variables (Dube, MacDonald, Mansfield, Holcomb, & Ahearn, 2004; Holth, 2005; Holth, 2011; Isaksen & Holth, 2009). One such account was provided by Dube et al. (2004) related to the occurrence of joint attention. Initiation of joint attention (IJA), recognized as one of the earliest forms of communication in young children (Bruner, 1975; Mundy, Sigman, & Kasari, 1994; Taylor & Hoch, 2008), consists of the coordination of visual attention between another individual in the environment and an object of interest, presumably serving to direct the other's gaze to the item in question (Arnold et al., 2000). According to the interpretative analysis offered by Dube et al. (2004) an interesting event (e.g., a plane flying across the sky) in the context of a familiar adult who is not attending to the event acts as an MO (Michael, 1993).

This environmental arrangement establishes the value of adult-attending stimuli (i.e., the adult orienting toward the interesting event) as reinforcers and evokes behavior that produces those reinforcers, specifically gaze shift behavior. The adult-attending stimuli function as reinforcers due to a history of adult reactions to the interesting event leading to greater access to reinforcement. In addition, Dube et al. (2004) suggested adult-attending stimuli also act as discriminative stimuli correlated with the availability of reinforcement in the form of event-related and adult-mediated consequences for event-related behavior.

Though only identified as an MO by Dube et al. (2004), the environmental arrangement that includes an interesting event as an MO and the context of a familiar adult's presence implicates more specifically the role of the transitive conditioned motivating operation (CMO-T; Michael, 1993). This behavioral antecedent variable can engender other stimuli with reinforcing value (Michael, 1993) and occurs when one already existing MO combines with an environmental context in which access to some relevant reinforcer is blocked or interrupted. In the case of joint attention, the CMO-T consists of the interesting event and the context includes the presence of a familiar adult who is not yet attending to the interesting event.

An account similar to Dube et al.'s (2004) regarding joint attention may be offered as an explanation for the development of eye contact behavior by the child in this case study. Figure 2 provides a diagram of the possible behavioral variables implicated in establishing eye contact responses for typical children. Similar to the interesting event functioning as an MO in the analysis of joint attention, in this case study environmental variables were manipulated to contrive an MO for an item, activity, or food item. The programmed contingencies were then arranged such that access to the reinforcer was denied or blocked when an eye contact response did not occur. This environmental arrangement may have acted as a CMO-T that momentarily established the value of the sight of the eyes or face of a listener as a reinforcer and evoked eye contact behavior. In the analysis of joint attention offered by Dube et al. (2004) the onset of an interesting event and the presence of a familiar adult who is not attending to the interesting event is analogous to the stimulus condition acting as a CMO-T and evoking eye gaze shift in this case study. Under the conditions of the CMO-T in this study, the sight of the eyes or face of the communicative partner may have served not only as the reinforcer for the eye contact response but also as a discriminative stimulus for the mand response. This is consistent with Dube et al.'s (2004) description of the two effects of the adult-attending stimuli in the analysis of joint

attention. In the current case study, the mand response was then reinforced by the delivery of the item specific to the relevant MO.

The analysis offered above is an interpretative account of eye contact, consistent with the principles of behavior analysis derived from an experimental analysis. This analysis offers a plausible explanation for the acquisition of eye contact responses in typically developing children and provides a reasonable basis from which to derive teaching methods for children with autism. The value of proposing this analysis of the findings of this study is found in the fact that the conditioning of social consequences as reinforcers is vitally important to the effective treatment of children with autism and suggests a potentially fruitful line of research for others to follow.

In order to validate the interpretative analysis of eye contact offered here and provide evidence of the reinforcing and discriminative function of the sight of the eyes or face of the listener, two revisions to the procedures described should be considered. First, in this study the listener was always looking at Jake and eye contact responses often occurred simultaneously with the mand response. Consequently, both the sight of the listener's eyes or face and the delivery of the manded stimulus often, but not always, occurred simultaneously. This arrangement of reinforcement made it difficult to ascertain the specific controlling variables for the two responses and might lead some to conclude that this was merely a two-component mand response (i.e., eye contact response and vocal mand). In order to more clearly distinguish between the reinforcing effects of the sight of the listener's eyes and face and the item that was ultimately delivered as a reinforcer, future studies should include a condition in which the listener's face or body is turned away from the child and some response (e.g., positioning his body in front of the listener, tapping the listener on the shoulder) must occur to produce sight of the eyes of the listener. The additional responses required to produce the eye contact would provide more convincing evidence of the reinforcing effects of the listener's eye gaze. For example, a listener may sit with her face turned from the child and require that the child taps the listener on the shoulder or moves his body to be in line with the listener's face prior to making eye contact. The occurrence of these responses would provide further support of the interpretative analysis offered and more clearly demonstrate the separate reinforcing effects of the sight of the listener's eyes and face compared to the reinforcing value of the item ultimately delivered for the mand.

The second consideration involves a thorough demonstration that the listener's eyes or face acquired discriminative control over

the ultimate mand response. Michael (2004) defined a discriminative stimulus as:

A stimulus condition that (1) alters the current or momentary frequency of a type of behavior (2) because of a historical relation between the presence/absence of that stimulus condition and the *differential availability* of an effective reinforcer given that type of behavior (p. 59).

In order to support the contention that the sight of the listener's eyes and face were discriminative for mands responses, it is necessary to show that in the absence of those stimuli, or the S-delta condition, mand responses occurred at a lower frequency relative to the frequency of responses in the presence of the eyes and face of the listener. To demonstrate empirically the discriminative control of the listener's eyes and face, future research should include a condition in which the listener is turned away from the child but when the child emits responses that have typically produced the sight of the listener's eyes or face as a form of reinforcement (e.g., tapping the listener on the shoulder, moving to be in line with listener's face, gaze shifting), the listener does not turn to look at the child. According to the interpretative analysis offered here, this experimental arrangement would produce two effects. First, behavior previously maintained by access to the sight of the listener's eyes and face (e.g., tapping the listener's shoulder) would be put on extinction and gradually decrease. Second, if the sight of the listener's eyes and face had become discriminative for the availability of reinforcement for mand responses, the frequency of mands for reinforcing items and activities would also decrease. The decrease in mand responses under this condition would suggest that the absence of the listener's eyes and face served as an S-delta condition and would therefore suppress the mand response. The inclusion of this condition would provide further experimental verification of the accuracy and completeness of the interpretative analysis offered in this paper.

The need for a more thorough experimental analysis notwithstanding, the results of this research and the interpretative analysis offered have some important implications for the study of social skills training for children with autism. Teaching topographically appropriate social responses to children with autism by delivering reinforcers that have not selected and maintained the same responses in typically developing children can lead to less than effective outcomes. If naturally occurring stimuli are not conditioned as reinforcers, the responses taught may occur only when the motivation for the specifically

programmed “extrinsic” reinforcer is high and therefore limit the generality of the response. In addition, what may appear to be appropriate social responses, based upon their form, may be functionally unrelated to the desired response. For example, Holth (2011) suggested that joint attention responses that are taught without first conditioning the social attention of a communication partner as a reinforcer may actually be nothing more than mands for the “extrinsic” reinforcer that have been programmed by the experimenter. Consequently, a topographically identical but functionally different response would be established. Dube et al. (2004) made the same point by suggesting that the practice of teaching topographically correct responses without regard for the relevant controlling variables produces only “mechanistic imitations of meaningful behavior” (p. 205).

In this case study, it is suspected that the sight of the listener’s eyes and face were conditioned as reinforcers within the context of manding for preferred items and activities. This is one of many conditions in which eye contact responses occur for nondisabled children. However, if in fact social consequences can be conditioned as reinforcers, as is suspected in this case, the implications for functional outcomes for children with autism using these and similar procedures is vast. The eye contact response targeted here is one step in a progression of increasingly complex social interactions that require further examination. The procedures and analysis offered by the results of this case study could act as a model for future research efforts in the area of social skills instruction in children with autism.

The data reported in this case study show a substantial change following implementation of the treatment method and should therefore encourage other authors to pursue an experimental analysis of the procedures reported in this paper. Perhaps more importantly, the conceptual analysis offered, related to conditioning social consequences as reinforcement for eye contact responses, addresses a critical issue in autism research and treatment. This account is a valuable extension to the available literature on teaching social pragmatic skills to children with autism and provides researchers with numerous opportunities for future empirical work.

There are some limitations of this case study and additional research is needed, however, to support this conceptual analysis. The case study data of only one participant reported here provide only tentative evidence for the effectiveness of the procedures implemented but do not demonstrate a functional relation or allow for conclusive statements regarding the accuracy of the analysis offered. Experimental investigations across multiple participants with rigorous research designs and measures of treatment integrity are necessary to demon-

strate a functional relation between the independent and dependent variables of concern and to elucidate the specific role of each variable identified in this interpretative analysis. In addition, future studies should investigate the extent to which eye contact responses established under the conditions described within this case study are maintained over time and generalized across stimulus conditions. Some limited evidence of the generality of these effects was demonstrated in that Jake emitted eye contact responses across four instructors. Notwithstanding these limitations, the conceptual analysis offered is cogent, conceptually systematic, and amenable to experimentation.

References

- Arnold, A., Semple, R. J., Beale, I., & Fletcher-Flinn, C. M. (2000). Eye contact in children's social interactions: What is normal behavior? *Journal of Intellectual & Developmental Disability, 25*, 207–216.
- Baer, D. M., Wolf, M. M., Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*, 91-97.
- Baron-Cohen, S. (1988). Social and pragmatic deficits in autism: Cognitive or affective? *Journal of Autism and Developmental Disorders, 18*, 379–402.
- Baron-Cohen, S., Allen, J., & Gillberg, C. (1992). Can autism be detected at 18 months? The needle, the haystack, and the CHAT. *British Journal of Psychiatry, 161*, 839–843.
- Berler, E. S., Gross, A. M., & Drabman, R. S. (1982). Social skills training with children: Proceed with caution. *Journal of Applied Behavior Analysis, 15*, 41–53.
- Bruner, J. (1975). From communication to language: A psychological perspective. *Cognition, 3*, 255–287.
- Burgoon, J. K., Coker, D. A., & Coker, R. A. (1986). Communicative effects of gaze behavior: A test of two contrasting explanations. *Human Communication Research, 12*, 495–524.
- Carbone, V.J., Sweeney-Kerwin, E., Attanasio, V., & Kasper, T. (2010). Increasing the vocal responding of children with autism and other developmental disabilities using manual sign language, mand training, prompt delay procedures, and vocal prompting. *Journal of Applied Behavior Analysis, 43*, 705–709.
- Dube, W. V., MacDonald, R. P. F., Mansfield, R. C., Holcomb, W. L., & Ahearn, W. H. (2004). Toward a behavioral analysis of joint attention. *The Behavior Analyst, 27*, 197-207.

- Duker, P. C., & Van Lent, C. (1991). Inducing variability in communicative gestures used by severely retarded individuals. *Journal of Applied Behavior Analysis, 24*, 379–386.
- Fay, W. H., & Schuler, A. L. (1980). *Emerging language in autistic children*. Baltimore, MD: University Park Press.
- Fox, R. M. (1977). Attention training: The use of overcorrection avoidance to increase the eye contact of autistic and retarded children. *Journal of Applied Behavior Analysis, 10*, 489–499.
- Greer, D. R., & Ross, D. E. (2007). *Verbal behavior analysis*. New York, NY: Pearson Education.
- Grow, L. L., Kelley, M. E., Roane, H. S., & Shillingsburg, M. A. (2008). Utility of extinction induced response variability for the selection of mands. *Journal of Applied Behavior Analysis, 41*, 15–24.
- Harding, J. W., Wacker, D. P., Berg, W. K., Rick, G., & Lee, J. F. (2004). Promoting response variability and stimulus generalization. *Journal of Applied Behavior Analysis, 37*, 185–195.
- Helgeson, D. C., Fantuzzo, J. W., Smith, C., & Barr, D. (1989). Eye-contact skill training for adolescents with developmental disabilities and severe behavior problems. *Education and Training in Mental Retardation, 24*, 56–62.
- Holth, P. (2005). An operant analysis of joint attention skills. *Journal of Early and Intensive Behavioral Intervention, 2*, 160–175.
- Holth, P. (2011). Joint attention in behavior analysis. In E. A. Mayville & J. A. Mulick (Eds.), *Behavioral Foundations of Effective Autism Treatment*. (pp. 73–89). Cornwall-on-Hudson, NY: Sloan Publishing.
- Hwang, B., & Hughes, C. (1995). Effects of social interactive strategies on early social-communicative skills of a preschool child with developmental disabilities. *Education and Training in Mental Retardation and Developmental Disabilities, 30*, 336–349.
- Hwang, B., & Hughes, C. (2000). The effects of social interactive training on early social communicative skills of children with autism. *Journal of Autism and Developmental Disorders, 30*, 331–343.
- Isaksen, J., & Holth, P. (2009). An operant approach to teaching joint attention skills to children with autism. *Behavioral Interventions, 24*, 215–236.
- Jones, E. A., & Carr, E. G. (2004). Joint attention in children with autism: Theory and intervention. *Focus on Autism & Other Developmental Disabilities, 19*, 13–26.

- Kleinke, C. L. (1986). Gaze and eye contact: A research review. *Psychological Bulletin*, 100(1), 78–100.
- Koegel, R. L., & Frea, W. D. (1993). Treatment of social behavior in autism through the modification of pivotal social skills. *Journal of Applied Behavior Analysis*, 26, 369–377.
- Lalli, J. S., Zanolli, K., & Wohn, T. (1994). Using extinction to promote response variability in toy play. *Journal of Applied Behavior Analysis*, 27, 735–736.
- Lee, K., Eskritt, M., Symons, L. A., & Muir, D. (1998). Children's use of triadic eye gaze information for "mind reading." *Developmental Psychology*, 34, 525–539.
- Leekam, S., Baron-Cohen, S., Perrett, D., Milders, M., & Brown, S. (1997). Eye-direction detection: A dissociation between geometric and joint attention skills in autism. *British Journal of Developmental Psychology*, 15, 77–95.
- Lerman, D. C., & Iwata, B. A. (1996). Developing a technology for the use of operant extinction in clinical settings: An examination of basic and applied research. *Journal of Applied Behavior Analysis*, 29, 345–382.
- Lovaas, O. I. (1977). *The autistic child: Language development through behavior modification*. New York, NY: Irvington.
- Lovaas, O. I. (1981). *Teaching developmentally disabled children. The "me" book*. Austin, TX: PRO-ED.
- Michael, J. (1993). Establishing operations. *The Behavior Analyst*, 16, 191–206.
- Michael, J. (2004). *Concepts and principles of behavior analysis*. Kalamazoo, MI: Association for Behavior Analysis International.
- Mirenda, P. L., Donnellan, A. M., & Yoder, D. E. (1983). Gaze behavior: A new look at an old problem. *Journal of Autism and Developmental Disorders*, 13, 397–409.
- Morgan, D. L., & Lee, K. (1996). Extinction-induced response variability in humans. *Psychological Record*, 46(1), 145–159.
- Mundy, P., Sigman, M., & Kasari, C. (1994). Joint attention, developmental level, and symptom presentation in autism. *Journal of Autism and Developmental Disabilities*, 20, 115–128.
- Mundy, P., Sigman, M., Ungerer, J., & Sherman, T. (1986) Defining the social deficits of autism: The contributions of non-verbal communication measures. *Journal of Child Psychology and Psychiatry*, 27, 657–669.

- Partington, J. W., & Sundberg, M. L. (1998). *The assessment of basic language and learning skills*. Pleasant Hill, CA: Behavior Analysts, Inc.
- Pierce, K., & Schreibman, L. (1995). Increasing complex social behaviors in children with autism: Effects of peer-implemented pivotal response training. *Journal of Applied Behavior Analysis, 28*, 285–295.
- Plavnick, J. B., & Ferreri, S. J. (2012). Collateral effects of mand training for children with autism. *Research in Autism Spectrum Disorders, 6*, 1366–1376.
- Podrouzek, W., & Furrow, D. (1988). Preschoolers' use of eye contact while speaking: The influence of sex, age, and conversational partner. *Journal of Psycholinguistic Research, 17*, 89–98.
- Rollins, P. R. (1999). Early pragmatic accomplishments and vocabulary development in preschool children with autism. *American Journal of Speech-Language Pathology, 8*, 181–190.
- Seibert, J. M., & Oller, D. K. (1981). Linguistic pragmatics and language intervention strategies. *Journal of Autism and Developmental Disorders, 11*, 75–88.
- Skinner, B. F. (1957). *Verbal behavior*. Acton, MA: Copley Publishing Group.
- Stern, D. (1985). *The interpersonal world of the infant*. New York, NY: Basic Books.
- Sundberg, M. L., & Michael, J. (2001). The value of Skinner's analysis of verbal behavior for teaching children with autism. *Behavior Modification, 25*, 698–724.
- Taylor, B. A., & Hoch, H. (2008). Teaching children with autism to respond to an initiate bids for joint attention. *Journal of Applied Behavior Analysis, 41*, 377–391.
- Tiegerman, E., & Primavera, L. H. (1984). Imitating the autistic child: Facilitating communicative gaze behavior. *Journal of Autism and Developmental Disorders, 14*, 27–38.
- Turkstra, L. S. (2005). Looking while listening and speaking: Eye-to-face gaze in adolescents with and without traumatic brain injury. *Journal of Speech, Language, and Hearing Research, 48*, 1429–1441.
- Whalen, C., & Schreibman, L. (2003). Joint attention training for children with autism using behavior modification procedures. *Journal of Child Psychology and Psychiatry, 44*, 456–468.

- Wing, L. (Ed.) (1976). *Early childhood autism* (2nd ed.). New York, NY: Pergamon Press.
- Wimpory, D. C., Hobson, R. P., Williams, M. G., & Nash, S. (2000). Are infants with autism socially engaged? A study of recent retrospective parental reports. *Journal of Autism and Developmental Disorders*, *30*, 525–536.
- Woods, J. J., & Wetherby, A. M. (2003). Early identification of and intervention for infants and toddlers who are at risk for autism spectrum disorder. *Language, Speech, and Hearing Services in Schools*, *34*, 180–193.

