THE EFFECT OF NATURALISTIC BEHAVIOR STRATEGIES ON THE QUALITY OF
SOCIAL INTERACTIONS FOR CHILDREN WITH AUTISM

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Autism is primarily a social disorder and deficits in social-orienting may be responsible for the failure of children with autism to initiate critical social behaviors. The purpose of this research was to improve the quality of social interactions of children with autism by implementing naturalistic behavior strategies intervention utilizing a multiple baseline design across four participants. Naturalistic behavior strategies comprised a comprehensive package of integrated components including: (a) intervention in the child’s natural environment; (b) child-initiated play activities; (c) prompts to emit language; (d) shaping for all vocal approximations and (e) delivery of natural reinforcement with embedded social interactions to maintain learned behavior. In addition to intervention, generalization of child behaviors was assessed across untrained parents and/or caregivers in the same environment. Results indicated the effectiveness of naturalistic teaching strategies package in increasing (a) the frequency of vocal mands for all children, (b) the number of times that children initiated social engagement during manding, and (c) intervals of nonverbal dyadic orienting. These skills generalized across two untrained caregivers in the same clinical setting without any training from the interventionist. Two parents required training during the generalization phase in order for their child’s behaviors to maintain at levels demonstrated during the intervention phase. Implications for future research and clinical practice are discussed.
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The Effect of Naturalistic Behavior Strategies on the Quality of Social Interactions for Children with Autism

Introduction

Autism has long been regarded as a social disorder (Kanner, 1943) manifested through an inability to relate to others, obliviousness about surroundings, social unawareness, preferred aloneness, rigid body postures, inattention during communication, and an overall impairment in relating to people. Proposed revisions to the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V; American Psychiatric Association, 2012) will soon combine the social and communication deficits into one domain (i.e., social-communication) because the characteristics (e.g., limited social initiations, unresponsiveness to the social approaches of others) are often inseparable.

Throughout childhood, social impairments manifest in a variety of different ways in children with autism. They may include the absence of social interaction skills such as joint attention, social engagement, and inattention to people and activities. Observed impairments in nonverbal behaviors may include decreased eye contact, restricted affect, limited visual tracking and eye gaze, and reduced social smiling (Bieberich & Morgan, 1998; Charman et al., 1997; Mundy, Sigman, Ungerer, & Sherman, 1986). Researchers have noted poor imitation skills, lack of demonstration of empathy (Charman et al., 1997), restricted affect, and social avoidance (Gillis, Callahan, & Romanczyk, 2011; Koegel et al., 2009; Prior & Oznff, 1998) as challenges for individuals with autism. This is because children with autism have difficulty understanding facial expressions, initiating social interactions, and responding to the social bids of other individuals (Gillis et al., 2011). These characteristics of autism make communication and social engagement complicated throughout the lifespan.
Many researchers (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Koegel et al., 2009; Mundy et al., 1986; Prior & Ozonoff, 1998; Ventola et al., 2007; Wetherby, Watt, Morgan, & Shumway, 2007; Zwaigenbaum, et al., 2005) agree that the social communication skills (e.g., eye contact, affect, social engagement, social initiations) of children with autism are notably impaired as early as infancy and persist throughout childhood. These social-emotional deficits compromise social competence and leave children with autism unable to take advantage of opportunities necessary for establishing a foundation in social exchanges that require the use of affect and perspective-taking (Gillis et al., 2011; Scambler, Hepburn, Rutherford, Wehner, & Rogers, 2007; Williams-White, Keonig, & Scahill, 2007).

Teaching early social communication skills (e.g., joint attention, gesture use, symbolic play, dyadic orienting, and affect) can lead to later improvements in social interaction skills in children with autism (Ingersoll, 2010; Koegel, 2000). Children with autism who receive early and intensive behavior analytic treatment that incorporates highly supportive teaching environments and builds in generalization to the natural environment are likely to make substantial gains impacting functional development that persists through the lifespan (Anderson & Romanczyk, 1999; Dawson & Osterling, 1997; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005; Lovaaas, 1987). According to the National Autism Center (NAC; 2009b) and the National Research Council (NRC; 2001), an overwhelming amount of research indicates that strategies based in ABA (e.g., modeling, prompting, imitation, reinforcement, self-monitoring) are the most effective for skills-instruction involving children with autism. Similarly, naturalistic teaching methods (e.g., natural environment, natural reinforcers, child-initiated), also based in ABA, can increase the social behaviors of children with autism (NAC, 2009a; NRC, 2001; Reichow & Volkmar, 2010; Simpson, 2005).
Researchers have described naturalistic behavior strategies as forms of discrete trial teaching that are initiated by the child and result in the delivery of natural reinforcement (NRC, 2001). Implementing naturalistic behavior strategies have led to increases in language and generalization for children with autism (Delprato, 2001; Koegel et al., 1987; Reichow & Volkmar, 2010). Naturalistic behavior strategies used in the treatment of individuals with autism are referred to in the literature as normalized behavioral language intervention (Delprato, 2001), natural environment teaching (NET; Sundberg & Partington, 1998), incidental teaching (Hart & Risley, 1975), natural language teaching paradigm (Koegel et al., 1987), pivotal response training (PRT; Koegel & Koegel, 2006) and milieu teaching (Hancock & Kaiser, 2002). Incorporating methods and techniques established in ABA and naturalistic teaching appear to be essential in the remediation of skill deficits of children with autism.

Research utilizing naturalistic behavior strategies that includes the use of clear prompts, interspersed mastery and acquisition tasks, choice activities to increase task motivation, experimenter and child turn-taking in order to provide teaching opportunities, contingent reinforcement following child response, reinforcement of correct and prompted responses, and the use of reinforcers that are directly tied to the responses made by the child in the natural environment has shown that children with autism made significant gains in their ability to respond to and initiate joint attention, thus increasing their social awareness (Whalen & Schreibman, 2003). Additionally, this intervention produced collateral increases in initiations, positive affect, spontaneous speech, and empathic responses for children with autism (Whalen, Schreibman, & Ingersoll, 2006).

Researchers have used similar naturalistic behavior interventions successfully to teach object imitation (Ingersoll & Schreibman, 2006), play (Kasari, Freeman, & Paparella, 2006),
communication and social interaction (Hankock & Kaiser, 2002; Vismara & Lyons, 2007), and joint attention (Kasari et al., 2006; Rocha, Schreibman, & Stahmer, 2007; Taylor & Hoch, 2008). Findings often extend beyond targeted skills resulting in collateral changes in language, pretend play, and joint attention (Ingersoll & Schreibman, 2006) and generalize without direct training to other environments (Hankock & Kaiser, 2002; Kasari et al., 2006; Rocha et al., 2007).

Recently, researchers examined specific components of intervention procedures that were responsible for improving the social initiations of young children with autism (Koegel, Vernon, & Koegel, 2009; Vernon, Koegel, Dauterman, & Stolen, 2012). In 2009, they implemented PRT procedures to provide language opportunities by presenting a discriminative stimulus, waiting for child’s response, and then reinforcing the child’s response with the preferred stimulus (Koegel et al., 2009). Researchers utilized a reversal design to determine if embedding social interactions into child-preferred reinforcers during natural language training was effective in increasing self-initiated social engagement, nonverbal dyadic orienting, and general child affect. Results of the study indicated that when adult social interactions were embedded into reinforcers, increases occurred in child-initiated social engagement during communication, dyadic orienting, and affect. In 2012, Vernon et al. trained parents to implement similar PRT procedures with embedded social interactions with their child with autism. The results of this study also included increases in child eye contact, positive affect, and initiations. Importantly, these results indicate that, while conducting critical language training (i.e., requesting), improvements in social interaction behaviors occurred, which led to improved outcomes for participants. Additionally, this supports the concept of embedding social interactions into natural reinforcers during language training in order to increase the social communication skills of children with autism (Koegel et al., 2009; Vernon et al., 2012).
Researchers have documented the effectiveness of PRT and other naturalistic behavior strategies in accelerating social communication behaviors in children with autism by targeting motivation (through the use of child choice, preferred items/activities, natural reinforcement, mand training; Carr & Durand, 1985; Koegel et al., 2009; Rocha et al., 2007; Sundberg & Michael, 2001; Vismara & Lyons, 2007; Whalen & Schreibman, 2003; Whalen et al., 2006). It is also important to determine if naturalistic behavior strategies (i.e., natural environment, child-initiated, prompting, shaping, and natural reinforcers with embedded social interactions) delivered as a package will improve the quality of social communication for this population. In addition, if naturalistic behavior strategies lead to improved social communication and generality of child-initiated behaviors (Delprato, 2001; Koegel et al., 1987; Reichow & Volkmar, 2010), it is important to determine whether the measured variables will generalize to other untrained adults in the same setting.

The purpose of this research is to increase the language and improve the quality of social interactions in young children with autism in the natural environment. The proposed study will utilize naturalistic behavior strategies to target language (specifically manding) and social interactions (self-initiated social engagement during manding, nonverbal dyadic orienting) in order to determine the effectiveness of natural behavior strategies.

Methodology

Participants

Four young children diagnosed with autism participated in this study. The inclusion criteria required each child: (a) to have an independent diagnosis of autism using DSM-IV criteria (American Psychiatric Association, 2000), (b) to be between the chronological age of 2
and 5 years, (c) to display persistent deficits in eye contact, and (d) to have early or emerging vocal language. No exclusion criteria regarding demographic characteristics were established as long as participants met all inclusion criteria. The interventionist/first author confirmed each participant’s diagnosis and age by reviewing records during the initial meeting. Records reviewed commonly included school district Full and Individual Evaluation (FIE), psychological evaluations, and medical records. During the initial meeting, the interventionist confirmed persistent deficits in eye contact and early or emerging language by asking parents/caregivers to complete the Communication and Symbolic Behavior Scales Developmental Profile Infant-Toddler Checklist (CSBS; Wetherby & Prizant, 2002). The CSBS is a checklist that consists of 24 questions regarding the following language predictors: emotion and use of eye gaze, use of communication, gestures, sounds, words, objects, and understanding of words. Completion of the checklist took approximately 5—10 min; the interventionist then scored the checklist during the initial meeting at no cost to the parents. Participants needed to receive a score between 0—5 in the eye gaze cluster and a score of 1 or greater in the use of words cluster in order to be considered eligible to participate.

In addition to administering the CSBS, the interventionist asked parents to share any relevant records (e.g., Individual Education Plans, data sheets, evaluation reports, verbal reports, and observations) that would aid in determining any previously learned tasks and responses for the purpose of arranging the environment and selecting the best words/word forms for mand training. The parents/caregivers also completed a reinforcer assessment that was used to obtain information regarding their child’s preferences for different items and activities. The interventionist used this information in order to obtain items and to plan activities that would promote language and social interaction during the experimental conditions. Prior to completion
of the meeting, the researcher collected the completed CSBS checklist, reinforcer assessment, and signed informed consent. In addition, the interventionist determined each participant’s weekly schedule for conducting experimental sessions. Table 1 includes additional background information regarding each participant. The researcher obtained Institutional Review Board (IRB) approval prior to initiating any contact with young children with autism for the purpose of this study. Participants’ parents or legal guardians received a letter for informed consent, which included the purpose and procedures of the study, foreseeable risks and benefits, confidentiality procedures, and participants’ rights.

Child 1

Child 1 was a 4-year-old, African American boy. He lived in a single-family household with his adoptive mother and one older adopted sibling. He displayed persistent deficits in eye-contact based on results from the CSBS, caregiver reports, and initial observations. He had emerging language that consisted of 11—30 words based on the CSBS. Initial observations and parent reports indicated that he primarily used one- to two-word utterances to request items and activities, label items, and answer simple questions. According to the reinforcer assessment and baseline observations, he enjoyed physical contact (e.g., hugs, tickles, jumping); musical toys; watching television (e.g., Blue’s Clues, Thomas); and playing with trucks, trains, and computers.

Child 2

Child 2 was a 4-year-old, Caucasian boy. He lived in a single-family household with his biological parents and twin brother. He displayed persistent deficits in eye-contact based on results from the CSBS, caregiver reports, and initial observations. The CSBS, initial
observations, and parent reports indicated that he primarily used one- to two-word utterances to request items and activities, label items, and answer simple questions. He also produced “sing-song” vocalizations during independent play. According to the reinforcer assessment and baseline observations, he enjoyed listening to children’s music; playing with toys (e.g., musical and light-up toys, trains, puzzles); watching television (e.g., Sesame Street, Mickey Mouse); and engaging in activities incorporating shapes, colors, letters and numbers.

Child 3

Child 3 was a 2-year-old, Caucasian boy. His parents were divorced and his living was apportioned between his biological mother’s home, and his biological father and stepmother in their home. He displayed persistent deficits in eye-contact based on results from the CSBS, caregiver reports, and initial observations. He had emerging language consisting of 11—30 words based on the CSBS. Initial observations and parent reports indicated that he primarily used one-word utterances to request/protest items and activities and label items. According to the reinforcer assessment and baseline observations, he enjoyed physical activities (e.g., jumping, swinging, swimming); music and singing; playing computer games (e.g., Thomas the Train, Mickey Mouse, Chuggington); and playing with trucks, trains, and dinosaurs.

Child 4

Child 4 was a 4-year-old, Caucasian boy. He lived in a single-family household with his biological mother and father, and two older siblings. He displayed persistent deficits in eye-contact based on results from the CSBS, caregiver reports, and initial observations. He had early language consisting of 4—10 vocal approximations of words (e.g., open, more, up) based on the
CSBS and parent reports. Initial observations and parent reports indicated that he primarily used one- to two-syllable vocalizations to request items when prompted by another person. According to the reinforcer assessment and baseline observations, he enjoyed physical activity (e.g., jumping, swinging, spinning), playing with sensory-based toys (e.g., tactile, spinning), and water play.

**Setting and Materials**

The researcher conducted the intervention in a research laboratory on a university campus. The research lab was a small room furnished with a couch, large table, shelves, and a two-way mirror for observation. The room was arranged with age-appropriate toys (e.g., musical toys, trains, race tracks, balls, blocks, cars, puzzles) and activities (e.g., trampoline, bean bucket, bubbles) on shelves in full view of the children. A video camera was mounted on a tripod in the corner of the room for the purpose of collecting video data. All experimental sessions for all participants occurred in this room, including generalization across caregivers.

**Dependent Variables**

In accordance with best-practice recommendations for single subject research methodology (Horner et al., 2005), the dependent measures used in this study were operationally defined, measured frequently throughout the study, assessed for consistency by multiple observers, and socially significant to the participants and the field. The researcher used the following dependent variables to evaluate the effects of naturalistic behavior strategies on the quality of social interactions for children with autism.

*Vocal Mand*
A vocal mand is defined as the occurrence of unprompted and prompted vocal responses (including speech sounds, word approximations, or adult word forms) that result in access to a specific reinforcer (Carbone, Sweeny-Kerwin, Attansio, & Kasper, 2010). Skinner (1957, p. 35-36) originally defined a mand as “a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation”. What differentiates a mand from other verbal operants (e.g., tact, intraverbal) is that, in a mand, control is exerted by the motivating operations (MO) and is strengthened only by reinforcement specific to the relevant MO benefitting only the speaker. Examples of vocal responses emitted by the participants included speech sounds (e.g., “ba” for open, “mmm” for food, “muh” for up, “dah” for jump), word approximations (e.g., “buh” for ball, “juh” for jump, “sin” for spin, “sing” for swing), or adult word forms (e.g., “ball”, “jump”, “spin”, and “swing”). Non-examples included vocal self-stimulatory sounds made by the child, purposeless vocalizations that did not indicate interest in an item/activity, echolalia, labeling of items, or responses in conversation. Gestures or pointing not accompanied by a vocalization were not counted as vocal mands.

In order to measure the frequency of vocal mands, the interventionist conducted and video recorded a 10-min language session (Koegel et al., 2009). During each session, the primary observer scored the items or activities that the child vocally requested as either prompted or unprompted. A prompted mand included any vocal mands that occurred after the interventionist delivered an echoic prompt that drew attention to a preferred item or activity. An unprompted mand included any vocal mand emitted by the participant without an echoic prompt from the interventionist regarding the item or object visually present in the environment. The interventionist calculated the frequency of vocal mands by counting the total number of mands.
following each session. In addition, the mands were scored as either prompted or unprompted, and the frequency was determined by counting the total number of prompted versus unprompted responses.

Child-initiated Social Engagement during Manding

Child-initiated social engagement during manding was defined as the physical orientation of the child toward the interventionist and/or the display of positive affect (i.e., smiling, laughing) toward the interventionist during a vocal mand initiated by the child (Koegel et al., 2009). Examples of physical orientation during vocal mands included the child’s whole body facing the adult, the child’s head turned toward the adult, or the child looking at any part of the adult’s face. Non-examples included the child turning his/her back or side to the front (face) of interventionist’s body while manding. Examples of affect during vocal request included the child smiling or laughing during a request. Non-examples of affect during a vocal request would be a request in which the child’s expression is neutral or s/he cries, pouts, or tantrums.

Child-initiated social engagement during vocal mands was measured during the 10-min language session. During the session, the primary observer coded whether the child either physically oriented toward the interventionist and/or displayed positive affect while manding for an item or activity. The primary observer counted the total number of mands in which the child physically oriented and/or displayed affect in order to determine the frequency of mands in which the child initiated social engagement.

Nonverbal Dyadic Orienting

Nonverbal dyadic orienting was defined as the child looking at the interventionist’s eyes
(i.e., eye contact) following an action emitted by the interventionist (Koegel et al., 2009).

Examples of this behavior included the child facing and looking toward the interventionist’s face or eyes. Non-examples included the child facing the interventionist, but looking at their arms, legs, or torso; looking at an object in the room; or facing the adult with eyes closed.

The primary observer measured occurrences and non-occurrences of dyadic orienting by coding the same 10-min video of the session using 10-s intervals. After data coding, the total number of occurrences were divided by 60 intervals to obtain the percentage of intervals the child engaged in dyadic orienting.

*Measurement Procedures*

Equipment and Materials

All experimental sessions were video recorded using a Sony high-definition wide angle handycam with a 160GB internal hard drive mounted on a tripod. Following each session, interventionist transferred the videos to a 700GB external hard drive for storage and to facilitate data coding by the observers. The primary data collector for the dependent variables used the videos to code dyadic orienting and IOA for procedural fidelity. The primary observer for procedural fidelity used the video recording to code fidelity of implementation. The secondary data collectors for the dependent variables used the video recordings to code all dependent variables for IOA.

Direct Observation

Direct observation of target behaviors was conducted across all experimental conditions. Each session began with a 3-min warm-up period, followed by a 10-min recorded session.
During each session, the primary observer collected data for two dependent variables (i.e., vocal mands, child-initiated social engagement). The interventionist video recorded each 10-min session for further data coding and analysis of the dependent measures for each experimental condition (i.e., baseline, intervention, generalization) and procedural fidelity. Following each daily session, interventionist downloaded all recorded video to an external hard drive for storage and coding purposes.

Frequency data were collected on both prompted and unprompted vocal mands. The frequency measure included the number of responses emitted during each 10-min session (Cooper, Heron, & Heward, 2007). The interventionist also collected frequency data on child-initiated social engagement during manding. The frequency measure included the number of times that the child initiated social engagement during a vocal mand during each 10-min session (Cooper et al., 2007). Partial-interval recording was used to collect data on nonverbal dyadic orienting. The researcher divided each 10-min session into 10-s intervals and scored if the behavior was present at some point during the interval (Cooper et al., 2007).

Interobserver Agreement

Interobserver agreement (IOA) was collected and reported for a minimum of 25% of all sessions across each experimental condition. Following intensive training in direct observation of the dependent variables including examples and non-examples, two observers scored the videos from each session based on the dependent measures previously described.

The interventionist calculated each child’s percent throughout all phases of the study. For the first two dependent variables (i.e., vocal mands and social engagement during manding), each observer determined a frequency count; agreement was obtained by dividing the smaller
number by the larger number and multiplying by 100 in order to determine the total percent agreement. For the third dependent variable (i.e., nonverbal dyadic orienting), partial-interval data were collected, and an interval was counted as an agreement if both data coders recorded the occurrence or nonoccurrence of the target response. IOA was calculated by dividing agreements by the sum of agreements plus disagreements with the resulting value multiplied by 100 to determine the percentage.

The outcomes of IOA for vocal mands are as follows: Child 1 ($M = 96.6\%$; range = 83—100%), Child 2 ($M = 94.75\%$; range = 84—100%), Child 3 ($M = 94.9\%$; range = 82—100%), and Child 4 ($M = 96.6\%$; range = 88—100%). The outcomes of IOA for social engagement are as follows: Child 1 ($M = 95.9\%$; range = 86—100%), Child 2 ($M = 93.4\%$; range = 84—100%), Child 3 ($M = 90.8\%$; range = 83—100%), and Child 4 ($M = 93.8\%$; range = 88—100%). The outcomes of IOA for dyadic orienting are as follows: Child 1 ($M = 95.6\%$; range = 92—100%), Child 2 ($M = 94\%$; range = 88—100%), Child 3 ($M = 95\%$; range = 88—98%), and Child 4 ($M = 90.3\%$; range = 80—100%).

**Research Design**

A single subject multiple baseline design across participants (Gast, 2010; Horner et al., 2005; Kazdin, 1982) was utilized in order to determine the existence of a functional relationship between the use of naturalistic behavior strategies and the quality of social interactions in children with autism.

**Experimental Procedures**

The intervention consisted of the use of naturalistic behavior strategies delivered in a
clinical setting to young children with autism. Experimental procedures included baseline, implementation of naturalistic behavior strategies, and generalization of child behavior across parents or caregivers. Each session during intervention began with a review of the individual child’s reinforcer assessment and previous session notes to ensure that motivating items and activities were selected and used during intervention. Each session lasted 10 min and was delivered approximately twice a day with at least 10 min between sessions, two to three times per week. There was a total of 116 sessions across all phases and participants in the study.

Baseline

Baseline sessions consisted of free play with the interventionist in the research lab. Each baseline session began with a 3-to 5-min warm-up period in which the interventionist introduced the child to preferred items in the room in order to make the child comfortable in the environment and allow him/her to acclimate to the setting. Following the 3-to 5-min warm-up period and a signal from the interventionist, the primary data collector set a timer and recorded a 10-min clip of video to measure the dependent variables. During the baseline phase, the interventionist did not manipulate the environment to initiate any interaction with the child, but all vocal mands initiated by the child were reinforced with the delivery of the preferred item or activity. If a child led the interventionist to a toy, the interventionist delivered the item to the child without giving verbal feedback. Following each 10-min session, the room was reset (i.e., toys were put away on the shelves) while the child took a short break (e.g., walk, snack). Upon returning to the treatment room, another 10-min session began. The parents received general information about their child’s participation in the session, and the interventionist addressed any questions and concerns before and after each session.
Intervention: Naturalistic Behavior Strategies

The interventionist implemented the intervention (naturalistic behavior strategies) in a sequential and staggered manner across participants after each individual participant demonstrated stable baseline patterns. The intervention sessions also began with a 3-to 5-min warm-up period in which the interventionist introduced the child to preferred items in the room in order to make the child comfortable in the environment and allow them to acclimate to the setting. The intervention included the five components of naturalistic behavior strategies described by Ingersoll (2010) in order to target children’s language (specifically manding) and social interaction (child-initiated social engagement, dyadic orienting). These five components are (a) all teaching occurs in the natural environment during typical routines, (b) every teaching episode is child-initiated, (c) the target behavior is prompted by the adult, (d) all target behavior is reinforced using natural reinforcers, and (e) shaping is used by the interventionist to reinforce successive approximations of target behavior.

Procedural Fidelity

In order to ensure that the intervention was implemented accurately across all sessions, fidelity of implementation was scored for 30% of all naturalistic behavior intervention sessions (Gresham, Gansle, & Noell, 1993). The primary fidelity observer scored fidelity on an interval by interval basis for the presence of the naturalistic behavior strategies (i.e., natural environment, child-initiated, prompting, natural reinforcement, and shaping). For the purpose of this study, the standard criterion for measurement of fidelity of implementation of intervention was established at 80% or higher. The fidelity of implementation of intervention was calculated to be 100%.
across all intervention sessions. A second observer conducted reliability assessments for 30% of
the session.

Generalization

Following the intervention phase and demonstration of stability of the behavioral pattern
as a function of implementation of the intervention condition, generalization sessions were
conducted to determine if the target behaviors of the child generalized to parents who were not
formally trained to implement intervention procedures. Prior to the generalization phase,
interventionist read the following script to the parents:

Spend a few minutes (3 min) introducing your child to the toys in the room in order to
make them comfortable with you in the setting. When the session begins, we will video
record you and your child for a 10-minute session. During this session we ask that you
play with your child being sure to encourage communication using the toys and materials
present in the room. If your child requests/asks for something during the session, it is
important that you deliver the item to your child. The interventionist and data collector
will be present in the room, but will remain unobtrusive and only be present to collect
data and video record the session. After the session, you will be able to talk with the
interventionist about your child if you need to.

The generalization phase for each participant began with a 3-to 5-min warm-up period in
which the parent listened to the script above. During these sessions, data collection procedures,
treatment room, and all materials were exactly the same as intervention except for the addition of
the generalization target (parent/caregiver). Although parents were allowed to observe the
intervention session, they did not receive any formal or direct training in the use of naturalistic
behavior strategies.

Generalization Plus Phase

A “generalization plus” phase was implemented within the generalization phase for two
participants (Child 1 and Child 4) after noting a decreasing trend in the data on the dependent variables. The generalization plus phase consisted of a video-feedback session with the parent and review of a training script that was individualized for each child. During this session, a recorded intervention session was selected and reviewed with the parents. While watching the video, the interventionist emphasized the components of the intervention with the parent/caregiver. The training sessions lasted approximately 30 min.

*Social Validity*

In order to ensure that the research conducted had social importance, social validity was assessed following the intervention. Social validity (Wolf, 1978) is judged by examining the social acceptability of the goals, procedures, and outcomes of the study. At the completion of the study, participants’ parents completed an open-ended questionnaire to assess (a) the social significance of the dependent variables, (b) the social acceptance of the experimental procedures, and (c) parental satisfaction regarding the outcomes of the study.

*Results*

*Vocal Mands*

The intervention (naturalistic behavior strategies) appeared to have been highly effective in increasing the frequency of vocal mands for all participants when compared to their individual baseline rates (see Figure 1).

As predicted, Child 1’s data showed a dramatic change in the behavior pattern upon the introduction of intervention. A higher level of vocal mands \((M = 24.4; Mdn = 24)\) was observed during this phase when compared to baseline \((M = 0)\). The data pattern indicated an increasing
trend based on the slope of the best-fit straight line within the phase. Even though some variability in the data has been detected, the deviation around the slope of the best-fit straight line showed a range of 15—37 and a standard deviation of 5.6. Data showed immediacy of effect of intervention when compared to baseline. A comparison between the three data points for vocal mands (0) in baseline with the first three data points in the intervention \((M = 24)\) demonstrate the magnitude of change based on the change in level, trend, and variability. Finally, the absence of overlap across baseline and intervention also indicated the effectiveness of the intervention.

Following an increasing trend in the pattern of vocal mands for Child 1 during intervention, the generalization phase was introduced across a caregiver not formally trained to implement intervention. As predicted, the frequency of vocal mands during generalization showed a steadily decreasing trend until it dropped to 5 mands in Session 22. Based on observation of the caregiver’s interaction style during the play sessions (e.g., more demands for tacts instead of mands; encouragement of independent play instead of reciprocal play), a brief 30- min training with the caregiver was instituted. The interventionist provided the caregiver with a script showing the type and sequence of prompting and shaping behaviors critical for eliciting vocal mands and the process of contingently reinforcing child behavior. Following this brief training, Child 1’s frequency of vocal mands increased slightly but dropped to 3 mands by session 25. The interventionist retrained the caregiver by showing a video of an intervention session concurrently with the script provided to the caregiver previously. The focus of this training was on describing behavioral strategies that elicited prompted or unprompted vocal mands. This type of training produced an immediate increase in the frequency of mands from an average of 9.5 at the start of the generalization phase to an average of 21 after caregiver training.
Child 2’s data also indicated a change in the behavioral pattern as a function of intervention. The level of vocal mands increased significantly ($M = 21.6; Mdn = 21$) when compared to baseline ($M = .2$). The interventionist observed some variability in the data pattern during the intervention phase; the deviation around the slope of the best-fit straight line showed a range of 9-34 and a standard deviation of 6.2, indicating no clear trend in the data. However, data do show an immediate effect of intervention as indicated by comparing the average of the last three data points of intervention ($M = 21$) with the last three data points in baseline ($M = .33$). The absence of overlap across the two adjacent phases also indicated the effectiveness of the intervention.

Following an increasing trend in the pattern of vocal mands for Child 2 during intervention, the generalization phase was introduced across a caregiver not formally trained to implement intervention. The frequency of vocal mands increased during generalization ($M = 25.3$) when compared to intervention ($M = 21.6$) across three generalization sessions. The caregiver of Child 2 received no additional training.

Child 3’s data showed higher levels of vocal mands ($M = 13.7; Mdn = 14$) with the implementation of intervention when compared to baseline ($M = .1$). Data indicated a high degree of variability in scores; the deviation around the slope of the best-fit straight line showed a range of 6—24 and a standard deviation of 4.6, indicating no clear trend in the data. However, the average of the last three data points on the frequency of vocal mands (.14) in baseline to the first three data points in intervention (10.3) demonstrate immediacy of effect on the dependent variable. The absence of overlap across the baseline and intervention also indicated the effectiveness of the intervention.
Following an increasing trend in the pattern of vocal mands for Child 3 during intervention, the generalization phase was introduced across a caregiver not formally trained to implement intervention. The frequency of vocal mands increased slightly during generalization ($M = 15$) when compared to intervention ($M = 13.7$) across three generalization sessions. No additional training was given to the caregiver of Child 3.

Child 4’s data indicated an increase in the level of vocal mands ($M = 19.8; Mdn = 19$) during the intervention phase when compared to baseline ($M = .27$). The data pattern indicated an increasing trend based on the slope of the best-fit straight line within the phase. Although some variability in the data has been detected, the deviation around the slope of the best-fit straight line showed a range of 14—31 and a standard deviation of 5.8. Data showed immediacy of effect of intervention when compared to baseline as evidence from the average of the last three data points in baseline (0) to the average of the first three data points in the intervention phase (19.3). The absence of overlap across the two adjacent phases also indicated the effectiveness of the intervention.

Following an increasing trend in the pattern of vocal mands for Child 4 during intervention, the generalization phase was introduced across a caregiver not formally trained to implement intervention. The frequency of vocal mands during generalization remained stable for the first two generalization sessions ($M = 16$) and then quickly dropped to 6 mands in Session 27. Based on observation of the caregiver’s interaction style during the play sessions (e.g., stopped following child’s lead, tried to engage child with different toys), the interventionist instituted a brief 30-min training with the caregiver. The interventionist trained the caregiver by showing a video of an intervention session and provided the caregiver with a script that showed the type and sequence of prompting and shaping behaviors critical for eliciting vocal mands, how
to follow the child’s lead, and the process of contingently reinforcing child behavior. Following this brief training, the frequency of mands immediately increased from an average of 9.3 at the start of the generalization phase to an average of 19.25 after caregiver training.

**Unprompted Mands**

The frequency of unprompted mands was also analyzed for each child for each phase of the study to evaluate the extent to which target behavior occurred without adult prompting. The mean of unprompted mands for Child 1 during baseline, intervention, and generalization were 0, 13.9, and 14.9, respectively. The mean of unprompted mands during baseline, intervention, and generalization for Child 2 was .2, 16.7, and 24.7, respectively; for Child 3, it was .14, 9.3, and 15, respectively; and for Child 4, it was .3, 11, and 11.4 respectively.

Following an assessment of the behavioral pattern for each participant within-phase, an evaluation was conducted to determine the behavioral pattern across participants in order to determine a functional relation between the independent and dependent variables. Data showed that for all four participants, the first three baseline sessions on the frequency of mands ranged from 0 to 2, indicating a stable performance. Upon implementation of intervention for Child 1, his target response increased dramatically whereas no change was observed in the baseline rates for any other participant. A similar pattern was observed across replications with three additional participants with whom a change in frequency of vocal mands was indicated only when the intervention was implemented but not prior to that time. The magnitude of separation between the last data point of each baseline condition compared to the first intervention point for a given participant with whom the intervention was implemented provides a demonstration of experimental control. These aspects provide evidence of control over threats to internal validity.
Collectively, the overall data pattern across participants provides a demonstration of a functional relation between the independent and dependent variables.

**Child-initiated Social Engagement during Manding**

The results of child-initiated social engagement during manding are visually displayed in Figure 2.

The graph displays the total number of mands relative to the total number of mands in which the child initiated social engagement. The average number of times that Child 1 displayed social engagement during manding was 0 in baseline, 22.3 (mands in which the child initiated social engagement) out of 24.4 (mands) during intervention, and 17.2 out of 18.3 mands respectively, during generalization. The average number of times that Child 2 displayed social engagement during manding was .2 during baseline, 20.2 (mands in which the child initiated social engagement) out of 21.6 (mands) during intervention, and 25.3 out of 25.3 mands respectively, during generalization. The average number of times that Child 3 displayed social engagement during manding was .14 during baseline, 12.2 (mands in which the child initiated social engagement) out of 13.7 (mands) during intervention, and 14 out of 15 mands respectively, during generalization. The average number of times that Child 4 displayed social engagement during manding was .3 during baseline, 19.3 (mands in which the child initiated social engagement) out of 19.8 (mands) during intervention, and 16.4 out of 16.4 mands respectively during generalization.

**Nonverbal Dyadic Orienting**

The results of nonverbal dyadic orienting are shown in Figure 3.
All of the children demonstrated improvements in dyadic orienting from baseline to intervention, with improvements generalizing to their parent/caregiver during play sessions. Child 1 engaged in nonverbal dyadic orienting for a mean of 1% of intervals during baseline, a mean of 24.3% of intervals during intervention, and a mean of 17.5% of intervals during generalization. Child 2 engaged in nonverbal dyadic orienting for a mean of 1.6% of intervals during baseline, a mean of 7.1% of intervals during intervention, and a mean of 9.6% of intervals during generalization. Child 3 engaged in nonverbal dyadic orienting for a mean of 4.6% of intervals during baseline, a mean of 9.2% of intervals during intervention, and a mean of 4% of intervals during generalization. Child 4 engaged in nonverbal dyadic orienting for a mean of 23.7% of intervals during baseline, a mean of 58.2% of intervals during intervention, and a mean of 51.7% of intervals during generalization.

Effect Size of Intervention on Vocal Mands

Effect size was calculated for vocal mands for all participants across baseline and intervention phases. The effect size was measured using Cohen’s $d$ index. According to Dunst, Hamby, & Trivette (2004), if data demonstrate minimal overlap across baseline and intervention phases for each participant, then the following formula is a better indicator of effect size when compared to alternative methods for measuring effect size for single subject research data:

$$d = (M_I - M_B)/(SD_p/\sqrt{2(1-r)})$$

where $M_I$ is the mean score for the intervention phase data, $M_B$ is the mean score for the baseline phase data, $SD_p$ is the pooled standard deviation for both data phases, and $r$ is the correlation between the baseline and intervention. (p. 6)

The criteria for evaluating the magnitude at which dependent variables may have changed due to the effect of the intervention and not any extraneous variables is small ($d = .25$), medium ($d = .50$), and large ($d = .80$).
To evaluate the magnitude of naturalistic behavior strategies on the frequency of vocal mands, the effect size ($d$) was calculated for each participant across adjacent phases and the overall effect size for all participants across all baselines and all intervention conditions. The effect size for Child 1 ($d = 4.25$), Child 2 ($d = 3.96$), Child 3 ($d = 3.53$), Child 4 ($d = 4.75$) and overall ($d = 3.41$) demonstrated a large magnitude, implying the effectiveness of intervention procedures in producing behavior change in participants.

**Social Validity**

Following the completion of the study, the primary caretaker of each child participant completed a social validation questionnaire. The purpose of the questionnaire was to determine: (a) the social significance of the dependent variables, (b) the social acceptance of the experimental procedures, and (c) parental satisfaction regarding the outcomes of the study. A detailed response to the questions on the social validity measure is presented in Table 3.

In response to the first question assessing the social significance of the dependent variable, three out of the four respondents ranked the three dependent variables targeted in the study as their most important. Their responses also suggest that generalization is an important part of programming. In regard to the experimental procedures, the caretakers all seemed confident in their responses to implement the same intervention strategies at home, with the exception of shaping behavior, which two caretakers described as difficult. Overall, the caretakers reported that they were satisfied with the outcomes of the study.
Discussion

Results of this study indicated the effectiveness of implementing naturalistic behavior strategies for: (a) improving the quality of social interactions for children with autism (Research Question 1) and (b) generalizing these skills across untrained caregivers in the same clinical setting (Research Question 2). Specifically, increases in the frequency of vocal mands, social engagement, and percent intervals with dyadic orienting were documented as a function of manipulation of the independent variable. Data also indicated that child behavior was more likely to generalize across untrained caregivers if they utilized similar prompting, shaping, and reinforcement strategies that were effective during the intervention phase. This section will discuss the findings of the study with regard to the impact on dependent variables and present the implications for practice, limitations of the study, and directions for future research.

Vocal Mands

Researchers have established the use of behaviorally based naturalistic language interventions that are effective for improving the language in children with autism (Ingersoll, 2011). Existing research has clearly documented the importance of focusing on the mand in initial language training for children with autism (Sundberg & Michael, 2001; Sundberg & Partington, 1998). Mands allow early learners to control the delivery of reinforcement, develop the role of a speaker, and lead to improved spontaneity and generalization (Sundberg & Michael, 2001) due to the relationship of mands with intrinsic motivation. The results of this study indicated large effects of naturalistic behavioral strategies on the increased frequency of vocal mands when measured through visual analysis and effect size. Although a large effect size is not uncommon in single-subject research, when this finding is combined with visual analysis of the
data, high levels of IOA on dependent measures, and a high level of procedural fidelity, a demonstration of experimental control is a predictable outcome. All of the children in this study demonstrated near zero levels of manding behavior during baseline when no contingencies for communication were in place. Implementation of intervention indicated that the components of the intervention led to an overall increase in total mands.

Specifically targeting language in the natural environment with child-led interactions supports theories of motivation and communication in children with autism (Koegel et al., 1987; Koegel, 2000). Speech patterns characteristic of children with autism are often described as unnatural and usually under the verbal control of others (Charlop, Schriebman, & Thibodeau, 1985). In other words, children with autism do not often initiate speech on their own, as evident during the baseline condition for this study. It is interesting to note that although manding increased for all children, unprompted responses also increased for all children; that is, child responses that occurred independent of an echoic prompt from the interventionist or the caregiver. Although the item that the children were manding for was generally still present in the environment, which made it not truly spontaneous behavior as defined by some researchers (Sundberg, 2005; Sweeney-Kerwin, Carbone, O’Brien, Zecchin, & Janecky, 2007), unprompted manding is still an important variable to address in regard to improving social initiations (Vernon, Koegel, Dauterman, & Stolen, 2012). This is because the ability of children with autism to make spontaneous initiations during interactions is an important predictor of social competence (Koegel, 2000).

While the quantity of vocal mands expressed by the children was quite impressive and supports a functional relation between the use of naturalistic behavior strategies and increased frequency of vocal mands, it is equally important to note that quantity was not the only indicator
of quality. Social validation of the goals and outcomes of the study revealed that all of the parents/caregivers in this study noted that “the ability of their child to vocally express their wants and needs” was one of the most important aspects of social communication.

**Child-Initiated Social Engagement**

Koegel et al. (2009) defined child-initiated social engagement as the occurrence of physical orientation and/or the display of positive affect during a verbal request made by the child. In the current study, all of the children improved in the area of child-initiated social engagement as demonstrated from near zero levels in baseline to an overall average of 18 mands per session, in which the participants displayed positive affect and/or oriented toward the interventionist while manding for items/activities in the environment. These results established a functional relation between the use of naturalistic behavior strategies and improved social engagement with a large effect size for this variable. Koegel et al. (2009) found similar results when social interactions were embedded into reinforcers delivered to the child. In a follow-up study, Vernon et al. (2012) examined the same PRT procedures with embedded social interactions when implemented by parents. This research also supports an increase in positive affect providing additional evidence for intervention components that may increase social motivation, which is often viewed as a pivotal area of development (Koegel & Koegel, 2006). This improvement in social engagement was likely due to child-choice activities and the use of natural reinforcers with embedded social interactions. When an adult embeds a social interaction into the delivery of reinforcement (e.g., jumping on a trampoline with a child, rolling a car back and forth), it provides the child with an opportunity to engage that may not be present with just the delivery of a reinforcer.
Findings from Whalen et al.’s (2006) research also supported improvements in social-communication behavior. The researchers examined the collateral effects of naturalistic behavior modification techniques to evaluate the effects on social communication responses of children with autism. Results indicated observed collateral increases in initiations, positive affect, spontaneous speech, and empathic responses for all children with autism as a function of joint attention training. Although the social engagement variable measured in this study included physical orientation as well as positive affect, examination of the display of affect during manding is important because this may provide evidence of improved social interaction skills. Whalen et al. (2006) specifically discussed the important relationship between displays of positive affect and social sharing. Along with other authors (Kasari, Sigman, Mundy, & Yirmiya, 1990), Whalen et al. suggested that when children with autism display positive affect, it may suggest that they are exhibiting true social behaviors (e.g., joint attention) as opposed to simple requesting behaviors (i.e., mands).

*Intervals of Dyadic Orienting*

Due to the difficulties that children with autism display in social orienting, the current researchers were interested in measuring dyadic (child-other) orienting as it is an important behavior upon which other social communication behaviors are founded (Leekam & Ramsden, 2006). Although no predictable patterns in dyadic orienting were demonstrated during intervention in the current study, all of the participants demonstrated increased levels of eye contact during intervention when compared to baseline levels. This finding may indicate a functional relation between the use of naturalistic behavior strategies and improved dyadic orienting. It is very likely that child-led interactions (Siller & Sigman, 2002) and the addition of
a social interaction by the interventionist while delivering natural reinforcement (Koegel et al., 2009; Vernon et al., 2012) were important components of the intervention that led to improved dyadic orienting. The added presence and interaction displayed by the interventionist (as opposed to just delivering a reinforcer when requested) likely resulted in increased eye contact. Most of the eye contact during sessions occurred when the interventionist created an opportunity for the child to mand and when the interventionist joined the child in a reinforcing activity (e.g., jumped on the trampoline with the child, sang songs with child, and danced with the child). Delivering natural reinforcers to children alone without the addition of adult social interaction limits the ability of children to perceive other people as potential sources of reinforcement (Koegel et al., 2009).

This study did not indicate similar levels of dyadic orienting that Koegel et al. (2009) documented in their research. The difference may be related to the intervention procedure. The present study focused on creating and reinforcing multiple language opportunities following the child’s motivation whereas Koegel et al. created a relatively equal number of language opportunities across each condition. The average number of mands per child per session in this study was about 20 mands (both prompted and unprompted). The increase in language opportunities during one-to-one interactions may have made the children less likely to engage in eye contact (Volkmar & Mayes, 1990). In analyzing the data on dyadic orienting, child characteristics warrant attention in this discussion. While Child 4 had the most impairments in language (e.g., he was only able to produce vocal approximations), his eye contact was the highest. Similarly, Child 2 displayed low levels of eye contact throughout the intervention, but the session with the highest percentage of eye contact was the same session with the lowest
number of mands, which implies that quantity does not always equal quality, at least not concurrently.

While eye contact continues to be a challenge for children with autism, it is important to continue to measure this variable in order to isolate other variables that may affect its use. Joint attention continues to receive attention in the area of autism intervention (Rocha et al., 2007; Whalen & Schreibman, 2003; Whalen et al., 2006) as it has been established as a critical impairment that differentiates children with autism from their typically developing peers. While these contributions to the literature are important, it may be necessary to look at measures that are precursors to joint attention (i.e., triadic orienting) by first focusing on dyadic orienting measures.

**Generalization**

Following the intervention phase and increased levels of vocal mands, the researcher assessed generalization with parents/caregivers in the same setting to see if the children would demonstrate learned behaviors during free play with their parents. The advantage of naturalistic behavior strategies is that generalization training is already built into the procedure. Generalization training usually includes the use of direct and natural consequences, teaching in different settings (e.g., home, school, community) with a variety of materials, and programming common stimuli (DeQuinzio, Townsend, Sturmey, & Poulson, 2007). Research indicates that when naturalistic behavior strategies are implemented to target language in children with autism, their responses generalize to non-trained settings (Koegel et al., 1987). All of the children demonstrated moderate levels of vocal manding, social engagement, and dyadic orienting with their primary parent/caregiver without formal training during the generalization sessions.
Although each of the parents/caregivers varied on their levels of prior knowledge and training, they all had the opportunity to observe intervention sessions from a two-way mirror.

In regards to vocal mands, the majority of the children’s mands during generalization were unprompted and remained at almost the same levels as unprompted mands during intervention. This was likely due to the mands being under the control of the child’s MO and did not rely on the prompts used during intervention. Child 1’s data indicated that although his behaviors initially generalized during the first three sessions, they began to decrease during the fourth generalization session. This is likely because the same reinforcing contingencies that were present during intervention were no longer in place. For example, when Child 1 manded for an item or activity (e.g., to turn on toy), his caregiver frequently responded with “you can do it yourself” in an attempt to promote independence. Because many of his mands were not reinforced, it is likely that they began to decrease as a function of inadvertent use of extinction.

In order for skills to generalize to other settings and people, the same reinforcing contingencies (if not the same amount) that were present during acquisition must also be present during generalization (Cooper et al., 2007). Child 4 also began to show a decrease in vocal mands after generalization Session 27. During this session, the child’s mother attempted to engage him in different toys that were not reinforcing to him. This session also documented very low levels of dyadic orienting and social engagement. Following these decreases in vocal mands, the researchers initiated a “generalization plus” phase in order to train the caregiver/parent on components of the intervention that likely led to improvements in their child’s behavior. For Child 1, the training focused on delivering natural reinforcers following her child’s communication attempts and on reciprocity while reserving prompts for independent functioning to daily life skills. For Child 4, the training focused on following the child’s lead during the
course of play. Following this additional training, increased levels were seen on all dependent variables.

**Implications for Practice**

The research to practice gap in autism intervention is evident when comparing interventions across different settings (NAC 2009a; Dingfelder & Mandell, 2011). The results of this research provide several important implications for practitioners and parents of children with autism. The first implication is for educators and practitioners charged with designing early intervention programs for children with autism. While published studies measuring social skills in children with autism are increasing in the literature (Reichow & Volkmar, 2010), there may be a research-to-practice gap based on the diffuson of innovation theory proposed by Dingfelder and Mandell (2011). The research has clearly documented how to increase language in children with autism (Bourrett, Vollmer, & Rapp, 2004; Hancock & Kaiser, 2002; Koegel, O’Dell, & Koegel, 1987; McGee, Morrier, & Daly, 1999; Sundberg & Partington, 1998) with manuals and curriculums used across home, clinical, and school settings. However, effective strategies for increasing social interaction skills may be difficult for practitioners to implement without manuals and programs to guide intervention, further limiting their implementation in early intervention programs (Dingfelder & Mandell, 2011; Reichow & Volmar, 2010). It is crucial that practitioners involved in designing and implementing early intervention programs for children with autism begin to focus on strategies that increase social interactions as well as communication. It is the researcher’s experience, that often times when teachers work with children with autism on communication skills such as manding, they deliver reinforcers to children without the addition of a social interaction limiting the opportunity for social
engagement. Additionally, they often teach communication and social interaction in contrived settings relying heavily on DTT, without utilizing naturally occurring stimuli in the environment. Due to the social impairments associated with autism, social engagement and dyadic orienting potentially could decrease due to the addition of the interventionist’s social interaction and the desire for the child with autism to be alone. This did not appear to be the case with this research, which supports the notion that these early social deficits can be corrected though intensive intervention.

Another important implication of this research is for families of children with autism. The social validation results implied that parents felt generally confident in applying the same naturalistic behavior strategies at home even without intensive training. Due to enhanced generalization and the ease of implementation, it is important for parents and caregivers to utilize these strategies at home in order to maximize learning opportunities for their children with autism. Teachers and applied behavior analysts should prioritize parent training programs that teach parents to utilize naturalistic behavior strategies in the home and community settings in order to produce meaningful changes in social functioning (Vernon et al., 2012).

Limitations of the Study

A major limitation of the current study was that the intervention was implemented in a research lab setting as opposed to the natural play environment of children (e.g., home, community). Although the researcher selected a setting that was designed to replicate a typical play area for preschool-aged children, naturalistic behavior strategies are designed to be delivered in the child’s natural environment. If the intervention had been delivered in the home setting, the results may have led to improved generalization and maintenance as the participants
would have had greater opportunities to contact naturally occurring stimuli (Koegel & Koegel, 2006) that may not necessarily be present in the lab setting.

This study utilized a single-subject research design (Gast, 2010) to explore the functional relation between naturalistic behavior strategies and the quality of social interactions. Although small sample sizes are characteristic of single-subject research, and this study meets the standard for the number of participants in a multiple baseline design (Reichow, Doehring, Cichetti, & Volkmar, 2011), the limited number of participants poses some threats to external validity (Gast, 2010). In addition to the small number of participants, the individual differences (e.g., social and communication deficits, IQ) between the participants leads to difficulty in concluding that this intervention will have the same effect when implemented with other children with autism. However, children with autism who share characteristics similar to participants in this study are more likely to experience similar effects of intervention.

An additional limitation of the study is that the staggered implementation of intervention for Child 2 and 3 could have been instituted after a clear demonstration of the effect of intervention (~6—7 data points) for Child 1. Intervention for Child 2 and 3 was implemented based on immediacy of effect and the magnitude of the intercept gap between the best-fit straight lines associated with two phases at each point of intervention (Parker, Vannest, & Brown, 2009). Yet, a lag of 5—7 data points is desirable in a multiple baseline design.

Directions for Future Research

As described in the introduction section of this manuscript, given the increasing prevalence rate of autism and increasing in the need for efficient delivery of early intervention services, it is imperative that future research isolate the components (i.e., child-led interaction,
reinforcers with embedded social engagement) of naturalistic interventions that improve the social communication deficits associated with autism. Isolating variables of naturalistic behavioral interventions are more likely to improve the efficacy and efficiency of early intervention programs and lead to improved outcomes in children with autism.

This study evaluated social interaction responses of children with autism as a function of implementation of naturalistic behavior strategies. The specific dependent variables constituted a measure of the quality of social interactions as opposed to changes in the frequency of discrete behavior alone. Future research needs to continue to address the quality of social interactions as a unit of measurement within the context of social engagement with both adults and same age peers as a true measure of improved social interaction skills.

The social outcomes of children with autism in this study appear to be superior because of consideration to the motivational aspects of the play environment (e.g., child-led interactions including access to preferred toys, natural reinforcers with embedded social interactions, and reinforcement of vocal approximations of verbal behavior). Future research designed to increase the social interaction skills of children with autism, needs to incorporate the motivational aspects of behavior that could influence the outcomes of the study.
Table 1

Participant Background Information

<table>
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<tr>
<th>Child</th>
<th>Age</th>
<th>CSBS Cluster Score</th>
<th>Spoken Language</th>
<th>Educational Placement</th>
<th>ABA therapy</th>
<th>Related Services</th>
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<td>5</td>
<td>6</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child 3</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>One-word utterances</td>
<td>ECI services in daycare setting</td>
<td>Center-based ABA 2 days/week</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child 4</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>Vocal Approximations</td>
<td>PPCD (2 days/week)</td>
<td>Center-based ABA 3 days/week</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. CSBS = Communication and Symbolic Behavior Scales Developmental Profile Infant-Toddler Checklist; ABA = Applied Behavior Analysis; PPCD = Public Preschool for Children with Disabilities; ECI = Early Childhood Intervention
Table 2

*Interobserver Agreement*

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Participants</th>
<th>Range</th>
<th>Mean Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocal Mands</td>
<td>Child 1</td>
<td>83-100</td>
<td>96.6%</td>
</tr>
<tr>
<td></td>
<td>Child 2</td>
<td>84-100</td>
<td>94.75%</td>
</tr>
<tr>
<td></td>
<td>Child 3</td>
<td>82-100</td>
<td>94.9%</td>
</tr>
<tr>
<td></td>
<td>Child 4</td>
<td>88-100</td>
<td>96.6%</td>
</tr>
<tr>
<td>Social Engagement</td>
<td>Child 1</td>
<td>86-100</td>
<td>95.9%</td>
</tr>
<tr>
<td></td>
<td>Child 2</td>
<td>84-100</td>
<td>93.4%</td>
</tr>
<tr>
<td></td>
<td>Child 3</td>
<td>83-100</td>
<td>90.8%</td>
</tr>
<tr>
<td></td>
<td>Child 4</td>
<td>88-100</td>
<td>93.8%</td>
</tr>
<tr>
<td>Dyadic Orienting</td>
<td>Child 1</td>
<td>92-100</td>
<td>95.6%</td>
</tr>
<tr>
<td></td>
<td>Child 2</td>
<td>88-100</td>
<td>94%</td>
</tr>
<tr>
<td></td>
<td>Child 3</td>
<td>88-98</td>
<td>95%</td>
</tr>
<tr>
<td></td>
<td>Child 4</td>
<td>80-100</td>
<td>90.3%</td>
</tr>
</tbody>
</table>
Table 3

**Social Validity Results**

<table>
<thead>
<tr>
<th>Question</th>
<th>Parent/Caregiver Response (1-most important, 7-least important)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What social-communication behaviors are most important to you?</td>
<td>Facing speaker during communication 4 4 5 3</td>
</tr>
<tr>
<td></td>
<td>Using vocalizations/words to ask for what they want 1 3 1 1</td>
</tr>
<tr>
<td></td>
<td>Following the gaze of others 7 5 7 5</td>
</tr>
<tr>
<td></td>
<td>Using gestures (e.g., pointing) 5 6 4 4</td>
</tr>
<tr>
<td></td>
<td>Showing objects of interest to others 6 7 3 7</td>
</tr>
<tr>
<td></td>
<td><strong>Making eye contact</strong> 3 1 2 6</td>
</tr>
<tr>
<td></td>
<td><strong>Displaying social smile and positive affect</strong> 2 2 6 2</td>
</tr>
<tr>
<td>2. Importance of generalization</td>
<td>“I find that learned skills are huge in a child’s progress. Early intervention learning will carry on into a child’s school years where learned skills are the majority of the day.”</td>
</tr>
<tr>
<td></td>
<td>“very important”</td>
</tr>
<tr>
<td></td>
<td>“very important”</td>
</tr>
<tr>
<td></td>
<td>“It is very important that my child be able to learn in any environment and with other people because he goes to school and there might be other opportunities for him to learn in different environment.”</td>
</tr>
<tr>
<td>3. To what extent can you display strategies used in intervention at home?</td>
<td>“I am fairly confident that I can”</td>
</tr>
<tr>
<td></td>
<td>“during playtime”</td>
</tr>
<tr>
<td></td>
<td>“We are using the strategies everyday”</td>
</tr>
<tr>
<td></td>
<td>“being able to turn attention”</td>
</tr>
<tr>
<td>4a. How difficult/easy will it be for you to: Target social communication skills in the natural environment?</td>
<td>“fairly simple”</td>
</tr>
<tr>
<td></td>
<td>“somewhat easy”</td>
</tr>
<tr>
<td></td>
<td>“easy”</td>
</tr>
<tr>
<td></td>
<td>“--’s communication skills are increasing daily. He now tells us his wants, needs, labels items, etc.”</td>
</tr>
<tr>
<td>4b. How difficult/easy will it be for you to: Follow your child’s lead and interest?</td>
<td>“very easy”</td>
</tr>
<tr>
<td></td>
<td>“easy”</td>
</tr>
<tr>
<td></td>
<td>“easy--- now comes and takes us by the hand leading us to what he wants to do.”</td>
</tr>
<tr>
<td></td>
<td>“fairly simple”</td>
</tr>
</tbody>
</table>

*(table continues)*
<table>
<thead>
<tr>
<th>Question</th>
<th>Parent/Caregiver Response (1-most important, 7-least important)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4c. Model correct behavior?</td>
<td>“fairly easy”</td>
</tr>
<tr>
<td></td>
<td>“easy”</td>
</tr>
<tr>
<td></td>
<td>“getting --- to not be frustrated when we model correct behavior is still something we are working on”</td>
</tr>
<tr>
<td></td>
<td>“I don’t have as much practice at this as I’ve been concentrating on language”</td>
</tr>
<tr>
<td>4d. Deliver natural reinforcers?</td>
<td>“very easy”</td>
</tr>
<tr>
<td></td>
<td>“easy”</td>
</tr>
<tr>
<td></td>
<td>“easy”</td>
</tr>
<tr>
<td></td>
<td>“fairly simple”</td>
</tr>
<tr>
<td>4e. Shape desired behavior following responses made by your child?</td>
<td>“fairly easy”</td>
</tr>
<tr>
<td></td>
<td>“somewhat difficult”</td>
</tr>
<tr>
<td></td>
<td>“easy”</td>
</tr>
<tr>
<td></td>
<td>“shaping behavior can be a little more difficult, but he’s a sweet guy, so it’s not really work”</td>
</tr>
<tr>
<td>5. Are you satisfied with the outcomes of the study?</td>
<td>“Yes, very satisfied”</td>
</tr>
<tr>
<td></td>
<td>“Very pleased. --- has better eye contact and asks for more things more now.”</td>
</tr>
<tr>
<td></td>
<td>“Yes, I feel that --- really enjoyed working with interventionist and she was very positive in helping --- not to stim on certain toys and redirecting his attention to others. She was also very helpful in getting --- to imitate and voice his wants”</td>
</tr>
<tr>
<td></td>
<td>“Very satisfied. I think that certain people have that magic, where everything that they touch turns to gold. For ---, since he has a general disinterest in people, having interest in what they are doing doesn’t come easily for him. Interventionist created games and activities that spoke to him, and he’s thrilled to be playing those same games at home now, because he first played them with her.”</td>
</tr>
</tbody>
</table>
**Table 4**

**Dependent Variables**

**Target Behavior: Vocal Mands**

**Operational Definition:** The frequency of unprompted (no echoic prompt delivered) and prompted (echoic prompt delivered) vocal responses (including speech sounds, word approximations, or adult word forms) resulting in access to a specific reinforcer.

<table>
<thead>
<tr>
<th>Examples of Vocal Responses</th>
<th>Non-examples of Vocal Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Speech sounds (e.g., <em>ba, mmm, muh, dah</em>)</td>
<td>• Vocal self-stimulatory sounds made by the child</td>
</tr>
<tr>
<td>• Word approximations (e.g., “buh” for ball, “juh” for jump, “sin” for spin, “sing” for swing)</td>
<td>• Purposeless vocalizations that do not indicate interest in an item/activity</td>
</tr>
<tr>
<td>• Adult word forms (e.g., “ball”, “jump”, “spin”, and “swing”)</td>
<td>• Delayed echolalia</td>
</tr>
<tr>
<td></td>
<td>• Labeling of items (evident if item was delivered and child does not want)</td>
</tr>
<tr>
<td></td>
<td>• Responses in conversation</td>
</tr>
<tr>
<td></td>
<td>• Answering questions</td>
</tr>
<tr>
<td></td>
<td>• Gestures or pointing not accompanied by a vocalization will not be counted as a vocal mand</td>
</tr>
<tr>
<td></td>
<td>• Child emits a vocal response, but the child does not want the item that was delivered.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples of Prompted Mands</th>
<th>Non-examples of Prompted Mands</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Any vocal response that occur after a echoic prompt (interventionist models the adult word form for the child) that results in access to a specific reinforcer.</td>
<td>• The child emits a mand at the same time the interventionist is providing a prompt</td>
</tr>
<tr>
<td></td>
<td>• No echoic prompt is delivered (unprompted)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples of Unprompted Mands:</th>
<th>Non-examples of Unprompted Mands</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Any vocal mands emitted by the participant without any an echoic prompt from the interventionist regarding the item or object visually present in the environment that results in access to a specific reinforcer.</td>
<td>• Mands emitted following the delivery of an echoic prompt (prompted)</td>
</tr>
<tr>
<td>• The frequency (number of times) this behavior occurs will be measured during each 10 minute session.</td>
<td>(table continues)</td>
</tr>
</tbody>
</table>
Table 4 (continued).

Target Behavior: Child-initiated social engagement during manding

Operational Definition: Physical orientation of the child toward the interventionist and/or the display of positive affect (i.e., smiling, laughing) toward the interventionist during a vocal mand initiated by the child (Koegel et al., 2009).

<table>
<thead>
<tr>
<th>Examples of physical orientation</th>
<th>Non-examples of physical orientation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Includes the child’s whole body facing the adult, the child’s head is turned toward the adult, or the child looks at the adult while vocally manding/requesting an item.</td>
<td>Includes the child turning his/her back or side to the front (face) of interventionist’s body while manding.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples of affect</th>
<th>Non-examples of affect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Includes the child smiling or laughing during a vocal request.</td>
<td>A request in which the child’s expression is neutral or s/he cries, pouts, or tantrums.</td>
</tr>
<tr>
<td>Includes the child displaying positive affect following initial initiation until the delivery of the reinforcer</td>
<td>The display of positive affect following the delivery of the reinforcer</td>
</tr>
</tbody>
</table>

- This behavior is only measured during a vocal request/mand made by the child.

Target Behavior: Nonverbal dyadic orienting

Operational Definition: is defined as the child looking at the interventionist’s eyes following an action emitted by the interventionist (Koegel et al., 2009).

<table>
<thead>
<tr>
<th>Examples of nonverbal dyadic orienting</th>
<th>Non-examples of nonverbal dyadic orienting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Includes the child facing the interventionist and looking toward their face or eyes.</td>
<td>Includes the child facing the interventionist, but looking at their arms, legs, or torso; looking at an object in the room; or facing the adult with eyes closed.</td>
</tr>
<tr>
<td>Head is in view of camera but face is not, if the head is not turned toward interventionist score (-)</td>
<td></td>
</tr>
</tbody>
</table>

- The occurrence/nonocurrence of this variable will be measured during 10 second intervals.
- Score an interval as NA if the child or interventionist face is out of view for the PART/ENTIRE interval
- Score and interval as NA if no action was made by the interventionist (Baseline)
Table 5

*Intervention Components*

<table>
<thead>
<tr>
<th>Natural environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>The intervention is being delivered in the child’s natural environment. For this age and population of children the natural environment is likely to be on the floor with age-appropriate toys and preferred items and activities set up around the room.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-examples</th>
</tr>
</thead>
</table>
| - Items and activities selected are age appropriate OR related to child’s specific interest.  
- Activities take place on the floor  
- Setting is arranged to look like a typical play setting that other children of the same age/level would engage. | - Child is required to participate in activities not developmentally appropriate or geared toward their interest.  
- Child is required to sit at table and engage in academic activities not related to interest.  
- Child is required to engage toys that are not age/developmentally appropriate. |

<table>
<thead>
<tr>
<th>Child-initiated</th>
</tr>
</thead>
</table>
| The interventionist follows the child’s lead in determining target tasks and activities. It is critical that the interventionist prevents the child from engaging in dangerous (e.g., self-injury, climbing on furniture) or inappropriate (e.g., self-stimulatory behaviors) behaviors. If the child is showing little interest in task, the interventionist should redirect the child to another activity.  
Initiation is demonstrated when a child shows motivation for an item or activity |

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-examples</th>
</tr>
</thead>
</table>
| - Child is walking towards trampoline  
- Child is reaching for a bottle of bubbles  
- Child is watching a car go down a ramp  
- Child is looking at interventionist during physical contact | - Child is turned away from toy  
- Child is irritated with interventionists attempt to provide physical contact  
- Child is stimming in corner away interventionist  
- Child is not looking in direction of items or activities presented by interventionist |

<table>
<thead>
<tr>
<th>Prompting</th>
</tr>
</thead>
<tbody>
<tr>
<td>The target behavior (vocal mand) will be prompted by the interventionist following the child’s initiation (i.e., looking, reaching, and walking towards item). The interventionist will first provide the nonverbal stimulus (e.g. desired item, access to activity) along with a verbal stimulus (i.e., echoic prompt, for example “jump”) if no vocal response is made by the child w/in 5 seconds and reinforce with specific reinforcement (i.e., desired item or activity).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-examples</th>
</tr>
</thead>
</table>
| - The interventionist says “jump” when the child is walking toward trampoline  
- The interventionist says “cow” when the child is trying to complete a farm puzzle and needs the cow piece.  
- The interventionist says “spin” when the child is in a chair waiting to be spun around. | - The interventionist begins to provide an echoic prompt (“ja..”) and the child responds before the whole adult form of the word is modeled  
- The child emits a vocal response before an echoic prompt is delivered.  
- The interventionist provides an echoic prompt more than 5 seconds after the child makes an initiation |

* (table continues)
Table 5 (continued).

### Natural Reinforcement

All reasonable language attempts (prompted responses and unprompted correct responses) made by the child will be reinforced using natural reinforcers. Reinforcement will be contingent on the child’s verbal behavior (e.g., the child says “jump” and is immediately provided with access to the trampoline) with the addition of a social interaction by the adult (e.g., adult jumps on the trampoline with the child) (Koegel, Vernon, Koegel, 2009).

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Child mands for trampoline and then the interventionist jumps on the trampoline with the child</td>
<td>• Child jumps on trampoline by themselves</td>
</tr>
<tr>
<td>• Child mands for music and the interventionist sings preferred song to child</td>
<td>• Child is played music</td>
</tr>
<tr>
<td>• Child mands for spin and the interventionist spins child in the chair</td>
<td>• Child is given a chair to spin in</td>
</tr>
<tr>
<td></td>
<td>• Child asks for a specific item (“jump”) and is given a piece of candy</td>
</tr>
</tbody>
</table>

### Shaping of Successive Approximations

• A loose shaping procedure (Koegel & Koegel, 1995) will be implemented so that any verbal attempts (attempts do not have to be completely correct or as good as previous attempts to receive reinforcement, but are within a broader range of correct responses) made by the child are also differentially reinforced. If a child emits a particular sound (e.g., “ja” for jump) in the presence of the nonverbal stimulus, the response will be reinforced and the word *jump* will be shaped by providing a correct echoic “jump” while delivering reinforcement.

• Reinforcement will be provided if the child emits a reasonable attempt by directing a response at the interventionist or training materials and the response is within a broader class of correct responses.

<table>
<thead>
<tr>
<th>Examples</th>
<th>Non-examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Child says “ja” for jump and the interventionist then models the correct form of the word “jump” while allowing the child to jump on the trampoline</td>
<td>• Child says “ja” for jump and the interventionist allows the child to jump without providing correct verbal feedback.</td>
</tr>
<tr>
<td></td>
<td>• Child says “ja” for jump and the interventionist says “good job”.</td>
</tr>
</tbody>
</table>
Figure 1. Frequency of vocal mands for all child participants.
Figure 2. Child-initiated social engagement for all child participants.

Figure 2. Child-initiated social engagement for all child participants.
Figure 3. Intervals of dyadic orienting for all child participants.

*Figure 3.* Intervals of dyadic orienting for all child participants.
References


Ingersoll, B. R., & Schreibman, L. (2006). Teaching reciprocal imitation skills to young children with autism using a naturalistic behavioral approach: Effects on language, pretend play,


The Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR; American Psychiatric Association, 2000) describes the social deficits of autism as “… lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g., by a lack of showing, bringing, or pointing out objects of interest)” and “a marked impairment in the use of multiple nonverbal behaviors such as eye-to-eye gaze, facial expression, body postures, and gestures to regulate social interaction” (p. 75). Proposed revisions to the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V; American Psychiatric Association, 2010) will soon combine the social and communication deficits into one domain (i.e., social-communication) because the characteristics (e.g., limited social initiations, unresponsiveness to the social approaches of others) are often inseparable. In the original report of autism disturbance, Kanner (1943) stated that the underlying basis of this condition was the children’s social deficits and difficulties, beginning in infancy and persisting throughout childhood. These social impairments, manifested through an inability to relate to others, obliviousness about surroundings, social unawareness, preferred aloneness, rigid body postures, inattention during communication, and an overall impairment in relating to people (Kanner, 1943), hinder critical social development in individuals with autism. Although the diagnosis of autism also includes impairments in communication and restricted interest, the core deficit is a lack of reciprocal social interaction (Prior & Ozonoff, 1998; Wing & Gould, 1979).

As early as infancy, children grow and develop in social worlds which include other people. These opportunities and experiences establish the importance of our ability to socially relate to others and affect how we feel, think and act (Grossman & Johnson, 2007). Autism is primarily a social disorder and deficits in social-orienting skills may be responsible for the failure of this population of children to initiate critical social behaviors that are necessary for
creating shared experiences responsible for optimal neurodevelopmental outcomes (Gillis, Callahan, & Romanczyk, 2011; Grossman & Johnson, 2007; Mundy & Burnette, 2005).

Social Communication Profiles of Children with Autism

When compared to their same age neurotypical peers, the social initiation behaviors of children with autism are notably more impaired than other communication behaviors (e.g., responding to initiations) (Hauck, Fein, Waterhouse, & Feinstein, 1995; Koegel, Vernon, & Koegel, 2009; Mundy, Sigman, Ungerer, & Sherman, 1986). In addition, children with autism who may have learned social initiation skills at a younger age are likely to show more positive outcomes as adolescents (Koegel, Koegel, Shoshan, & Mc Nerney, 1999). Social initiation behaviors include showing affection, giving information, greeting others, initiating play, engaging in joint attention, seeking aid/information (verbally or nonverbally), imitating, echoing others, looking at others, moving into the proximity of others, and displaying neutral physical contact (Hauck et al., 1995; Koegel et al., 2009). Impairments in social initiations are prevalent from the earliest developmental stages of communication acquisition and tend to continue to persist even as children grow older. In order for children with autism to become proficient in social communication skills, it is essential that they become fluent in making spontaneous initiations (Koegel, 2000) across functions of speech (e.g., requesting, labeling).

Social communication profiles of children with autism show notable impairment as early as the first year of life (Charman et al., 1997; Mundy et al., 1986; Prior & Oznoff, 1998; Zwaigenbaum et al., 2005). Infants with autism are often described as being resistant to human contact, undemanding of human attention, passive, and either extremely stiff or floppy (Prior & Oznoff, 1998). In a study comparing infants at risk for developing autism with other siblings and low risk infants, siblings who were later diagnosed with autism manifested impairments in social
communication as early as twelve months (Zwaigenbaum et al.). The authors noted impairments in eye contact, visual tracking, visual attention, responding to name, imitation, social smile, reactivity, social interest and decreased expression of positive affect (Zwaigenbaum et al.).

Toddlers with autism are known to exhibit unique social behaviors which differentiate them from children without autism. At the age of two years, toddlers with autism exhibit deficits in attending to stimuli (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998), imitation, joint attention (specifically directing attention), and play (Stone, Coonrod, & Ousley, 2000). Wetherby and her colleagues compared the social communication responses of two-year-old children with autism with same age peers who had other developmental disabilities. They showed that children with autism scored significantly lower on social communication measures including the ability to shift their gaze, follow the gaze and points of others, emit communicative acts, initiate acts for joint attention, and use conventional gestures (Wetherby, Watt, Morgan, & Shumway, 2007).

Additional research comparing toddlers with autism and global developmental delays or developmental language disorders on the Autism Diagnostic Observation Schedule-Generic (ADOS) found significant differences between the two groups in the reciprocal social interaction domain (i.e., eye contact, shared enjoyment, showing, initiation of joint attention, response to joint attention, and quality of social overtures) and one item (i.e., pointing) from the communication domain (Ventola et al., 2007).

Communication deficits in young children with autism generally overlap with social behaviors (gaze, facial expressions, body gestures, social regulation) and are directly tied to pragmatic communication (Landa, 2007). These disruptions may present themselves in a variety of ways including abnormal vocal patterns and affective expression, delayed babbling, limited use of gestures, and restricted responding to communication bids of others (Landa, 2007). While
children with autism tend to make more requests than comments in social situations, they are less likely to use gestures (e.g., pointing), show objects to others, or use eye gaze when communicating with people (Stone, Ousley, Yoder, Hogan, & Hepburn, 1997; Ventola et al. 2007; Wetherby et al., 2007). Landa further adds that as children get older, these communication impairments include a reduced rate and variety of communication attempts in their repertoire, isolated use of gestures, and impaired initiation of social communication (including joint attention).

Throughout childhood, social impairments are manifested in a variety of different ways. They may include the absence of social interaction skills like joint attention (i.e., the use of gestures and eye contact to coordinate attention and share enjoyment with others), social engagement, and inattention to people and activities. Impairments in nonverbal behaviors may be observed through decreased eye contact, restricted affect, limited visual tracking and eye gaze, and reduced social smiling (Bieberich & Morgan, 1998; Charman et al., 1997; Mundy et al., 1986). Poor imitation skills, lack of demonstration of empathy (Charman et al., 1997), restricted affect and social avoidance (Gillis et al., 2011; Koegel et al., 2009; Priori & Oznoff, 1998) are often noted as challenges for individuals with autism. This is because it is often difficult for children with autism to understand facial expressions, initiate social interactions, and respond to the social bids of other individuals (Gillis et al., 2011). It is these characteristics of autism that make communication and social engagement complicated throughout the lifespan.

To summarize the above research, the social communication skills (e.g., eye contact, affect, social engagement, social initiations) of children with autism are notably impaired as early as infancy and persist throughout childhood (Dawson et al., 1998; Koegel et al., 2009; Mundy et al., 1986; Prior & Oznoff, 1998; Wetherby et al., 2007; Ventola et al., 2007;
Zwaigenbaum, et al., 2005). In addition, due to the social-emotional deficits, social competence may be compromised as well. As a result, children may not be able to take advantage of opportunities necessary for establishing a foundation in social exchanges that require the use of affect and perspective-taking (Gillis et al., 2011; Scambler, Hepburn, Rutherford, Wehner, & Rogers, 2007; Williams White, Keonig, & Scahill, 2007). Researchers have suggested that social communication behaviors are related to pivotal communication skills that should be targeted in early intervention programs (Ingersoll, 2010; Wetherby et al.).

Rationale for Teaching Social Communication Skills

Teaching early social communication skills (e.g., joint attention, gesture use, symbolic play, dyadic orienting, and affect) can lead to later improvements in social interaction skills in children with autism (Ingersoll, 2010; Koegel, 2000). Children with autism who receive early and intensive behavior analytic treatment that incorporates highly supportive teaching environments and builds in generalization to the natural environment, are likely to make substantial gains impacting functional development that persists through the lifespan (Anderson & Romanczyk, 1999; Dawson & Osterling, 1997; Lovaas, 1987; Howard, Sparkman, Cohen, Green, & Stanislaw, 2005).

Applied behavior analysis (ABA) is the application of the behavioral theory that aims to explain human behavior and responses (Webber & Scheuermann, 2008). It is a recommended treatment for changing the social and communication impairments associated with autism (Lovaas, 1987; Wolery, Barton, & Hine, 2005). In 2009(b), the National Autism Center (NAC) published a comprehensive report known as the National Standards Report regarding the scientific evidence supporting educational and behavioral treatments available for individuals with autism. The outcomes of the report yielded 11 established treatments that are considered to
be effective in treating the core deficits in individuals with autism. A majority of the treatments in this category have been derived from the field of ABA and include comprehensive behavioral treatment for young children, joint attention intervention, modeling, naturalistic teaching strategies, and pivotal response treatment (NAC, 2009b). The National Research Council (NRC; 2001) also discusses the critical role of ABA in the area of research on successful interventions for individuals with autism.

According to the National Autism Center (NAC; 2009b) and the National Research Council (NRC; 2001), there is an overwhelming amount of research that indicates strategies based in ABA (e.g., modeling, prompting, imitation, reinforcement, self-monitoring) are the most effective for skills-instruction involving children with autism. Similarly, naturalistic teaching methods (e.g., natural environment, natural reinforcers, child-initiated), also based in ABA, are frequently cited in the literature to increase the social behaviors of children with autism (NAC, 2009a; NRC, 2001; Reichow & Volkmar, 2010; Simpson, 2005).

Incorporating methods and techniques established on ABA and naturalistic teaching appear to be essential in the remediation of skill deficits of children with autism. The aim of the present study is to utilize naturalistic behavior strategies rooted in ABA to increase language and quality of social interactions in young children with autism and to assess generalization of these skills with untrained caregivers. The following section describes the theoretical foundation for the proposed study that influences the design and implementation of intervention for individuals with autism.
ABA stems from the philosophy of behaviorism (Cooper, Heron, & Heward, 2007; Skinner, 1974). ABA is best defined as “the science in which tactics derived from the principles of behavior are applied systematically to improve socially significantly behavior and experimentation is used to identify the variables responsible for behavior change” (Cooper et al., 2007, p. 20). ABA utilizes specific methods that systematically change behavior in measurable ways (Anderson & Romanczyk, 1999). All treatments that are behavioral in nature are based on a set of shared assumptions that most social behavior is learned and maintained by its unique history of antecedents and consequences that control its rate of occurrence (Alberto & Troutman, 2009; Cooper et al.). In addition, by manipulating antecedents in the environment and systematically applying the principles of reinforcement, new behavior can be learned and undesired behavior changed (Alberto & Troutman, 2009; Cooper et al.). Behavioral interventions are designed to apply the principles of positive and negative reinforcement, punishment, extinction, modeling and shaping to improve socially significant behavior of individuals (Wolery et al., 2005).

Seven critical dimensions of ABA were described in 1968 by Baer, Wolf, and Risley. The first is that ABA is applied, meaning that studies must be relevant to society. Second, ABA is behavioral, meaning that it directly measures the behaviors of participants without attending to additional assumptions. Third, ABA is analytical, employing only experimental designs and procedures. Fourth, ABA is technological in that all experimental conditions are operationally defined and replicable. Fifth, ABA is conceptually systematic in that the experimental procedures are well defined within the framework of behaviorism. Sixth, ABA is effective in that
intervention must produce substantial changes in behavior. Lastly, ABA incorporates *generality*, meaning that changes sustain over time and extend to other people, environments, and behaviors. Despite varying intervention programs that may be employed in the behavioral treatment of autism, all treatment that is rooted in ABA will display these seven critical dimensions (Wolery et al., 2005).

**Role of Applied Behavior Analysis in Autism Intervention**

The philosophical roots of ABA are established in behaviorism. Behaviorism is known as the philosophy of the science of behavior (Cooper et al., 2007). Behaviorism moved the field of psychology in the early 1900s into an objective and experimental branch of natural science. Watson (1913) was known as the father of behaviorism and focused his study on the importance of predicting and controlling human behavior. He relied on direct observation and was interested in the relationship between the ability of stimuli to evoke responses. His work was followed by B. F. Skinner in the 1930s and the idea of operant conditioning. Operant conditioning extended the stimulus-response (S-R) behaviorism set forth by Watson by accounting for the consequences (both reinforcement and punishment) that follow behavior (Skinner, 1974). This became known as the three-term contingency or S-R-S and through systematic manipulation Skinner was able to establish functional relationships between behavior and the environment leading to the behavioral treatment of autism in the late 1950s (Celiberti, Alessandri, Fong, & Weiss, 1993).

In the 1960s Fester used the behavioral theory to explain behaviors exhibited by individuals with autism (Fester, 1961). He examined the functions of their problem behaviors (communication) and the ability to bring behaviors under control by manipulating the antecedents and consequences. This initial application of the behavioral theory in individuals with autism took place in laboratory settings using highly controlled responses and mostly
primary reinforcers (food) (Celiberti et al., 1993; Fester & DeMyer, 1960). In 1964, Wolf, Risley, and Mees applied operant procedures, initially developed in a laboratory, to a hospitalized preschool child with autism. The techniques included “handshaping, extinction, food deprivation, time-out from positive reinforcement, and discrimination training” (p. 305) to target relevant behaviors including tantrums, bedtime problems, wearing glasses, eating problems, and verbal behavior (Wolf, Risley, & Mees, 1964). This research demonstrated the effectiveness of basic behavioral techniques (e.g., modeling, shaping, prompt fading, extinction, and differential reinforcement) and provided support for them as a critical component of behavioral intervention for young children with autism (Celiberti et al.).

Then in 1987, a landmark study was published by Lovaas which documented the effectiveness of a long-term behavior modification procedure for addressing the severe skill deficits of young children with autism. This behavioral intervention was implemented with 19 children with autism for 40 hours per week of one-on-one treatment for over two years. The treatment procedures were based on the operant principles of reinforcement. The first year of the study focused on decreasing problem behavior (e.g., aggression, self-stimulation) through the use of time-out, ignoring, contingent physical aversives and teaching replacement behaviors. Additionally compliance, imitation, and toy play were targeted with treatment extending to the family. By the second year of treatment, learning targets focused on expressive and abstract language, and interactive toy play while extending treatment into preschool programs in the community. In the third year, teaching focused on use of emotions, preacademic skills, and observational learning in a preschool setting (Lovaas, 1987). The results of this study were significant to the field of autism in that following intensive behavioral treatment, 47% of
children in the experimental group “achieved normal intellectual and educational functioning in contrast to only 2% of the control group” (p. 7) (Lovaas, 1987).

In the time following the research reported by Lovaas in 1987, techniques established in ABA continued to dominate the field of autism intervention. To date there is an overwhelming amount of evidence that supports the effectiveness of early and intensive behavioral treatment of autism utilizing the principles and techniques of ABA (Eikeseth, Smith, Jahr, & Eldevik, 2002; Howard et al., 2005; Koegel, Koegel, Harrower, & Carter, 1999; Lovaas, 1987; McEachin, Smith, & Lovass, 1993; McGee, Morrier, & Daly, 1999; Stahmer & Ingersoll, 2004; Wolery et al., 2005; Wolf et al., 1964; Zachor, Ben-Itzchak, Rabinovich, & Lahat, 2007). While applied behavior analytic principles have been utilized in research throughout the years, the implementation of teaching procedures in applied settings has gone through changes from discrete trials and structured teaching to more naturalistic and antecedent-based interventions (Celiberti et al., 1993; NRC, 2001).

Discrete trial teaching (DTT) is an intensive behavioral teaching process used to teach critical skills (Webber & Scheuermann, 2008). DTT incorporates many trials and focuses on breaking important skills into smaller parts. These sub-skills are then taught to mastery using behavioral procedures such as prompting, fading, and reinforcement (Leaf, Taubman, & McEachin, 2008). While DTT is intensive and easy to implement in classroom settings for children with autism learning new skills, it does have several disadvantages (Webber & Scheuermann, 2008). The biggest disadvantage of DTT relates to lack of generalization of child behaviors and the use of artificial reinforcers, making it difficult to teach critical communication and social skills needed in naturalistic settings (Koegel, Koegel, & Surrant, 1992; Koegel, O’Dell, & Koegel, 1987). Naturalistic behavioral strategies utilize ABA principles but include
the use of natural consequences, variation in materials and settings, and programming common stimuli (i.e., teaching materials are available across settings) to promote generalization (NAC, 2009a). In addition, naturalistic behavior strategies teach skills during child-initiated interaction leading to an increased ability to promote generalization through the use of natural reinforcement and child motivation (Koegel et al., 1992; Koegel et al., 1987). The proposed study is established on naturalistic behavior strategies as an improved application of ABA for facilitating acquisition of social communication responses beyond the intervention context.

Recently, Rogers and Vismara (2008) conducted a review of the behavioral literature focusing on the early treatment of autism. In a summary of their findings, they stress the importance of using positive behavior supports to treat challenging behaviors, teaching spontaneous functional communication, engaging in meaningful activities that utilize naturalistic teaching approaches, receiving effective early intervention, building in peer interaction, programming generalization, and incorporating families in intervention. Naturalistic behavioral interventions often include the use of environmental manipulations, instructional variations, embedded instruction, and use of peers (Wolery et al., 2005) and align with the current recommendations for the behavioral treatment of autism.

**Naturalistic Behavior Strategies**

Naturalistic behavior strategies are described as forms of discrete trial teaching that are initiated by the child and result in the delivery of natural reinforcement (NRC, 2001). Implementing naturalistic behavior strategies have led to increases in language and generalization for children with autism (Delprato, 2001; Koegel et al., 1987; Reichow & Volkmar, 2010). Naturalistic behavior strategies used in the treatment of individuals with autism are referred to in the literature as normalized behavioral language intervention (Delprato, 2001),
natural environment teaching (NET) (Sundberg & Partington, 1998), incidental teaching (Hart & Risley, 1975), natural language teaching paradigm (Koegel et al., 1987), pivotal response training (PRT; Koegel & Koegel, 2006) and milieu teaching (Hancock & Kaiser, 2002). Each of these approaches will be discussed in greater detail as they are frequently referred to in the literature related to teaching individuals with autism.

Incidental Teaching

Incidental teaching is the process of utilizing naturally occurring adult-child interactions to teach language skills (Hart & Risley, 1975). The incidental teaching process is child-initiated and begins when a child makes either a verbal or nonverbal request to an adult (e.g., child approaches trampoline). The response of the adult begins the incidental teaching process. If the adult responds to the child’s request (e.g., allows child to jump), the target behavior of the child is determined (e.g., a verbal response “jump” or a verbal approximation “juh” for the word jump), and an adult cue is delivered (e.g., “say jump”). Following the cue from the adult, the child’s desired behavior is prompted to the degree necessary to obtain a correct response (Hart & Risley, 1975).

The incidental teaching approach developed and described by Hart and Risley (1975) was originally developed for preschoolers without disabilities but a comprehensive incidental teaching curriculum is also appropriate for young children with autism by providing intervention during age appropriate play in the natural environment (McGee et al., 1999). McGee and colleagues (1999) describe a mild variation of incidental teaching procedures developed for toddlers with autism as part of a comprehensive early intervention approach. All teaching opportunities are child-initiated, but may be primed by adults through environmental manipulations. Following child initiations, the adult provides up to three prompts for a correct
elaborated response ending in delivery of reinforcement (delivery of item, praise, and a statement of the child’s correct response) (McGee et al., 1999). Incidental teaching approaches focus on language instruction by shaping speech production, providing errorless instruction, and delivering powerful reinforcers (preferably natural, non-edible reinforcement). In addition, the incidental teaching approach also focuses on instruction in social approaches and promoting child engagement (McGee et al.). Early outcome data on the application of this model suggests that the incidental teaching approach has an important impact on the language and social behaviors of toddlers with autism. These changes were seen as increases in the children’s ability to verbalize meaningful words and increased peer proximity (Charlop-Christy & Carpenter, 2000; McGee et al.; McGee & Daly, 2007; Miranda-Linne & Melin, 1992).

**Pivotal Response Treatment**

“PRT is a comprehensive service delivery model that uses both a developmental approach and applied behavior analysis (ABA) procedures” to change pivotal behaviors (Koegel & Koegel, 2006, p. 4). Pivotal areas of development (e.g., motivation) are described as responses or behaviors that when changed, can lead to large improvements in other critical areas of development (e.g., social interaction skills) (Koegel & Koegel, 2006; Koegel et al., 1999). Koegel et al. (1999) describe critical components of the PRT model. These involve intervention on individualized target behaviors in the most natural and inclusive setting possible consistently provided throughout the day monitored by a highly skilled specialist with additional interventionists consisting of family and teachers (Koegel et al., 1999). Pivotal areas of development for children with autism include responding to multiple cues, motivation, self-management, self-initiations (Koegel et al., 1999) and empathy (Koegel & Koegel, 2006).
Natural Environment Training

NET is an educational program developed by Sundberg and Partington in 1998 based on the principles of verbal behavior as described by Skinner in 1957 (Weiss, 2001). NET shares many features of the Natural Language Paradigm (NLP) described by Koegel and his colleagues in 1987 (Koegel et al., 1987). These features focus on the child’s immediate interest and activities, implementation in the child’s typical daily environment, focus on stimulus and response variation, and the use of natural consequences for correct verbal responses (Sundberg & Partington, 1998). The most important distinction between the NLP and NET, is that NET incorporates Skinner’s (1957) functional analysis of verbal behavior.

Skinner’s analysis of verbal behavior asserts that “language is learned behavior under the control of a variety of different environmental variables” (Sundberg & Partington, 1998, p. 259). Sundberg and Partington (1998) delineate six different verbal operants that are critical components of language training for a child with autism. These include mand, receptive, tact, echoic, imitation, and intraverbals. Although NET incorporates all of the verbal operants in language training, the primary focus of instruction revolves around teaching the mand, commonly referred to as requesting behavior. According to Sundberg and Partington (1998), when language training, specifically mand training, capitalizes on establishing/motivating operations (EO/MO; Michael, 1993; Sundberg & Michael, 2001), intervention is not only more successful (Carr & Durand, 1985), but engaging for the child as well. Mands allow early learners to control the delivery of reinforcement, develop the role of a speaker, and lead to improved spontaneity and generalization (Sundberg & Michael, 2001) due to the mands relationship to motivation.
Milieu Teaching

Milieu teaching is a developmental procedure that has been used to increase the social-communication skills of preschool-aged children with autism (Hancock & Kaiser, 2002; Kasari, Freeman, & Paparella, 2006). Components of milieu teaching include child-initiated activities, systematic prompting procedures, reinforcement, utilizing naturally occurring opportunities, imitation of child’s actions, and using child interest in activity to develop play routines (Kasari et al., 2006).

In a comparison of the different naturalistic behavior approaches (e.g. PRT, incidental teaching) used to teach social communication, Ingersoll (2010) described five basic components that are shared between each of the approaches. These five components are (a) all teaching occurs in the natural environment during typical routines, (b) every teaching episode is child-initiated, (c) the target behavior is prompted by the adult, (d) all target behavior is reinforced using natural reinforcers, and (e) shaping is used by the interventionist to reinforce successive approximations of target behavior. These components set the stage for the proposed intervention and are described in further detail below.

Components of Natural Behavior Strategies

Natural behavior strategies evolved in the literature as a way to improve child outcomes and enhance generalization and maintenance of skills (Ingersoll, 2010). Although there are variations in the application of natural behavior strategies, the existing literature describes the following components as essential to the implementation of this approach in children with autism.
Natural Environment

Naturalistic behavior strategies are often described as techniques utilized in everyday environments (Ingersoll, 2010). For a child with autism, the natural environment may encompass their home, classroom, clinic, or community setting (e.g., church or park). The importance of using natural environments grew out of the recommendations from Stokes and Baer (1977) to improve generalization of learned skills beyond the intervention setting. The strategies recommended by Stokes and Baer (1977) included teaching under various conditions and with different stimuli, as well as loosening stimulus control in order to facilitate generalization. The use of natural environments allows interventionists to take advantage of everyday teachable moments that frequently occur throughout the course of the day (Webber & Scheuermann, 2008) and arranging the environment so that teaching opportunities can be incorporated across settings (Koegel & Koegel, 2006). An advantage of this feature is that child responses begin to come under the control of the natural environment (Koegel & Koegel, 2006) rather than under the stimulus control of only the training setting.

Child-Initiated

Another feature of naturalistic behavior strategies is that teaching episodes are child-initiated or child-led, and language instruction is guided by following the child’s interest or establishing operations (EO) (Sundberg & Partington, 1998). Hart and Risley (1975) may have been the first to utilize this approach with young children with disabilities in an attempt to teach language. They used the term “child-selected” to describe a situation in which the “child initiates interaction by requesting assistance from the adult” (p. 412). Most recently, the Koegels (2006) described this feature as “child-choice,” in which the interventionist follows the child’s choice in regard to preferred tasks and activities. This requires the interventionist to make on-the-spot
decisions regarding the child’s current motivation by controlling dangerous, inappropriate, and uninteresting activities and redirecting them to another activity in order to provide opportunities to target social and communication skills (Koegel & Koegel, 2006). In regards to language intervention, interventions that incorporated child-choice within a naturalistic framework (Carter, 2001; Koegel et al., 1987) found that children with autism displayed more spontaneous language (e.g., utterances, targeted morphemes) that generalized outside of treatment conditions, demonstrated decreased social avoidance and maladaptive behaviors, and showed increased play initiations when the children were able to make choices regarding task item and activities.

Prompts are defined as “supplementary antecedent stimuli used to occasion a correct response in the presence of an S^D that will eventually control the behavior” (Cooper et al., 2007, p. 401). When a prompt operates on the response of the child it is described as a response prompt and usually occurs in the form of verbal instructions, modeling, and physical guidance (Cooper et al., 2007). The use of prompts in naturalistic behavior strategies vary based on the initiation response of the child (Delprato, 2001). Model prompts are often delivered during vocal mand training to determine if imitation will occur and elicit the child’s target response (Bourret, Vollmer, & Rapp, 2004). Prompting is a critical part of the procedure used for establishing mands (Sundberg, 2007) and often times both nonverbal (preferred item) and echoic (vocal word) prompts are critical components in early mand training (Sundberg, 2007). It is essential that throughout teaching, prompts are faded (first echoic prompts and then stimulus prompts) in order to bring the child’s response under the control of the child’s motivation.
Shaping

The process of shaping is defined as “using differential reinforcement to produce a series of gradually changing response classes; each response class is a successive approximation toward a terminal behavior” (Cooper et al., 2007, p. 704). Naturalistic behavior strategies used to teach social communication frequently shape child’s vocal responses into more complex responses, reinforcing all vocal attempts by the child to respond (Delprato, 2001; Koegel & Koegel, 2006; Sundberg & Partington, 1998). Shaping vocal responses is an important component of teaching language to children with autism because it accounts for the terminal behavior, utilizes positive reinforcement procedures, and is easily combined with other behavior procedures (Cooper et al.; Koegel, O’Dell, & Dunlap, 1988) to teach complex skills, such as language, to early learners with autism.

Natural Reinforcement

The last and most critical component of naturalistic behavior strategies is the use of natural reinforcement (Koegel & Koegel, 2006; Koegel et al., 2009; Koegel & Williams, 1980). Natural reinforcement produces a strong response-reinforcer relationship (Williams, Koegel, & Egel, 1981). Reinforcement becomes more effective when a reinforcer is logically related to the response produced by a chain of behaviors often described as producing a direct response-reinforcer relationship (Koegel & Williams, 1980; Koegel et al). Skinner (1982) discussed the effectiveness of natural reinforcement on behavior. He noted that natural reinforcers are “much more effectively contingent upon the topography of behavior and the occasion upon which it occurs” (p. 4). Therefore, when natural reinforcement is used, the behavior produced is more likely to be strengthened and therefore repeated (Skinner, 1982).
Koegel and Williams (1980) and Williams et al. (1981) examined response-reinforcer relationships and their effect on the acquisition of learning for children with autism by comparing two reinforcement conditions. In one condition arbitrary reinforcers were used (i.e., reinforcers were contingently delivered, but were not related to the target behaviors). An example of the arbitrary condition is the student being handed a piece of candy for correctly opening a container. In the other condition functional reinforcers were examined (i.e., reinforcement was directly tied to performing the target response). In this condition when a child correctly opened a container, they found a piece of candy inside. They found that when functional reinforcers were used, acquisition of desired responses occurred more rapidly than responses produced using arbitrary or unrelated reinforcers (Koegel & Williams, 1980; Litt & Schreibman, 1981; Williams et al., 1981). The use of natural reinforcers remains a critical component of natural behavior strategies used to teach children with autism (NAC, 2009a).

Naturalistic Behavioral Approaches for Teaching Social Communication

Naturalistic teaching strategies have been established as an effective and evidence-based treatment for children with autism targeting acquisition skills and leading to improved generalization by using direct and natural consequences, varying materials and settings, and programming common stimuli (Delprato, 2001; NAC, 2009a; NRC, 2001). Naturalistic teaching strategies are designed to teach skills during naturally occurring child-initiated events that take advantage of the child’s motivation to communicate which is followed by natural reinforcement (Hancock & Kaiser, 2002; Ingersoll & Schreibman, 2006). Naturalistic behavioral interventions have been used frequently to increase the social-communicative behavior of children with autism (Koegel et al., 2009; Landa, 2007; Reichow & Volkmar, 2010; Rocha, Schreibman, & Stahmer, 2007; Whalen & Schreibman, 2003; Whalen, Schreibman, & Ingersoll, 2006; Williams-White et
al., 2007). The following sections provide a description of different naturalistic teaching strategies (e.g., milieu teaching, naturalistic behavior modification and pivotal response training) and the effect they have on the social and communication skills in young children with autism.

**Social and Communication Outcomes**

Naturalistic behavior modification techniques (including components of DTT and PRT) have been successfully implemented by researchers (Whalen & Schreibman, 2003; Whalen et al., 2006) to increase the joint attention behaviors of children with autism. The specific components of the intervention as implemented by Whalen and Schreibman (2003) included the use of clear prompts, interspersed mastery and acquisition tasks, choice activities to increase task motivation, experimenter and child turn-taking in order to provide teaching opportunities, contingent reinforcement following child response, reinforcement of correct and prompted responses, and the use of reinforcers that are directly tied to the responses made by the child in the natural environment. Results of their study showed that children with autism made significant gains in their ability to respond to joint attention increasing their social awareness, and also in their ability to initiate joint attention (Whalen & Schreibman, 2003). These behaviors not only increased in post-treatment observations, but were also seen in other settings demonstrating generalization of this skill across settings and people.

Extending their previous research, Whalen et al. (2006) examined the collateral effects of naturalistic behavior modification techniques to evaluate the effects on social communication responses of children with autism. Results indicated that as a function of joint attention training, collateral increases were observed in initiations, positive affect, spontaneous speech, and empathic responses for all children with autism. Based on the success of this intervention in increasing the social communication skills of children with autism, future research may evaluate
the effectiveness of individual intervention components in comparison to the comprehensive naturalistic behavior strategies package. Additionally, the authors (Whalen et al., 2006) specifically discuss the important relationship between displays of positive affect and social sharing. Along with other authors (Kasari, Sigman, Mundy, & Yirmiya, 1990), Whalen et al. suggest that when children with autism display positive affect, it may suggest that they are exhibiting true social behaviors (e.g., joint attention) as opposed to simple requesting behaviors (i.e., mands). Therefore, it is important to examine the display of affect during manding as this may provide evidence of improved social interaction skills.

A similar naturalistic behavioral intervention was implemented by Ingersoll and Schreibman (2006) to teach object imitation to young children with autism. Components of the intervention were implemented across five phases in the study based on typical developmental milestones. Initially, contingent imitation and linguistic mapping were used to gain the child’s attention and encourage them to respond, while simultaneously providing a model of appropriate language. In the second phase child-initiated interactions were requested and mixed with contingent imitation in an attempt to have the child imitate the therapist’s actions. As the phases progressed, modeling, prompting, and contingent reinforcement were provided to encourage more natural imitations by the child. The intervention successfully increased imitation skills in children with autism and positive collateral changes were also observed in other social communication behaviors including language, pretend play, and joint attention.

Naturalistic behavior analytic techniques were also used successfully to train parents to increase the number of initiations of joint attention made in order to promote responding and initiating by their children (Rocha et al., 2007). The specific behavior analytic techniques that the parents were trained to use included components from discrete trial training (complete trials,
appropriate instructions, distinguish and provide appropriate feedback based on children’s responses) and PRT (following the children’s choice and using motivating toys). Results from the study also indicated that all three children showed increases in all types of joint attention including placing hand on object, tapping object, showing objects, pointing, and shifting their gaze. In addition, parents increased the frequency of joint attention initiations. The results demonstrated that the social behavior of children increased during training and maintained during generalization sessions.

The naturalistic behavior principles of PRT have recently been expanded upon by using the perseverative interests of children with autism to promote social interactions and by assessing the collateral effects on joint attention (Vismara & Lyons, 2007). These researchers trained parents to implement PRT procedures through weekly sessions in order to increase the children’s verbal communication and social interactions in the natural environment. While the principles of PRT include using child-initiated stimuli, the researchers added an additional component that included using stimuli focused on the perseverative interest of each child that resulted in gains in joint attention initiations and improved quality of interactions between children and parents. These results imply that employing naturalistic behavior strategies, that incorporate the child’s perseverative interest, has important implications for improving the social motivation necessary for creating shared experiences with others.

Recently, a study by Taylor and Hoch (2008) examined the effectiveness of prompting and social reinforcement procedures for teaching joint attention skills (e.g., gaze shift between an object and another’s eyes, vocal responses to bids for joint attention, and vocal bids to initiate joint attention) to children with autism. Prior to intervention the children were able to respond to some joint attention bids, but were not able to consistently initiate bids for joint attention and
coordinate their gaze shift between an object and the eyes of another person. Results indicated that following intervention on responding to bids, each participant’s ability to look at items referenced by the instructor and make comments about the targeted item increased to 100%. In addition, substantial gains were also made in the areas of coordinated joint attention in which the participants looked back at the instructor following intervention on responding to joint attention. Initiating bids for joint attention were not consistently observed across participants until specific training on initiating bids. However, results for initiating joint attention for all three participants were modest suggesting that it may be hard to teach and measure the social function of joint attention. The features of this intervention, including the use of socially relevant stimuli and social reinforcers, expands on the current components of interventions to teach joint attention, a critical social behavior that is often impaired in children with autism.

The above research (Ingersoll & Schreibman, 2006; Rocha et al., 2007; Taylor & Hock, 2008; Vismara & Lyns, 2007; Whalen & Schreibman, 2003; Whalen et al., 2006) demonstrates the effectiveness of many components of naturalistic behavior strategies and the effect they have on social communication behaviors in young children with autism. In addition to improved social communication skills (e.g., joint attention, affect, initiations, imitation, language, play) research employing natural behavior strategies also promotes generalization (Ingersoll, Lewis, & Kroman, 2007; Whalen & Schreibman, 2003).

**Improved Generalization**

Generalization is defined as “the occurrence of relevant behavior under different, non-trained conditions (i.e., across subjects, settings, people, behaviors, and/or time) without the scheduling of the same events in those conditions as had been scheduled in the training conditions” (Stokes & Baer, 1977, p.350). More specifically, the term stimulus generality is used
to describe a situation in which a learner performs a target behavior in an environment that was not previously trained (Cooper et al., 2007). According to Stokes and Baer (1977) generalization can be enhanced in a variety of ways. The advantage of naturalistic behavior strategies is that generalization training is already built into the procedure. Generalization training includes the use of direct and natural consequences, teaching in different settings (e.g., home, school, community) with a variety of materials, and programming common stimuli (DeQuinzio, Townsend, Sturmey, & Poulson, 2007). Research indicates that when naturalistic behavior strategies are implemented to target language in children with autism, their responses generalize to non-trained settings (Koegel et al., 1987). Additional research that demonstrates generalization of social communication behaviors utilizing naturalistic behavior strategies is further discussed below.

Hancock and Kaiser (2002) used another naturalistic behavior approach described as enhanced milieu teaching (EMT) that integrates the behavioral and social interactionist approaches to improve the social communication skills of four preschool children with autism. This approach to language intervention utilized a single-subject multiple baseline design across participants. EMT was implemented in a clinic playroom twice a week for 15 min and included the following components: environmental manipulations that promote engagement and communication (begins with child request), responsive interaction techniques (expansions, turn-taking), the use of a prompt hierarchy (models, mands, time delay procedures), and contingent delivery of natural consequences (positive feedback, access to requested item/activity). Results of the study indicated that all of the children made gains in social communication in the following areas: number of utterances, spontaneous utterances, prompted and spontaneous targets, and diversity and complexity of language. The positive changes in language were found
to generalize to interactions with parents for three of the four participants (Hancock & Kaiser, 2002). The results of this study not only demonstrate the success of naturalistic teaching methods in increasing the social and communication behaviors of children with autism in a short period of time, but also that these changes can generalize to additional settings without direct training.

Milieu therapy has also been combined with DTT to target and prime specific social skills like joint attention and play for children with autism ages three to four years (Kasari et al., 2006). Children in the study were randomly assigned to a joint attention intervention, a symbolic play intervention, or control group and individual goals were determined for each child. The intervention for all participants included DTT at a table to teach their individualized goals. DTT consisted of the use of a prompt hierarchy (verbal prompt, model, physical prompt) followed by positive reinforcement for correct responses. Following training, the interventionist and children moved to a natural setting where the interventionist used shaping, systematic prompting, and reinforcement, but utilized naturally occurring opportunities in the environment. The procedures on the floor were all child-led, and incorporated continuous dialogue, expansions, corrective feedback, proximity control, eye contact, and environmental arrangements as necessary to facilitate the child’s social communication attempts. Following intervention, children with autism showed improvements in initiating and responding to bids to joint attention and also showed greater diversity and sophistication of play. In addition, these skills generalized from the treatment sessions to the home environments with caregivers.

These two studies (Hancock & Kaiser, 2002; Kasari et al., 2006) indicate that milieu therapy, which has traditionally been viewed as a developmental approach, appears to show promising outcomes when combined with applied behavior analytic procedures to produce positive changes in the social communication skills in young children with autism. In 2011,
Ingersoll compared the effects of three different naturalistic interventions: responsive interaction, milieu teaching, and a combination approach on the communication of preschool children with autism. The results indicated that behaviorally based milieu teaching produces more overall language and mands, while responsive interaction leads to more commenting behavior (Ingersoll, 2011). This research aligns other naturalistic behavior approaches that supports that components of intervention (e.g., natural environment, child-led activities, and natural reinforcement) are critical in producing improved social communication skills, but also promoting generalization.

Recently, researchers examined specific components of intervention procedures that were responsible for improving the social initiations of young children with autism (Koegel et al., 2009; Vernon, Koegel, Dauterman, & Stolen, 2012). In 2009, Koegel and colleagues examined specific components of intervention procedures that are responsible for improving the social initiations of young children with autism. The authors implemented PRT procedures to provide language opportunities by first presenting a discriminative stimulus, waiting for child’s response, and reinforcing the child’s response with the preferred stimulus. They utilized a reversal design to determine if embedding social interactions into child-preferred reinforcers during natural language training was effective in increasing self-initiated social engagement, nonverbal dyadic orienting, and general child affect. Results of the study indicated that when adult social interactions were embedded into reinforcers, increases were seen in child-initiated social engagement during communication, dyadic orienting, and affect. In 2012, the researchers trained parents to implement similar PRT procedures with embedded social interactions with their child with autism. The results of this study also found increases in child eye contact, positive affect, and initiations. These results are important in the current line of research, because they indicate that while conducting critical language training (i.e., requesting) improvements were also noted
in social interaction behaviors leading to improved outcomes for participants. Additionally, it begins to provide support for embedding social interactions into natural reinforcers during language training in order to increase the social communication skills of children with autism. (Koegel et al., 2009; Vernon et al., 2012).

**Significance of the Proposed Study**

As the above review indicates, early intervention using naturalistic applied behavior analytic procedures have been successful and perhaps necessary to teach social communication skills to children with autism. Due to the social nature of the disability and the critical deficits in social communicative development associated with autism (i.e., decreased use of language, limited eye-contact and restricted affect (Ventola et al., 2007; Zwaigenbaum et al., 2005), it is essential that child-initiated social behaviors be examined in order to promote social interactions in the natural environment. Research has clearly documented the effectiveness of PRT and other naturalistic behavior strategies in accelerating social communication behaviors in children with autism by targeting motivation (through the use of child choice, preferred items/activities, natural reinforcement, mand training) (Carr & Durand, 1985; Koegel et al., 2009; Rocha et al., 2007; Sundberg & Michael, 2001; Vismara & Lyons, 2007; Whalen & Schreibman, 2003; Whalen et al., 2006). It is also important to determine if naturalistic behavior strategies delivered as a package will improve the quality of social communication for this population. In addition, if naturalistic behavior strategies lead to improved social communication and generality of child-initiated behaviors (Delprato, 2001; Koegel et al., 1987; Reichow & Volkmar, 2010), it is important to determine if the measured variables will generalize to other untrained adults in the same setting.
The purpose of this research is to increase the language and improve the quality of social interactions in young children with autism in the natural environment. The proposed study will utilize naturalistic behavior strategies to target language (specifically manding) and social interactions (self-initiated social engagement during manding, nonverbal dyadic orienting) in order to determine the effectiveness of natural behavior strategies. It is anticipated that children with autism will increase their communication and improve the quality of social interactions in order to access natural reinforcement. In addition, there is a need to assess stimulus generalization across untrained parents/caregivers following intervention.

This proposed study seeks to answer the following research questions:

1. Is there a functional relationship between the use of naturalistic behavior strategies and the quality of social interactions for children with autism? Specifically, will the use of naturalistic behavior strategies increase the (a) frequency of vocal mands, (b) percentage of mands during which children display child-initiated social engagement, and (c) intervals of dyadic orienting?

2. Will the improved quality of social interactions of children with autism generalize to untrained caregivers in the same setting?
This section describes the detailed research methodology utilized in the study. The purpose of this research was to increase the frequency of vocal mands and improve the quality of social interactions in young children with autism in the natural play-based environment. The methodology, including research design, participant and setting description, measurement variables, and procedures are described in the sections below.

Participants and Setting

Participant Selection

Four young children diagnosed with autism participated in this study. Participants were recruited from two sources in the Dallas-Fort Worth metroplex. Initially, flyers were posted at the University of North Texas (UNT) Speech and Hearing Center and disseminated to clinical supervisors at the center. In addition, the recruitment flyer was emailed to clients on their waiting list. Participants were also recruited through the Greater Lewisville Special Education Parent Teacher Student Association (SEPTSA). The president of SEPTSA electronically disseminated they recruitment flyer through their listserv. Of all the families that made contact (via phone or email), the first four who met the inclusion criteria were selected to participate in the study.

The inclusion criteria required each child: (a) to have an independent diagnosis of autism using DSM-IV criteria (American Psychiatric Association, 2000), (b) to be between the chronological age of 2 and 5 years, (c) to display persistent deficits in eye contact, and (d) to have early or emerging vocal language. No exclusion criteria regarding demographic characteristics were established as long as participants met all inclusion criteria. Each participant’s diagnosis and age were confirmed by reviewing records during an initial meeting with the interventionist/lead researcher. Records reviewed commonly included school district Full and Individual Evaluation (FIE), psychological evaluations, and medical records. During the
initial meeting the interventionist confirmed persistent deficits in eye contact and early or emerging language by asking parents/caregivers to complete the Communication and Symbolic Behavior Scales Developmental Profile Infant-Toddler Checklist (CSBS); (Wetherby & Prizant, 2002) (see Appendix E for a copy). The CSBS is a checklist that consists of 24 questions regarding the following language predictors: emotion and use of eye gaze, use of communication, gestures, sounds, words, objects, and understanding of words. Completion of the checklist took approximately 5-10 min; the interventionist then scored the checklist during the initial meeting at no cost to the parents. Participants needed to receive a score between 0-5 in the eye gaze cluster, and a score of 1 or greater in the use of words cluster in order to be considered eligible to participate.

In addition to administering the CSBS, the interventionist asked parents to share any relevant records (Individual Education Plans, data sheets, evaluation reports, verbal reports, and observations) that would aid in determining any previously learned tasks and responses for the purpose of arranging the environment and selecting the best words/word forms for mand training. Following the pre-intervention protocol developed for this study (see Appendix F), the interventionist observed the child and asked the caregivers specific questions (e.g., “How does your child communicate his wants and needs?” “What items or activities are known to function as reinforcers for your child?”) in order to gain a better understanding of the child’s current levels of performance. Following the parent’s responses and observations, the interventionist compiled the information and used it to guide individual intervention.

The parents/caregivers also completed a reinforcer assessment (see Appendix G). The reinforcer assessment is a checklist that is used to obtain information regarding their child’s preferences for different items and activities. The interventionist used this in order to obtain
items and to plan activities that would promote language and social interaction during the experimental conditions. Prior to completion of the meeting, the interventionist collected the completed CSBS checklist, reinforcer assessment, and signed informed consent. In addition, the interventionist determined each participant’s weekly schedule for conducting experimental sessions.

Participants

Four young children with a diagnosis of autism, based on the diagnostic criteria of the DSM-IV-TR (American Psychiatric Association, 2000), participated in this study. All of the participants were between the chronological age of 2 and 5 years and displayed persistent deficits in social and communication skills. Table 1 includes additional background information regarding each participant. The interventionist obtained Institutional Review Board (IRB) approval prior to initiating any contact with young children with autism for the purpose of this study. Participants’ parents or legal guardians received a letter for informed consent which included the purpose and procedures of the study, foreseeable risks and benefits, confidentiality procedures, and participant’s rights.

Child 1

Child 1 was a 4-year-old, African American boy. He lived in a single-family household with his adoptive mother and one older adopted sibling. He displayed persistent deficits in eye-contact based on results from the CSBS, caregiver reports, and initial observations. He had emerging language that consisted of 11—30 words based on the CSBS. Initial observations and parent reports indicated that he primarily used one- to two-word utterances to request items and activities, label items, and answer simple questions. According to the reinforcer assessment and
baseline observations, he enjoyed physical contact (e.g., hugs, tickles, jumping); musical toys; watching television (e.g., Blue’s Clues, Thomas); and playing with trucks, trains, and computers.

Child 2

Child 2 was a 4-year-old, Caucasian boy. He lived in a single-family household with his biological parents and twin brother. He displayed persistent deficits in eye-contact based on results from the CSBS, caregiver reports, and initial observations. The CSBS, initial observations, and parent reports indicated that he primarily used one- to two-word utterances to request items and activities, label items, and answer simple questions. He also produced “sing-song” vocalizations during independent play. According to the reinforcer assessment and baseline observations, he enjoyed listening to children’s music; playing with toys (e.g., musical and light-up toys, trains, puzzles); watching television (e.g., Sesame Street, Mickey Mouse); and engaging in activities incorporating shapes, colors, letters and numbers.

Child 3

Child 3 was a 2-year-old, Caucasian boy. His parents were divorced and his living was apportioned between his biological mother’s home, and his biological father and stepmother in their home. He displayed persistent deficits in eye-contact based on results from the CSBS, caregiver reports, and initial observations. He had emerging language consisting of 11—30 words based on the CSBS. Initial observations and parent reports indicated that he primarily used one-word utterances to request/protest items and activities and label items. According to the reinforcer assessment and baseline observations, he enjoyed physical activities (e.g., jumping, swinging, swimming); music and singing; playing computer games (e.g., Thomas the Train, Mickey Mouse, Chuggington); and playing with trucks, trains, and dinosaurs.
Child 4

Child 4 was a 4-year-old, Caucasian boy. He lived in a single-family household with his biological mother and father, and 2 older siblings. He displayed persistent deficits in eye-contact based on results from the CSBS, caregiver reports, and initial observations. He had early language consisting of 4—10 vocal approximations of words (e.g., open, more, up) based on the CSBS and parent reports. Initial observations and parent reports indicated that he primarily used one- to two-syllable vocalizations to request items when prompted by another person. According to the reinforcer assessment and baseline observations, he enjoyed physical activity (e.g., jumping, swinging, spinning), playing with sensory-based toys (e.g., tactile, spinning), and water play.

Setting and Materials

The interventionist conducted the intervention in the Educational Psychology Research Laboratory on the UNT campus. The research lab was a small room furnished with a couch, large table, shelves, and a two-way mirror for conducting observations. The room was arranged with age-appropriate toys (e.g., musical toys, trains, race tracks, balls, blocks, cars, puzzles) and activities (e.g., trampoline, bean bucket, bubbles) on shelves in full view of the children. A video camera was mounted on a tripod in the corner of the room for the purpose of collecting video data. All experimental sessions for all participants occurred in this room, including generalization across caregivers.

Dependent Variables

In accordance with best-practice recommendations for single subject research methodology (Horner et al., 2005), the dependent measures used in this study were operationally defined, measured frequently throughout the study, assessed for consistency by multiple
observers, and socially significant to the participants and the field. The researcher used the following dependent variables to evaluate the effects of naturalistic behavior strategies on the quality of social interactions for children with autism. The operational definitions, as well as examples and non-examples for each dependent variable are shown in Table 4.

**Vocal Mand**

A vocal mand is defined as the occurrence of unprompted and prompted vocal responses (including speech sounds, word approximations, or adult word forms) that results in access to a specific reinforcer (Carbone, Sweeny-Kerwin, Attansio, & Kasper, 2010). Skinner (1957, p.35-36) originally defined a mand as “a verbal operant in which the response is reinforced by a characteristic consequence and is therefore under the functional control of relevant conditions of deprivation or aversive stimulation”. What differentiates a mand from other verbal operants (e.g., tact, intraverbal) is that, in a mand, control is exerted by the motivating operations (MO) and is strengthened only by reinforcement specific to the relevant MO benefitting only the speaker. Examples of vocal responses emitted by the participants included speech sounds (e.g., “ba” for open, “mmm” for food, “muh” for up, “dah” for jump), word approximations (e.g., “buh” for ball, “juh” for jump, “sin” for spin, “sing” for swing) or adult word forms (e.g., “ball”, “jump”, “spin”, and “swing”). Non-examples included vocal self-stimulatory sounds made by the child, purposeless vocalizations that did not indicate interest in an item/activity, echolalia, labeling of items, or responses in conversation. Gestures or pointing not accompanied by a vocalization were not counted as vocal mands.

In order to measure the frequency of vocal mands, the interventionist conducted and video recorded a 10-min language session (Koegel et al., 2009). During each session, the primary observer scored the items or activities that the child vocally requested as either prompted or
unprompted. A prompted mand included any vocal mands that occurred after the interventionist delivered an echoic prompt that drew attention to a preferred item or activity. An unprompted mand included any vocal mand emitted by the participant without an echoic prompt from the interventionist regarding the item or object visually present in the environment. The primary observer calculated the frequency of vocal mands by counting the total number of mands following each session. In addition, the mands were scored as either prompted or unprompted and the frequency was determined by counting the total number of prompted versus unprompted responses.

*Child-initiated Social Engagement During Manding*

Child-initiated social engagement during manding was defined as the physical orientation of the child toward the interventionist and/or the display of positive affect (i.e., smiling, laughing) toward the interventionist during a vocal mand initiated by the child (Koegel et al., 2009). Examples of physical orientation during vocal mands included the child’s whole body facing the adult, the child’s head turned toward the adult, or the child looking at any part of the adult’s face. Non-examples included the child turning his/her back or side to the front (face) of interventionist’s body while manding. Examples of affect during vocal request included the child smiling or laughing during a request. Non-examples of affect during a vocal request would be a request in which the child’s expression is neutral or s/he cries, pouts, or tantrums.

Child-initiated social engagement during vocal mands was measured during 10-min language sessions. During the session, the primary observer coded if the child either physically oriented toward the interventionist and/or displayed positive affect while manding for an item or activity. The primary observer counted the total number of mands in which the child physically
oriented and/or displayed affect were counted in order to determine the frequency of mands in which the child initiated social engagement.

**Nonverbal Dyadic Orienting**

Nonverbal dyadic orienting was defined as the child looking at the interventionist’s eyes (i.e., eye contact) following an action emitted by the interventionist (Koegel et al., 2009). Examples of this behavior included the child facing and looking toward the interventionist’s face or eyes. Non-examples included the child facing the interventionist, but looking at their arms, legs, or torso; looking at an object in the room; or facing the adult with eyes closed.

The primary observer measured occurrences and non-occurrences of dyadic orienting by coding the same 10-min video of the session using 10-s intervals. After data coding, the total number of occurrences were divided by 60 intervals to obtain the percentage of intervals the child engaged in dyadic orienting.

**Measurement Procedures**

**Equipment and Materials**

All experimental sessions were video recorded using a Sony high-definition wide angle handycam with a 160GB internal hard drive mounted on a tripod. Following each session, the interventionist transferred the videos to a 700GB external hard drive for storage and to facilitate data coding by the observers. The primary data collector for the dependent variables used the videos to code dyadic orienting and IOA for procedural fidelity. The primary observer for procedural fidelity used the video recording to code fidelity of implementation. The secondary data collectors for the dependent variables used the video recordings to code all dependent variables for IOA.
Direct Observation

Direct observation of target behaviors was conducted across all experimental conditions. Each session began with a 3-min warm-up period, followed by a 10-min recorded session. During each session, the primary observer collected data for two dependent variables (i.e., vocal mands, child-initiated social engagement). The interventionist video recorded each 10-min session for further data coding and analysis of the dependent measures for each experimental condition (i.e., baseline, intervention, generalization) and procedural fidelity. Following each daily session, the interventionist downloaded all recorded video to an external hard drive for storage and coding purposes. See Appendix H for a sample data sheet.

Frequency data were collected on both prompted and unprompted vocal mands. The frequency measure included the number of responses emitted during each 10-min session (Cooper, Heron, & Heward, 2007). The interventionist also collected frequency data on child-initiated social engagement during manding. The frequency measure included the number of times that the child initiated social engagement during a vocal mand during each 10-min session (Cooper et al., 2007). Partial-interval recording was used to collect data on nonverbal dyadic orienting. The researcher divided each 10-min session into 10-s intervals and scored if the behavior was present at some point during the interval (Cooper et al., 2007).

Interobserver Agreement

Interobserver agreement (IOA) was used as an “indicator of measurement quality” (Cooper et al., 2007, p. 113). IOA was collected and reported for a minimum of 25% of all sessions across each experimental condition. Following intensive training in direct observation of the dependent variables including examples and non-examples, two observers scored the videos from each session based on the dependent measures previously described. The observers were
required to meet a mastery criterion of 90% for 3 consecutive sessions before data collection was initiated. The primary observer was a doctoral student in special education, whereas the lead investigator and another doctoral student in special education served as the secondary observers for all dependent variables, and conducted reliability assessments. If IOA went below 80%, the primary data collector was asked to recode the variables from the video recording.

The interventionist calculated each child’s percent agreement throughout all phases of the study. For the first two dependent variables (i.e., vocal mands and social engagement during manding) each observer determined a frequency count; agreement was obtained by dividing the smaller number by the larger number and multiplying by 100 in order to determine the total percent agreement. For the third dependent variable (i.e., nonverbal dyadic orienting) partial-interval data were collected, and an interval was counted as an agreement if both data coders recorded the occurrence or nonoccurrence of the target response. IOA was calculated by dividing agreements by the sum of agreements plus disagreements with the resulting value multiplied by 100 to determine the percentage.

The outcomes of IOA for vocal mands are as follows: Child 1 ($M = 96.6\%$; range = 83—100%), Child 2 ($M = 94.75\%$; range = 84—100%), Child 3 ($M = 94.9\%$; range = 82—100%), and Child 4 ($M = 96.6\%$; range = 88—100%). The outcomes of IOA for social engagement are as follows: Child 1 ($M = 95.9\%$; range = 86—100%), Child 2 ($M = 93.4\%$; range = 84—100%), Child 3 ($M = 90.8\%$; range = 83—100%), and Child 4 ($M = 93.8\%$; range = 88—100%). The outcomes of IOA for dyadic orienting are as follows: Child 1 ($M = 95.6\%$; range = 92—100%), Child 2 ($M = 94\%$; range = 88—100%), Child 3 ($M = 95\%$; range = 88—98%), and Child 4 ($M = 90.3\%$; range = 80—100%).
Research Design

A single subject multiple baseline design across participants (Gast, 2010; Horner et al., 2005; Kazdin, 1982) was utilized in order to determine the existence of a functional relationship between the use of naturalistic behavior strategies and the quality of social interactions in children with autism. The design included three phases (i.e., baseline, intervention, and generalization) for each participant. Baseline assessment began concurrently with all participants, and intervention was implemented with each participant in a sequentially staggered manner. Following evidence of stable performance on the primary dependent variable (i.e., frequency of vocal mands) for Child 1, the intervention condition was initiated for this participant. During this time the other participants remained in the baseline phase. This was necessary to demonstrate that the target responses of other participants did not change until they were exposed to the experimental condition. The intervention was applied to the other participants (i.e., Child 2, Child 3, Child 4) in a sequential and staggered manner only after the intervention demonstrated behavior change for the previous participant (as evaluated through the use of visual analysis techniques). Following intervention, a generalization phase was implemented to determine if the newly acquired skills transferred when the child interacted with their parent or caregiver in the same setting.

Experimental Procedures

The intervention consisted of the use of naturalistic behavior strategies delivered in a clinical setting to young children with autism. Experimental procedures include baseline, implementation of naturalistic behavior strategies, and generalization of child behavior across parents or caregivers. Each session during intervention began with a review of the individual child’s reinforcer assessment and previous session notes to ensure that motivating items and
activities were selected and used during intervention. Each session lasted 10 min and was delivered approximately twice a day with at least 10 min between sessions, two to three times per week. In addition to a description of each experimental phase of the study, this section will also provide a description of the fidelity of implementation of the intervention procedures. There was a total of 116 sessions across all phases and participants in the study.

**Baseline**

Baseline sessions consisted of free play with the interventionist in the research lab. Each baseline session began with a 3- to 5-min warm-up period in which the interventionist introduced the child to preferred items in the room in order to make the child comfortable in the environment and allow him/her to acclimate to the setting. Following the 3- to 5-min warm-up period and a signal from the interventionist, the primary data collector set a timer and recorded a 10-min clip of video to measure the dependent variables. During the baseline phase, the interventionist did not manipulate the environment to initiate any interaction with the child, but all vocal mands initiated by the child were reinforced with the delivery of the preferred item or activity. If a child led the interventionist to a toy, the interventionist delivered the item to the child without giving verbal feedback. Following each 10-min session, the room was reset (i.e., toys were put away on the shelves) while the child took a short break (e.g., walk, snack). Upon returning to the treatment room, another 10-min session began. The parents received general information about their child’s participation in the session and the interventionist addressed any questions and concerns before and after each session.

**Intervention: Naturalistic Behavior Strategies**

The interventionist implemented the intervention (naturalistic behavior strategies) in a sequential and staggered manner across participants after each individual participant
demonstrated stable baseline patterns. The intervention sessions also began with a 3-to 5-min warm-up period in which the interventionist introduced the child to preferred items in the room in order to make the child comfortable in the environment and allow them to acclimate to the setting. The intervention included the five components of naturalistic behavior strategies described by Ingersoll (2010) in order to target children’s language (specifically manding) and social interaction (child-initiated social engagement, dyadic orienting). These five components are (a) all teaching occurs in the natural environment during typical routines, (b) every teaching episode is child-initiated, (c) the target behavior is prompted by the adult, (d) all target behavior is reinforced using natural reinforcers, and (e) shaping is used by the interventionist to reinforce successive approximations of target behavior. The interventionist naturally embedded these components within each intervention session as described below. See Table 5 for a detailed description of intervention components as well as examples and non-examples.

Natural Environment

The intervention took place in the child’s natural environment. Although the setting for this intervention is a small research lab, this is a part of the natural environment for a young child with autism due to the intensity of treatment required at an early age. To ensure that the environment was as natural as possible, the intervention usually took place on the floor with age-appropriate toys and preferred items and activities set up around the room.

Child-initiated

All teaching episodes were child-initiated. The interventionist followed the child’s choice in regards to tasks and activities and provided opportunities for the child to select preferred items and activities. This ensured that the child’s response was under control of the MO and not pre-determined stimuli (Sundberg & Partington, 1998). For example, if the child walked toward the
trampoline displaying excitement, the interventionist began a teaching episode by providing an opportunity for the child to jump.

Prompting

The target behavior was prompted by the interventionist following the child’s initiation. The interventionist first provided the nonverbal stimulus (e.g., desired item, access to activity) along with a verbal stimulus (i.e., echoic prompt, for example “jump”) and provided specific reinforcement. For example, if the child approached the trampoline with excitement, the interventionist would direct the child to the trampoline while providing an echoic prompt “jump” for the child.

Natural Reinforcement

All reasonable language attempts (prompted responses and unprompted correct responses) made by the child were reinforced using natural reinforcers so that direct response-reinforcer relationships are established. Reinforcement was contingent on the child’s verbal behavior (e.g., the child says “jump” and is immediately provided with access to the trampoline) with the addition of a social interaction by the adult (e.g., adult jumps on the trampoline with the child) (Koegel et al., 2009).

Shaping

A loose shaping procedure (Koegel & Koegel, 1995) was implemented so that any verbal attempts made by the child were also differentially reinforced. If a child emitted a particular sound (e.g., “ja” for jump) in the presence of the nonverbal stimulus, the response was reinforced and the word jump was shaped by providing a correct echoic “jump” while delivering reinforcement.
Procedural Fidelity

Fidelity of implementation is known as the accurate and consistent application of an intervention (Wheeler, Baggett, Fox, & Blevins, 2006). When an intervention is implemented with fidelity it ensures that the outcomes are related to the independent variable (Horner et al., 2005). In order to ensure that the intervention was implemented accurately across all sessions, fidelity of implementation was scored for 30% of all naturalistic behavior intervention sessions (Gresham, Gansle, & Noell, 1993). The primary fidelity observer scored fidelity on an interval by interval basis for the presence of the naturalistic behavior strategies (i.e., natural environment, child-initiated, prompting, natural reinforcement, and shaping) using the Procedural Fidelity data sheet located in Appendix I. See Table 5 for a detailed description of intervention components. For the purpose of this study, the standard criterion for measurement of fidelity of implementation of intervention was established at 80% or higher. The fidelity of implementation was calculated to be 100% across all intervention sessions. A second observer conducted reliability assessments for 30% of the session.

Generalization

Following the intervention phase and demonstration of stability of the behavioral pattern as a function of implementation of the intervention condition, generalization sessions were conducted to determine if the target behaviors of the child generalized to parents who were not formally trained to implement intervention procedures. Prior to the generalization phase, the interventionist read the following script to the parents:

Spend a few minutes (3 min) introducing your child to the toys in the room in order to make them comfortable with you in the setting. When the session begins, we will video record you and your child for a 10-min session. During this session we ask that you play with your child being sure to encourage communication using the toys and materials present in the room. If your child requests/asks for something during the session, it is important that you deliver the item to your child. The interventionist and data collector
will be present in the room, but will remain unobtrusive and only be present to collect
data and video record the session. After the session you will be able to talk with the
interventionist about your child if you need to.

The generalization phase for each participant began with a 3- to 5-min warm-up period in
which the parent listened to the script above. During these sessions, data collection procedures,
treatment room, and all materials were exactly the same as intervention except for the addition of
the generalization target (parent/caregiver). Although the parents were allowed to observe the
intervention session, they did not receive any formal or direct training in the use of naturalistic
behavior strategies.

Generalization Plus Phase

A “generalization plus” phase was implemented within the generalization phase for two
participants (Child 1 and Child 4) after noting a decreasing trend in the data on the dependent
variables. The generalization plus phase consisted of a video-feedback session with the parent
and review of a training script that was individualized for each child. During this session, a
recorded intervention session was selected and reviewed with the parents. While watching the
video, the interventionist emphasized the components of the intervention with the
parent/caregiver. The training sessions lasted approximately 30 min.

Social Validity

In order to ensure that the research conducted had social importance, social validity was
assessed following the intervention. Social validity (Wolf, 1978) is judged by examining the
social acceptability of the goals, procedures, and outcomes of the study. At the completion of the
study, participants’ parents completed an open-ended questionnaire to assess (a) the social
significance of the dependent variables, (b) the social acceptance of the experimental procedures,
and (c) parental satisfaction regarding the outcomes of the study. See Appendix J for a copy of the social validity questionnaire.
APPENDIX C

UNABRIDGED RESULTS
Visual Analysis of Data

Data for the study were analyzed utilizing the scientific standards for visual analysis typical of single subject research methodology (Gast, 2010; Horner et al., 2005). Visual analysis is the scientific examination of graphic data to identify meaningful change in the dependent variables as a function of systematic manipulation of the independent variable (Cooper et al., 2007; Gast, 2010; Horner et al., 2005). In single subject research methodology, visual display and analysis of data serve both formative and summative evaluation functions. It facilitates the process of decision-making regarding the effectiveness of intervention across participants, prevents under- or over-estimation of effect, and allows investigators to be vigilant about any potential threats to the internal validity of the study (Gast, 2010).

A visual analysis of the data was conducted to determine the (a) existence of a functional relationship between implementation of naturalistic behavior strategies on the quality of social interactions in young children with autism (Research Question 1), and (b) whether the quality of social interactions of children with autism generalized to untrained caregivers in the same setting (Research Question 2). Data were evaluated at three levels to understand, predict and control the behavioral pattern including within-phase for each participant, across adjacent phases for each participant, and across phases for all participants. Within-phase data were examined to (a) verify the sufficiency of data points in relation to the stability of the behavioral pattern; (b) to determine the level and assess the extent of variability of performance; and (c) to describe the direction and degree of trend for all dependent variables (Cooper et al., 2007; Horner et al., 2005). Decisions about phase change were made by calculating the stability envelope to ensure that 80% of the data points within a phase fell between 20% of the median (Gast, 2010).
Data were also examined across adjacent phases of the design for each participant to determine the (a) changes in level and trend of the behavioral pattern as a function of implementation of intervention; (b) immediacy of effect following initiation of intervention and (c) percentage of overlapping (POD) and non-overlapping data (PND)(Cooper et al., 2007; Horner et al., 2005). Finally, data were examined across all baseline, intervention, and generalization conditions across participants to determine the consistency of the behavioral pattern (Cooper et al., 2007; Horner et al., 2005).

**Visual Analysis for Vocal Mands**

The intervention (naturalistic behavior strategies) appeared to have been highly effective in increasing the frequency of vocal mands for all participants when compared to their individual baseline rates (see Figure 1).

As predicted, Child 1’s data showed a dramatic change in the behavior pattern upon the introduction of intervention. A higher level of vocal mands ($M=24.4$; $Mdn =24$) was observed during this phase when compared to baseline ($M=0$). The data pattern indicated an increasing trend based on the slope of the best-fit straight line within the phase. Even though some variability in the data has been detected, the deviation around the slope of the best-fit straight line showed a range of 15-37 and a standard deviation of 5.6. Data showed immediacy of effect of intervention when compared to baseline. A comparison between the three data points for vocal mands (0) in baseline with the first three data points in the intervention ($M=24$) demonstrate the magnitude of change based on the change in level, trend and variability. Finally, the absence of overlap across baseline and intervention also indicated the effectiveness of the intervention.
Following an increasing trend in the pattern of vocal mands for Child 1 during intervention, the generalization phase was introduced across a caregiver not formally trained to implement intervention. As predicted, the frequency of vocal mands during generalization showed a steadily decreasing trend until it dropped to 5 mands in Session 22. Based on observation of the caregiver’s interaction style during the play sessions (e.g., more demands for tacts instead of mands; encouragement of independent play instead of reciprocal play), a brief 30-min training with the caregiver was instituted. The interventionist provided the caregiver with a script showing the type and sequence of prompting and shaping behaviors critical for eliciting vocal mands and the process of contingently reinforcing child behavior. Following this brief training, Child 1’s frequency of vocal mands increased slightly but dropped to 3 mands by Session 25. The interventionist retrained the caregiver by showing a video of an intervention session concurrently with the script provided to the caregiver previously. The focus of this training was on describing behavioral strategies that elicited prompted or unprompted vocal mands. This type of training produced an immediate increase in the frequency of mands from an average of 9.5 at the start of the generalization phase to an average of 21 after caregiver training.

Child 2’s data also indicated a remarkable change in the behavioral pattern as a function of intervention. The level of vocal mands increased significantly ($M=21.6; Mdn=21$) when compared to baseline ($M=.2$). The interventionist observed some variability in the data pattern was observed during the intervention phase, the deviation around the slope of the best-fit straight line showed a range of 9-34 and a standard deviation of 6.2, indicating no clear trend in the data. However, data do show an immediate effect of intervention as indicated by comparing the average of the last three data points of intervention ($M=21$) with the last three data points in
baseline ($M = .33$). The absence of overlap across the two adjacent phases also indicated the effectiveness of the intervention.

Following an increasing trend in the pattern of vocal mands for Child 2 during intervention, the generalization phase was introduced across a caregiver not formally trained to implement intervention. The frequency of vocal mands increased during generalization ($M=25.3$) when compared to intervention ($M=21.6$) across 3 generalization sessions. No additional training was given to the caregiver of Child 2.

Child 3’s data showed a higher levels of vocal mands ($M=13.7; Mdn=14$) with the implementation of intervention when compared to baseline ($M=.1$). Data indicated a high degree of variability in scores; the deviation around the slope of the best-fit straight line showed a range of 6-24 and a standard deviation of 4.6, indicating no clear trend in the data. However, the average of the last three data points on the frequency of vocal mands (.14) in baseline to the first three data points in intervention (10.33), demonstrate immediacy of effect on the dependent variable. The absence of overlap across the baseline and intervention also indicated the effectiveness of the intervention.

Following an increasing trend in the pattern of vocal mands for Child 3 during intervention, the generalization phase was introduced across a caregiver not formally trained to implement intervention. The frequency of vocal mands increased slightly during generalization ($M=15$) when compared to intervention ($M=13.7$) across three generalization sessions. No additional training was given to the caregiver of Child 3.

Child 4’s data indicated an increase in the level of vocal mands ($M=19.8; Mdn=19$) during the intervention phase when compared to baseline ($M=.27$). The data pattern indicated an increasing trend based on the slope of the best-fit straight line within the phase. Although some
variability in the data has been detected, the deviation around the slope of the best-fit straight line showed a range of 14-31 and a standard deviation of 5.8. Data showed immediacy of effect of intervention when compared to baseline as evidence from the average of the last three data points in baseline (0) to the average of the first three data points in the intervention phase (19.33). The absence of overlap across the two adjacent phases also indicated the effectiveness of the intervention.

Following an increasing trend in the pattern of vocal mands for Child 4 during intervention, the generalization phase was introduced across a caregiver not formally trained to implement intervention. The frequency of vocal mands during generalization remained stable for the first two generalization session (\(M=16\)) and then quickly dropped to 6 mands in Session 27. Based on observation of the caregiver’s interaction style during the play sessions (e.g., stopped following child’s lead; tried to engage child with different toys), the interventionist instituted a brief 30-min training with the caregiver. The interventionist trained the caregiver by showing a video of an intervention session and provided the caregiver with a script that showed the type and sequence of prompting and shaping behaviors critical for eliciting vocal mands, how to follow the child’s lead, and the process of contingently reinforcing child behavior. Following this brief training, the frequency of mands immediately increased from an average of 9.3 at the start of the generalization phase to an average of 19.25 after caregiver training.

**Unprompted Mands**

The frequency of unprompted mands was also analyzed for each child for each phase of the study to evaluate the extent to which target behavior occurred without adult prompting. The mean of unprompted mands for Child 1 during baseline, intervention, and generalization were 0, 13.9, and 14.9 respectively. The mean of unprompted mands during baseline, intervention, and
generalization for Child 2 was .2, 16.7, and 24.7 respectively; for Child 3 it was .14, 9.3, and 15 respectively, and for Child 4 it was .3, 11, and 11.4 respectively.

Following an assessment of the behavioral pattern for each participant within-phase, an evaluation was conducted to determine the behavioral pattern across participants in order to determine a functional relation between the independent and dependent variables. Data showed that for all four participants, the first three baseline sessions on the frequency of mands ranged from 0 to 2, indicating a stable performance. Upon implementation of intervention for Child 1, his target response increased dramatically whereas no change was observed in the baseline rates for any other participant. A similar pattern was observed across replications with three additional participants in which a change in frequency of vocal mands was indicated only when the intervention was implemented but not prior to that time. The magnitude of separation between the last data point of each baseline condition compared to the first intervention point for a given participant with whom the intervention was implemented, provides a demonstration of experimental control. These aspects provide evidence of control over threats to internal validity. Collectively the overall data pattern across participants provides a demonstration of a functional relation between the independent and dependent variables.

Child-initiated Social Engagement during Manding

The results of child-initiated social engagement during manding are visually displayed in Figure 2.

The graph displays the total number of mands relative to the total number of mands in which the child initiated social engagement. The average number of times that Child 1 displayed social engagement during manding was 0 in baseline, 22.3 (mands in which the child initiated social engagement) out of 24.4 (mands) during intervention, and 17.2 out of 18.3 mands
respectively, during generalization. The average number of times that Child 2 displayed social engagement during manding was .2 during baseline, 20.2 (mands in which the child initiated social engagement) out of 21.6 (mands) during intervention, and 25.3 out of 25.3 mands respectively, during generalization. The average number of times that Child 3 displayed social engagement during manding was 14 during baseline, 12.2 (mands in which the child initiated social engagement) out of 13.7(mands) during intervention, and 14 out of 15 mands respectively, during generalization. The average number of times that Child 4 displayed social engagement during manding was .3 during baseline, 19.3 (mands in which the child initiated social engagement) out of 19.8 (mands) during intervention, and 16.4 out of 16.4 mands respectively during generalization.

*Nonverbal Dyadic Orienting*

The results of nonverbal dyadic orienting are shown in Figure 3.

All of the children demonstrated improvements in dyadic orienting from baseline to intervention, with improvements generalizing to their parent/caregiver during play sessions. Child 1 engaged in nonverbal dyadic orienting for a mean of 1% of intervals during baseline, a mean of 24.3% of intervals during intervention, and a mean of 17.5% of intervals during generalization. Child 2 engaged in nonverbal dyadic orienting for a mean of 1.6% of intervals during baseline, a mean of 7.1% of intervals during intervention, and a mean of 9.6% of intervals during generalization. Child 3 engaged in nonverbal dyadic orienting for a mean of 4.6% of intervals during baseline, a mean of 9.2% of intervals during intervention, and a mean of 4% of intervals during generalization. Child 4 engaged in nonverbal dyadic orienting for a mean of 23.7% of intervals during baseline, a mean of 58.2% of intervals during intervention, and a mean of 51.7% of intervals during generalization.
Effect Size of Intervention on Vocal Mands

Effect size is an important measure used in single-subject research to aid in determining the magnitude of effect of the intervention on the dependent variables (Dunst, Hamby, & Trivette, 2004), and allows for a more objective indicator of behavior change (Parker & Hagan-Burke, 2007). Effect size was calculated (Watkins & Pacheco, 2000) for vocal mands for all participants across baseline and intervention phases. The effect size was measured using Cohen’s $d$ index. According to Dunst et al. (2004), if data demonstrate minimal overlap across baseline and intervention phases for each participant, then the following formula is a better indicator of effect size when compared to alternative methods for measuring effect size for single subject research data:

$$d = \frac{(M_I - M_B)}{(SD_P/\sqrt{2(1 - r)})}$$

where $M_I$ is the mean score for the intervention phase data, $M_B$ is the mean score for the baseline phase data, $SD_P$ is the pooled standard deviation for both data phases, and $r$ is the correlation between the baseline and intervention. (p. 6)

The criteria for evaluating the magnitude at which dependent variables may have changed due to the effect of the intervention and not any extraneous variables is: Small ($d=.25$), medium ($d=.50$), and large ($d=1.0$ or greater).

To evaluate the magnitude of naturalistic behavior strategies on the frequency of vocal mands, the effect size ($d$) was calculated for each participant across adjacent phases and the overall effect size for all participants across all baselines and all intervention conditions. The effect size for Child 1 ($d=4.25$), Child 2 ($d=3.96$), Child 3 ($d=3.53$), Child 4 ($d=4.75$) and overall ($d=3.41$) demonstrated a large magnitude, implying the effectiveness of intervention procedures in producing behavior change in participants.


Social Validity

Following the completion of the study, the primary caretaker of each child participant completed a social validation questionnaire. The purpose of the questionnaire was to determine: (a) the social significance of the dependent variables, (b) the social acceptance of the experimental procedures, and (c) parental satisfaction regarding the outcomes of the study. The primary caretaker for each participant completed the questionnaire. A detailed response to the questions on the social validity measure is presented in Table 3.

In response to the first question assessing the social significance of the dependent variable, three out of the four respondents ranked the three dependent variables targeted in the study as their most important. Their responses also suggest that generalization is an important part of programming. In regard to the experimental procedures, the caretakers all seemed confident in their responses to implement the same intervention strategies at home with the exception of shaping behavior which two caretakers described as difficult. Overall, the caretakers reported that they were satisfied with the outcomes of the study.
APPENDIX D

EXTENDED DISCUSSION
The theoretical foundation for this study was built upon the philosophy of behaviorism and the original work of Watson and Skinner. While behaviorism has evolved over the years into what we now know as Applied Behavior Analysis, the basic tenets of the field remain the same. Behavioral interventions are designed to apply the principles of positive and negative reinforcement, punishment, extinction, modeling and shaping to improve socially significant behavior of individuals (Wolery et al., 2005). While applied behavior analytic principles have been utilized in research with individuals with autism throughout the years, the implementation of teaching procedures in applied settings has gone through changes from discrete trials and consequence-based strategies to more naturalistic and antecedent-based interventions (Celiberti et al., 1993; NRC, 2001). Naturalistic teaching strategies have been identified as an established practice by the National Standards Report (NAC, 2009b) for improving pivotal skills in young children with autism.

Results of this study indicated the effectiveness of implementing naturalistic behavior strategies for: (a) improving the quality of social interactions for children with autism (Research Question 1) and (b) generalizing these skills across untrained caregivers in the same clinical setting (Research Question 2). Specifically, increases in the frequency of vocal mands, social engagement, and percent intervals with dyadic orienting were documented as a function of manipulation of the independent variable. Data also indicated that child behavior was more likely to generalize across untrained caregivers if they utilized similar prompting, shaping, and reinforcement strategies that were effective during the intervention phase. This section will discuss the findings of the study with regard to the impact on dependent variables and present the implications for practice, limitations of the study, and directions for future research.
Contributions of the Study to the Current Literature

Vocal Mands

Researchers have established the use of behaviorally based naturalistic language interventions that are effective for improving the language in children with autism (Ingersoll, 2011). Existing research has clearly documented the importance of focusing on the mand in initial language training for children with autism (Sundberg & Michael, 2001; Sundberg & Partington, 1998). Mands allow early learners to control the delivery of reinforcement, develop the role of a speaker, and lead to improved spontaneity and generalization (Sundberg & Michael, 2001) due to the relationship of mands with intrinsic motivation. The results of this indicate large effects of naturalistic behavioral strategies on the increased frequency of vocal mands when measured through visual analysis and effect size. Although a large effect size is not uncommon in single-subject research, when this finding is combined with visual analysis of the data, high levels of IOA on dependent measures, and a high level of procedural fidelity, a demonstration of experimental control is a predictable outcome. All of the children in this study demonstrated near zero levels of manding behavior during baseline when no contingencies for communication were in place. Implementation of intervention clearly indicated that the components of the intervention led to an overall increase in total mands.

Specifically targeting language in the natural environment with child-led interactions supports theories of motivation and communication in children with autism (Koegel et al., 1987; Koegel, 2000). Speech patterns characteristic of children with autism are often described as unnatural and usually under the verbal control of others (Charlop, Schriebman, & Thibodeau, 1985). In other words, children with autism do not often initiate speech on their own, as evident during the baseline condition for this study. It is interesting to note, that although manding
increased for all children, unprompted responses also increased for all children; that is, child responses that occurred independent of an echoic prompt from the interventionist or the caregiver. Although the item that the children were manging for was generally still present in the environment, which made it not truly spontaneous behavior as by defined by some researchers (Sweeney-Kerwin, Carbone, O’Brien, Zecchin, & Janecky, 2007; Sundberg, 2005), unprompted manging is still an important variable to address in regard to improving social initiations (Vernon et al., 2012). This is because the ability of children with autism to make spontaneous initiations during interactions is an important predictor of social competence (Koegel, 2000).

While the quantity of vocal mands expressed by the children was quite impressive and supports a functional relation between the use of naturalistic behavior strategies and increased frequency of vocal mands, it is equally important to note that quantity was not the only indicator of quality. Social validation of the goals and outcomes of the study revealed that all of the parents/caregivers in this study noted that “the ability of their child to vocally express their wants and needs” was one of the most important aspects of social communication.

*Child-Initiated Social Engagement*

Koegel et al. (2009) defined child-initiated social engagement as the occurrence of physical orientation and/or the display of positive affect during a verbal request made by the child. In the current study, all of the children improved in the area of child-initiated social engagement as demonstrated from near zero levels in baseline, to an overall average of 18 mands per session in which the participants displayed positive affect and/or oriented toward the interventionist while manging for items/activities in the environment. These results established a functional relation between the use of naturalistic behavior strategies and improved social engagement with a large effect size for this variable. Koegel et al. (2009) found similar results
when social interactions were embedded into reinforcers delivered to the child. In a follow-up study, Vernon et al. (2012) examined same PRT procedures with embedded social interactions were examined when implemented by parents. This research also supports an increase in positive affect providing additional evidence for intervention components that may increase social motivation, which is often viewed as a pivotal area of development (Koegel & Koegel, 2006). This improvement in social engagement was likely due to child-choice activities and the use of natural reinforcers with embedded social interactions. When an adult embeds a social interaction into the delivery of reinforcement (e.g., jumping on a trampoline with a child, rolling a car back and forth), it provides the child with an opportunity to engage that may not be present with just the delivery of a reinforcer.

Finding from Whalen et al.’s (2006) research also supported improvements in social-communication behavior. The researchers examined the collateral effects of naturalistic behavior modification techniques to evaluate the effects on social communication responses of children with autism. Results indicated observed collateral increases in initiations, positive affect, spontaneous speech, and empathic responses for all children with autism as a function of joint attention training. Although the social engagement variable measured in this study included physical orientation as well as positive affect, examination the display of affect during manding is important because this may provide evidence of improved social interaction skills. Whalen et al. (2006) specifically discussed the important relationship between displays of positive affect and social sharing. Along with other authors (Kasari et al., 1990), Whalen et al. suggested that when children with autism display positive affect, it may suggest that they are exhibiting true social behaviors (e.g., joint attention) as opposed to simple requesting behaviors (i.e., mands).
**Intervals of Dyadic Orienting**

Due to the difficulties that children with autism display in social orienting, the current researchers were interested in measuring dyadic (child-other) orienting as it is an important behavior upon which other social communication behaviors are founded (Leekam & Ramsden, 2006). Although no predictable patterns in dyadic orienting were demonstrated during intervention in the current study, all of the participants demonstrated increased levels of eye contact during intervention when compared to baseline levels. This finding may indicate a functional relation between the use of naturalistic behavior strategies and improved dyadic orienting. It is very likely that child-led interactions (Siller & Sigman, 2002) and the addition of a social interaction by the interventionist while delivering natural reinforcement (Koegel et al., 2009; Vernon et al., 2012) were important components of the intervention that led to improved dyadic orienting. The added presence and interaction displayed by the interventionist (as opposed to just delivering a reinforcer when requested) likely resulted in increased eye contact. Most of the eye contact during sessions occurred when the interventionist created an opportunity for the child to mand and when the interventionist joined the child in a reinforcing activity (e.g., jumped on the trampoline with the child, sang songs with child; and danced with the child).

Delivering natural reinforcers to children alone without the addition of adult social interaction limits the ability of children to perceive other people as potential sources of reinforcement (Koegel et al., 2009).

This study did not indicate similar levels of dyadic orienting that Koegel et al. (2009) documented in their research. The difference may be related to the intervention procedure. The present study focused on creating and reinforcing multiple language opportunities following the child’s motivation whereas Koegel et al. created a relatively equal number of language
opportunities across each condition. The average number of mands per child per session in this study was about 20 mands (both prompted and unprompted). The increase in language opportunities during one-to-one interactions may have made the children less likely to engage in eye contact (Volkmar & Mayes, 1990). In analyzing the data on dyadic orienting, child characteristics warrant attention in this discussion. While Child 4 had the most impairments in language (e.g., he was only able to produce vocal approximations), his eye contact was the highest. Similarly, Child 2 displayed low levels of eye contact throughout the intervention, but the session with the highest percentage of eye contact was the same session with the lowest number of mands, which implies that quantity does not always equal quality, at least not concurrently.

While eye contact continues to be a challenge for children with autism, it is important to continue to measure this variable in order to isolate other variables that may affect its use. Joint attention continues to receive attention in the area of autism intervention (Rocha et al., 2007; Whalen & Schreibman, 2003; Whalen et al., 2006) as it has been established as a critical impairment that differentiates children with autism from their typically developing peers. While these contributions to the literature are important, it may be necessary to look at measures that are precursors to joint attention (i.e., triadic orienting) by first focusing on dyadic orienting measures.

Generalization

Following the intervention phase and increased levels of vocal mands, the researcher assessed generalization with parents/caregivers in the same setting to see if the children would demonstrate learned behaviors during free play with their parents. The advantage of naturalistic behavior strategies is that generalization training is already built into the procedure.
Generalization training usually includes the use of direct and natural consequences, teaching in different settings (e.g., home, school, community) with a variety of materials, and programming common stimuli (DeQuinzio et al., 2007). Research indicates that when naturalistic behavior strategies are implemented to target language in children with autism, their responses generalize to non-trained settings (Koegel et al., 1987). All of the children demonstrated moderate levels of vocal manding, social engagement, and dyadic orienting with their primary parent/caregiver without formal training during the generalization sessions. Although each of the parents/caregivers varied on their levels of prior knowledge and training, they all had the opportunity to observe intervention sessions from a two-way mirror. The parents of Child Three and Child Four had previous training in ABA and implementing language programs for their children with autism. The parents of Child One and Child Two did not have previous training in ABA or how to elicit communication from their children. The previous training backgrounds of each parent did not appear to have an impact on the generalization skills of the participants.

In regards to vocal mands, the majority of the children’s mands during generalization were unprompted and remained at almost the same levels as unprompted mands during intervention. This was likely due to the mands being under the control of the child’s MO and did not rely on the prompts used during intervention. Child 1’s data indicated that although his behaviors initially generalized during the first three sessions, they began to decrease during the fourth generalization session. This is likely because the same reinforcing contingencies that were present during intervention were no longer in place. For example, when Child 1 manded for an item or activity (e.g., to turn on toy), his caregiver frequently responded with “you can do it yourself” in an attempt to promote independence. Because many of his mands were not reinforced, it is likely that they began to decrease as a function of inadvertent use of extinction.
In order for skills to generalize to other settings and people, the same reinforcing contingencies (if not the same amount) that were present during acquisition must also be present during generalization (Cooper et al., 2007). Child 4 also began to show a decrease in vocal mands after generalization Session 27. During this session, the child’s mother attempted to engage him in different toys that were not reinforcing to him. This session also documented very low levels of dyadic orienting and social engagement. Following these decreases in vocal mands, the researchers initiated a “generalization plus” phase in order to train the caregiver/parent on components of the intervention that likely led to improvements in their child’s behavior. For Child 1, the training focused on delivering natural reinforcers following their child’s communication attempts and on reciprocity while reserving prompts for independent functioning to daily life skills. For Child 4, the training focused on following the child’s lead during the course of play. Following this training, increased levels were seen on all dependent variables.

Implications for Practice

The research to practice gap in autism intervention is evident when comparing interventions across different settings are compared (NAC 2009a; Dingfelder & Mandell, 2011). The results of this research provide several important implications for practitioners and parents of children with autism. The first implication is for educators and practitioners charged with designing early intervention programs for children with autism. While published studies measuring social skills in children with autism are increasing in the literature (Reichow & Volkmar, 2010), there may be a research to practice gap based on the diffusion of innovation theory proposed by Dingfelder and Mandell, 2011. The research has clearly documented how to increase language in children with autism (Bourrett, Vollmer, & Rapp, 2004; Hancock & Kaiser, 2002; Koegel, O’Dell, & Koegel, 1987; McGee, Morrier, & Daly. 1999; Sundberg & Partington,
1998) with manuals and curriculums used across home, clinical, and school settings. However, effective strategies for increasing social interaction skills may be difficult for practitioners to implement without manuals and programs to guide intervention, further limiting their implementation in early intervention programs (Dingfelder & Mandell, 2011; Reichow & Volmar, 2010). It is crucial that practitioners involved in designing and implementing early intervention programs for children with autism begin to focus on strategies that increase social interactions as well as communication. It is the researcher’s experience, that often times when teachers work with children with autism on communication skills such as manding, they deliver reinforcers to children without the addition of a social interaction limiting the opportunity for social engagement. Additionally, they often teach communication and social interaction in contrived settings relying heavily on DTT, without utilizing naturally occurring stimuli in the environment. Due to the social impairments associated with autism, social engagement and dyadic orienting potentially could decrease due to the addition of the interventionist’s social interaction and the desire for the child with autism to be alone. This did not appear to be the case with this research, which supports the notion that these early social deficits can be corrected though intensive intervention.

Another important implication of this research is for families of children with autism. The social validation results implied that parents felt generally confident in applying the same naturalistic behavior strategies at home even without intensive training. Due to enhanced generalization, and the ease of implementation, it is important for parents and caregivers to utilize these strategies at home in order to maximize learning opportunities for their children with autism. Teachers and applied behavior analysts should prioritize parent training programs that
teach parents to utilize naturalistic behavior strategies in the home and community settings in order to produce meaningful changes in social functioning (Vernon et al., 2012).

Limitations of the Study

A major limitation of the current study was that the intervention was implemented in a research lab setting as opposed to the natural play environment of children (e.g., home, community). Although the researcher selected a setting that was designed to replicate a typical play area for preschool-aged children, naturalistic behavior strategies are designed to be delivered in the child’s natural environment. If the intervention had been delivered in the home setting, the results may have led to improved generalization and maintenance as the participants would have had greater opportunities to contact naturally occurring stimuli (Koegel & Koegel, 2006) that may not necessarily be present in the lab setting.

This study utilized a single-subject research design (Gast, 2010) to explore the functional relation between naturalistic behavior strategies and the quality of social interactions. Although small sample sizes are characteristic of single-subject research, and this study meets the standard for the number of participants in a multiple baseline design (Reichow, Doehring, Cichetti, & Volkmar, 2011), the limited number of participants poses some threats to external validity (Gast, 2010). In addition to the small number of participants, the individual differences (e.g., social and communication deficits, IQ) between the participants leads to difficulty in concluding that this intervention will have the same effect when implemented with other children with autism. However, children with autism who share characteristics similar to participants in this study are more likely to experience similar effects of intervention.

An additional limitation of the study is that the staggered implementation of intervention for Child 2 and 3 could have been instituted after a clear demonstration of the effect of
intervention (6—7 data points) for Child 1. Intervention for Child 2 and 3 was implemented based on immediacy of effect and the magnitude of the intercept gap between the best-fit straight lines associated with two phases at each point of intervention (Parker, Vannest, & Brown, 2009). Yet, a lag of 5—7 data points is desirable in a multiple baseline design.

Directions for Future Research

As described in the introduction section of this manuscript, given the increasing prevalence rate of autism and increasing in the need for efficient delivery of early intervention services, it is imperative that future research isolate the components (i.e., child-led interaction, reinforcers with embedded social engagement) of naturalistic interventions that improve the social communication deficits associated with autism. Isolating variables of naturalistic behavioral interventions are more likely to improve the efficacy and efficiency of early intervention programs and lead to improved outcomes in children with autism.

This study evaluated social interaction responses of children with autism as a function of implementation of naturalistic behavior strategies. The specific dependent variables constituted a measure of the quality of social interactions as opposed to changes in the frequency of discrete behavior alone. Future research needs to continue to address the quality of social interactions as a unit of measurement within the context of social engagement with both adults and same age peers as a true measure of improved social interaction skills.

The social outcomes of children with autism in this study appear to be superior because of consideration to the motivational aspects of the play environment (e.g., child-led interactions including access to preferred toys, natural reinforcers with embedded social interactions, and reinforcement of vocal approximations of verbal behavior). Future research designed to increase
the social interaction skills of children with autism, needs to incorporate the motivational aspects of behavior that could influence the outcomes of the study.
APPENDIX E

COMMUNICATION AND SYMBOLIC BEHAVIOR SCALES

DEVELOPMENTAL PROFILE
CSBS DP Infant-Toddler Checklist

Child's name: ___________________________ Date of birth: ___________________________ Date filled out: ___________________________

Was birth premature? ___________________________ If yes, how many weeks premature? ___________________________

Filled out by: ___________________________ Relationship to child: ___________________________

Instructions for caregivers: This Checklist is designed to identify different aspects of development in infants and toddlers. Many behaviors that develop before children talk may indicate whether or not a child will have difficulty learning to talk. This Checklist should be completed by a caregiver when the child is between 6 and 24 months of age to determine whether a referral for an evaluation is needed. The caregiver may be either a parent or another person who nurtures the child daily. Please check all the choices that best describe your child's behavior. If you are not sure, please choose the closest response based on your experience. Children at your child's age are not necessarily expected to use all the behaviors listed.

Emotion and Eye Gaze
1. Do you know when your child is happy and when your child is upset? □ Not Yet □ Sometimes □ Often
2. When your child plays with toys, does he/she look at you if you are watching? □ Not Yet □ Sometimes □ Often
3. Does your child smile or laugh while looking at you? □ Not Yet □ Sometimes □ Often
4. When you look at and point to a toy across the room, does your child look at it? □ Not Yet □ Sometimes □ Often

Communication
5. Does your child let you know that he/she needs help or wants an object out of reach? □ Not Yet □ Sometimes □ Often
6. When you are not paying attention to your child, does he/she try to get your attention? □ Not Yet □ Sometimes □ Often
7. Does your child do things just to get you to laugh? □ Not Yet □ Sometimes □ Often
8. Does your child try to get you to notice interesting objects—just to get you to look at the objects, not to get you to do anything with them? □ Not Yet □ Sometimes □ Often

Gestures
9. Does your child pick up objects and give them to you? □ Not Yet □ Sometimes □ Often
10. Does your child show objects to you without giving you the object? □ Not Yet □ Sometimes □ Often
11. Does your child wave to greet people? □ Not Yet □ Sometimes □ Often
12. Does your child point to objects? □ Not Yet □ Sometimes □ Often
13. Does your child nod his/her head to indicate yes? □ Not Yet □ Sometimes □ Often

Sounds
14. Does your child use sounds or words to get attention or help? □ Not Yet □ Sometimes □ Often
15. Does your child string sounds together such as uh oh, mama, gaga, bye bye, bada? □ Not Yet □ Sometimes □ Often
16. About how many of the following consonant sounds does your child use: ma, na, la, da, ca, wa, la, ya, sa, sha? □ None □ 1-2 □ 3-4 □ 5-8 □ over 8

Words
17. About how many different words does your child use meaningfully that you recognize (such as baba for bottle; giggie for doggie)? □ None □ 1-2 □ 3-6 □ 7-10 □ 11-30 □ over 30
18. Does your child put two words together (for example, more cookie, bye bye Daddy)? □ Not Yet □ Sometimes □ Often

Understanding
19. When you call your child’s name, does he/she respond by looking or turning toward you? □ Not Yet □ Sometimes □ Often
20. About how many different words or phrases does your child understand without gestures? For example, if you say “where’s your tummy,” “where’s Daddy,” “give me the ball,” or “come here,” without showing or pointing, your child will respond appropriately. □ None □ 1-2 □ 3-6 □ 7-10 □ 11-30 □ over 30

Object Use
21. Does your child show interest in playing with a variety of objects? □ Not Yet □ Sometimes □ Often
22. About how many of the following objects does your child use appropriately: cup, bottle, bowl, spoon, comb or brush, toothbrush, washcloth, ball, toy vehicle, toy telephone? □ None □ 1-2 □ 3-6 □ 7-10 □ 11-30 □ over 30
23. About how many blocks (or rings) does your child stack? □ None □ 1-2 blocks □ 3-4 blocks □ 5 or more
24. Does your child pretend to play with toys (for example, feed a stuffed animal, put a doll to sleep, put an animal figure in a vehicle)? □ Not Yet □ Sometimes □ Often

Do you have any concerns about your child’s development? □ Yes □ No If yes, please describe on back.

Communication and Symbolic Behavior Scale: Developmental Profile by Janey M. Wetherby & Barry M. Prizzent © 2003 by Paul H. Brookes Publishing Co., Inc. All rights reserved.

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APPENDIX F

PRE-INTERVENTION PROTOCOL
Pre-Intervention Protocol

Initial Meeting: Prior to participation in research

☐ Confirm Autism Diagnosis
  • Record Review

☐ Confirm chronological age (0-5)
  • Record Review

☐ Have parents or caregivers complete the Communication and Symbolic Behavior Scales Developmental Profile Infant-Toddler Checklist (CSBS); (Wetherby & Prizant, 2002)
  ☐ Emotion and Eye Gaze Cluster Score
    ▪ A score of 0-5 is required for participation
  ☐ Use of Words Cluster Score
    ▪ A score of 1 or greater is required for participation

☐ Obtain Informed Consent
  • Attach Signed Informed Consent

☐ Have parents or caregivers conduct reinforcer assessment
  • Attach completed reinforcer assessment

☐ Schedule time for weekly sessions

☐ Information obtained from record review that will aid in intervention (Individual Education Plans, data sheets, evaluation reports, verbal reports, and observations)

________________________________________________________________________
________________________________________________________________________
Mastered Task

List ____________________________________________

________________________________________________

________________________________________________

☐ Reinforcing Items and Activities ________________________________________________________________

☐ Circumstances Affecting Motivation. List words that are related to:

• Strong motivation for an item
  ________________________________________________________________

• Items that involve slow satiation so multiple trials can be conducted
  ________________________________________________________________

• A specific item
  ________________________________________________________________

• Items that are consumed or dissipate
  ________________________________________________________________

• Items that are easy to deliver immediately
  ________________________________________________________________

• Items that are easy to remove when necessary
  ________________________________________________________________
APPENDIX G

REINFORCER ASSESSMENT
REINFORCER ASSESSMENT

INSTRUCTIONS: Use a checkmark (✓) to indicate the items or activities preferred.

<table>
<thead>
<tr>
<th>SOCIAL AND SENSORY REINFORCERS</th>
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<tbody>
<tr>
<td>Adult attention</td>
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<tr>
<td>Attention from specific adults</td>
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<tr>
<td>List preferred adults:</td>
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<tr>
<td>Being left alone</td>
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<tr>
<td>Time spent with peer</td>
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<tr>
<td>List preferred peers:</td>
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<tr>
<td>Freedom from interference from adults</td>
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<tr>
<td>Freedom from interference from peers</td>
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<td>A positive note to give to a person of choice</td>
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<td>List other:</td>
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<tr>
<th>PUBLIC RECOGNITION</th>
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<tr>
<td>Sit in adult's lap</td>
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<td>Public recognition</td>
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<tr>
<th>ACTIVITY REINFORCER</th>
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<tbody>
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<td>Music</td>
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<td>List preferred music:</td>
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<td>Playing with toys</td>
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<tr>
<td>List preferred toys:</td>
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<tr>
<td>Playing with pets</td>
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<tr>
<td>Going for a walk</td>
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<tr>
<td>Wearing jewelry</td>
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<td>List preferred materials:</td>
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<tr>
<td>Job responsibilities</td>
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<tr>
<td>More independence</td>
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<tr>
<td>Wearing cosmetics</td>
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<td>Being read to</td>
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<tr>
<th>Computer programs</th>
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<td>Outside play</td>
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<td>Riding toys</td>
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<td>Balloons</td>
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<tr>
<td>Making choices</td>
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<tr>
<td>Special seat</td>
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<tr>
<td>Bubbles</td>
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</table>

Please list preferred:
Social activities:
Leisure activities

Please list preferred:
APPENDIX H
DATA SHEET
<table>
<thead>
<tr>
<th>Data Sheet</th>
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<tbody>
<tr>
<td>Participant:</td>
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<td>Observer:</td>
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</table>

**DV 1 Vocal Mands**

the frequency of **unprompted** (no echoic prompt delivered) and **prompted** (echoic prompt delivered) vocal responses (including speech sounds, word approximations, or adult word forms) resulting in access to a specific reinforcer.

**DV 2 Child-initiated social engagement during manding**

the **physical orientation** of the child toward the interventionist **and/or** the display of **positive affect** toward the interventionist **during** a vocal mand initiated by the child.

<table>
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<th>DV 1</th>
<th>DV 2</th>
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<tbody>
<tr>
<td><strong>Frequency of vocal mands</strong></td>
<td><strong>Social Engagement during vocal request</strong></td>
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<td>Vocal Mand</td>
<td>Prompted</td>
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To determine dyadic orienting, total the number of + responses _____ divided by 60 intervals to determine the percentage of intervals the child engaged in dyadic orienting. **Percentage________________**

**Session**

**Comments:____________________________________________________________________**

DV 3  
Nonverbal Dyadic Orienting  
Following an action emitted by the adult, the child looks at the adult’s eyes.  
+ Indicates the child initiated eye contact during the interval  
- Indicates the child made no eye contact during the interval
APPENDIX I

CHECKLIST OF FIDELITY OF IMPLEMENTATION
Naturalistic Behavior Intervention

Fidelity of Implementation Scoring Sheet

<table>
<thead>
<tr>
<th>1-Minute Interval</th>
<th>Natural environment</th>
<th>Child-initiated</th>
<th>Prompt delivered</th>
<th>Natural reinforcement</th>
<th>Shaping of approx.</th>
</tr>
</thead>
<tbody>
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Instructions (based on Koegel & Koegel, 2006)

1. Fidelity of the intervention will be scored for 10, 1-minute intervals. Following each 1-minute interval, the following five naturalistic behavior strategies will be scored.
2. Score each strategy as:
   + (plus): The person being observed utilized this strategy
   - (minus): The person being observed did not demonstrate use of this strategy.
   NA: The interventionist did not have the opportunity to utilize this strategy.
3. The performance of the interventionist is scored independent of the child's response.
4. Intervals that have no opportunities are scored as “NA“ in the following categories (Prompt delivered, Natural Reinforcement, and Shaping of Approximations)
5. The person being observed must score 80% (8 out of 10) in each strategy to meet fidelity.

Comments_____________________________________________________________________
____________________________________________________________________________
______________________________________________________________________________
APPENDIX J

SOCIAL VALIDITY QUESTIONNAIRE
Social Validity Questionnaire

Parent: ________________________ Date: ____________
Child: ________________________

According to the DSM-IV, autism is characterized by impairments in social interaction and communication, and the display of restricted interest and repetitive behaviors. The purpose of this research was to improve the quality of social communication in children with autism.

1. In your opinion what social-communication behaviors are most important to you? Please rank the following in order of importance with ‘1’ being the most important and ‘7’ being the least important.

   ___ Facing speaker during communication
   ___ Using vocalizations/words to ask for what they want
   ___ Following the gaze of others
   ___ Using gestures (pointing)
   ___ Showing objects of interest to others
   ___ Making eye contact with others
   ___ Displaying social smile and positive affect

2. During the course of development, children are able to learn from different people and in different environments without being directly taught in that environment. What is your opinion about the importance of your child demonstrating learned skills in other situations? Please explain.

3. To what extent do you think you can display the same strategies used in the intervention at home?
4. How difficult/easy will it be for you to:
   
   a. Target social-communication skills in your child’s natural environment (home, park, store)?

   b. Follow your child’s lead and interest?

   c. Model correct behavior?

   d. Deliver natural reinforcers?

   e. Shape desired behavior following responses made by your child?

5. Are you satisfied with the outcomes of the study? Please explain.


Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.


